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Almanac of Enforceable State Laws to Control Nonpoint Source Water Pollution

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ALMANAC OF ENFORCEABLE STATE LAWS TO CONTROL NONPOINT SOURCE WATER POLLUTION

Environmental Law Institute

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Almanac of Enforceable State Laws to Control Nonpoint Source Water Pollution

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Introduction

Because of increasing interest in methods for controlling nonpoint sources of water pollution, the Environmental Law Institute (ELI) has been identifying and collecting *enforceable* provisions in state laws that bear on, or that could be brought to bear on, discharges from these sources. Nonpoint source discharges, which consist generally of polluted runoff from farms, forests, land development and other activities, are not regulated under the federal Clean Water Act's National Pollutant Discharge Elimination System permitting program.[1] Instead they are addressed primarily through nonregulatory means, such as planning, incentive and cost-share mechanisms, voluntary Best Management Practices (BMPs), and other approaches.[2]

Yet, increasingly, states are finding it necessary to deal with nonpoint source discharges that cannot be prevented, controlled, or abated adequately by these means. A broad summary of existing enforceable state laws was published by ELI in late 1997 as *Enforceable State Mechanisms for the Control of Nonpoint Source Water Pollution* (available on the Institute's website - www.eli.org). That study identified the types of enforcement-based state laws that apply to nonpoint source discharges, and the opportunities and obstacles affecting their use.[3] This new study builds upon the prior study. It provides a state-by-state summary of enforcement-based laws that are potentially applicable to nonpoint source water pollution.

Scope of Study

This study consists of 52 summary reports for the states, the District of Columbia, and the Commonwealth of Puerto Rico. The laws identified for each state do not represent the totality of that state's efforts to control nonpoint source water pollution – such as the voluntary, technical assistance, cost-share and other provisions that typically serve as the core of most state programs. Rather, the summary reports identify only the *enforceable* provisions that can apply to nonpoint source discharges in each state.

For purposes of this study, enforceability is defined as the ability of the state to impose a sanction upon an unwilling person or entity. This definition excludes provisions that simply prescribe the withholding of a benefit – such as the many forest and agricultural tax laws that require repayment of back taxes if a management plan is violated, or laws that allow a state agency to condition receipt of cost-share moneys upon compliance by the recipient.

The reader should note that the state laws identified are ones that *could* be used to address nonpoint source pollution. The summaries are not limited to state laws that are currently being used in this way. State laws written at various times and for various purposes can often be applied in new ways. Knowledge of existing enforceable laws is becoming increasingly important as many states attempt to deal with large inventories of waters that are impaired, in whole or in part, by nonpoint sources. States that must prepare load allocations for nonpoint sources under Total Maximum Daily Loads (TMDL) requirements, for example, will need such enforceable mechanisms to assure that the load allocation targets can be met.[4] Coastal states also need to demonstrate their ability to use enforceable mechanisms in order to continue to receive coastal zone

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and nonpoint source financial assistance from the federal government under the terms of the Coastal Zone Act Reauthorization Amendments of 1990.[5]

The state reports are, in essence, inventories of provisions that could be pressed into service to deal with nonpoint source water pollution discharges or activities that frequently cause such pollution. Because they are available without new legislation, these provisions present state agencies, governors, attorneys general, and citizen groups with potential tools that can be used in improving water quality.

Organization of State Reports

The enforcement-based provisions described in each state report are grouped under six headings for purposes of easy reference and to facilitate comparison among states. States with lengthy summary reports do not necessarily have stronger or more comprehensive laws than those with shorter reports. Nor do the summaries show how the state is using its array of tools.

The first three headings appear under the general category "Discharge Prohibitions." They are intended to identify enforceable state provisions that apply to nonpoint source discharges without regard to the type of source or activity creating the discharge:

> *Water Pollution Control Law* is intended to identify provisions in the state's primary water pollution law or environmental code that can be used as a basis for enforcement against some (or any) discharges from nonpoint sources. This section includes provisions in these laws that are broad enough to cover nonpoint sources even when, to date, they have been used only to address point source discharges. The reader should note applicable limitations, such as laws that cover only discharges of "waste," or laws that require the government to prove that the discharge caused impairment of the receiving waters.
>
> *Other Discharge Limitations* is intended to identify nuisance-type enforceable provisions, laws that protect public water supplies from impairment, public health laws, and other miscellaneous (often older) laws that apply to nonpoint source discharges. Often these provisions are usable only where there is a demonstrated harm, or where particular listed substances are discharged into the state's waters.
>
> *Fish/Fisheries Laws* is intended to identify provisions in state fish and game laws that impose discharge prohibitions or limitations, and provisions that may be used to take enforcement action when a nonpoint discharge results in taking, death, or injury to fish or other aquatic life.

The next three headings are grouped under the general category "Operational Requirements." This category is intended to identify laws that impose enforceable *operating* requirements -- not just discharge prohibitions -- for *three* particular kinds of activities that often result in nonpoint source water pollution discharges:

> *Forestry Requirements* is intended to identify enforceable regulatory requirements applicable to silviculture activities, including the harvesting of timber. If forestry

enforcement is only under the water pollution control law, however, this section may indicate that no specific operating requirements apply. For example, forestry best management practices that are not themselves enforceable are not listed here, even though the state may take enforcement action under its water pollution law if forestry operations cause water pollution incidents.

Agriculture Requirements is intended to identify enforceable regulatory requirements applicable to agricultural activities. It may include limits on soil erosion, pesticide use, fertilizer use, manure spreading, and regulation of animal operations with respect to nonpoint source discharges. This section does not report on state *point source* regulation of concentrated animal feeding operations (CAFOs) required under the federal Clean Water Act, but may identify state programs that address a wider universe of animal feeding operations than do federal CAFO requirements, or state programs that impose specific licensing, setback, manure management, or other requirements particularly relevant to nonpoint source pollution.

Development and Other Earth-Disturbing Activities is intended to identify enforceable state requirements applicable to excavation and land-clearing activities. In general, it does not include provisions that simply implement the urban stormwater *point source* requirements of the federal Clean Water Act.

Enforceable requirements applicable to some other kinds of nonpoint sources are not directly addressed in this compendium, such as laws addressing on-lot sewage systems, dams and hydromodification projects, marinas, and mineral development.

Conclusions

This review of the laws in 50 states, Puerto Rico, and the District of Columbia indicates that most states have a number of enforceable authorities that can be used to address various nonpoint source discharges, but that legal coverage of all nonpoint sources is often incomplete. The laws contain numerous exemptions, especially for agriculture and forestry. Much regulation under state laws is left up to local entities. These include conservation districts (only some of which have regulatory and enforcement powers) and municipal governments (which may or may not address nonpoint sources under their zoning and regulatory powers). The implications of the many exemptions and limitations are discussed in detail in ELI's 1997 study.

This almanac of enforceable state laws is intended to raise the level of visibility of these enforceable mechanisms, and to serve as a resource to state and federal legislators and policy makers seeking to control nonpoint source water pollution in the years ahead. The array of existing enforceable state laws that can be brought to bear on nonpoint source discharges is both impressive and discouraging. Impressive because of the diversity and ubiquity of state legal mechanisms. Discouraging because of the inconsistent treatment of similar problems from one state to the next, and because of the significant gaps in coverage that still exist in many states.

Endnotes

1. 33 U.S.C. § 1342; *see* definitions of "discharge of a pollutant" and "point source" at 33 U.S.C. § 1362(12), (14).
2. 33 U.S.C. § 1329, added to the Clean Water Act in 1987, provides a federal basis for planning and federal funding of state nonpoint source control programs using these tools.
3. *See also*, James M. McElfish, Jr., "State Enforcement Authorities for Polluted Runoff," 28 Envtl. L. Rep. (Envtl. L. Inst.) 10181 (April 1998).
4. *See* 33 U.S.C. § 1313(d).
5. 16 U.S.C. § 1455(d)(16). All submitted state programs were conditionally approved by the Environmental Protection Agency and the National Oceanic and Atmospheric Administration, but most need to demonstrate their ability to use the enforceable mechanisms identified in their submittals and/or to develop additional mechanisms. *See* http://www.nos.noaa.gov/ocrm/czm/6217/findings.html.

ALABAMA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Alabama's water pollution control law, which requires a permit for discharge of "pollution," provides a basis for enforcement against some nonpoint source discharges, but regulations exclude nonpoint source discharges from agriculture and silviculture from the permit requirement. The state also maintains that it may directly enforce against nonpoint sources, if they cause violation of water quality standards. In addition, the law provides two general authorities which allow the state to take enforcement action to deal with any type of water pollution resulting from negligence, or any water pollution that produces a health hazard.

- "Every person, prior to discharging any new or increased pollution into any waters of this state, shall apply to the commission [now the Alabama Department of Environmental Management (ADEM)] in writing for a permit and must obtain such permit before discharging such pollution."[1] But although Alabama's permit requirement is not limited to point sources,[2] nevertheless a permit is not required for discharges "from non-point source agricultural and silvicultural activities."[3]

- Enforceable provisions may include water quality standards.[4] In addition to setting standards, the regulations only require specifically, however, that "nonpoint source discharges shall use best management practices adequate to protect water quality consistent with the Department's nonpoint source control program" with respect to antidegradation of waters meeting water quality criteria and outstanding state and national waters.[5] The referenced program, however, appears to be largely based on cost-shares and technical assistance.[6]

Enforcement of these provisions follows this procedure: "Whenever the commission [ADEM] determines that any person is violating, or is about to violate, any of the provisions of this chapter, or any rule or regulation or order or permit...thereunder, [ADEM] may notify such person of such determination... Within such time as may be specified in such notice, such person shall file with the commission [ADEM] a full report showing steps that have been taken and are being taken to control such pollution. Thereupon, the commission [ADEM] may make such orders as in its opinion are reasonable."[7] Enforcement includes orders, injunctions, civil actions for damages for pollution (including "any reasonable costs to prevent, minimize, or clean up any damage," costs for restocking of fish killed, civil penalties of $100 to $25,000 per day, and criminal penalties for willful violation or grossly negligent violations.[8]

- The law also provides that ADEM, the attorney general or any district attorney "may commence a civil action for damages for pollution of the waters of the state including, but not limited to, any reasonable costs to prevent, minimize or clean up any damage resulting from the wrongful act, omission or negligence of a person."[9]

• Furthermore, "Any and all pollution is...declared to be a public nuisance and, if it creates, or is about to create, a health hazard, shall be subject to immediate control of the commission [ADEM] by order or injunction. Any order issued under this subsection shall be deemed to be final and conclusive for the purposes of this chapter."[10]

Other Discharge Limitations

• Nuisance liability is noted above.

• Alabama law gives some rulemaking powers with respect to pollution discharges to the department of conservation and natural resources.[11] But the department cannot make "any rules or regulations which will hamper industry or which will interfere with the operation of any industrial plant or plants or any industrial operation...[or] which will hamper or interfere with the construction of dams built for impounding private waters...[or] which will in any way hamper or interfere with the maximum development of private waters as a source of food, farm income and recreation in the state of Alabama..."[12]

Fish/Fisheries Laws

• The taking or killing of any fish by depositing in any public stream or body of water "any poison, poisonous substance...or other deleterious or poisonous matter" is an offense.[13] The taking or killing of any fish by any means other than those expressly allowed by law or regulation of the department of conservation and natural resources is an offense.[14] These are punishable as misdemeanors, with a fine of $50 to $200.

OPERATIONAL REQUIREMENTS

Forestry Requirements

• The State Forestry Commission has power to operate state forests and to administer all laws relating to timber and forestry.[15] "The commission shall have the power to adopt and promulgate rules and regulations pertaining to all phases of forestry within this state, which rules and regulations when adopted shall have the force and effect of law."[16] However, the commission has not adopted enforceable nonpoint source regulations, relying instead on voluntary BMPs. The commission has adopted licensing requirement for foresters.[17] There are no enforcement provisions in the regulations apart from the licensing requirements. The state reports that it relies on its water pollution control act for enforcement.

• State law provides for the establishment of soil and water conservation districts;[18] the districts have the power to carry out preventive and control measures and to provide assistance, to develop comprehensive plans, and "to make and, from time to time, amend and repeal rules and regulations not inconsistent with this article to carry into effect its purposes and powers."[19] Specifically, the supervisors of a district have authority to "formulate regulations governing the use of lands within the district in the interest of conserving soil and soil resources and preventing and controlling soil erosion."[20] Such regulations may only go into effect after a referendum results in their approval by 4/5 of the votes cast; and the supervisors are not required to adopt the regulations even if the referendum is favorable.[21]

• A separate law provides that "any management guidelines developed by watershed management authorities [a special form of authority within some soil and water conservation districts] to protect forested watersheds shall follow the best management practices established by the Alabama Forestry Commission as they pertain to forested watersheds."[22] Enforcement of soil and water conservation district land use regulations is by injunction sought by the supervisors in the circuit court; or the supervisors may perform the work and recover the expenses thereof.[23]

Agriculture Requirements

• Enforceable land use regulation by soil and water conservation districts is described above.

• The Alabama Pesticide Act provides for pesticide registrations, for permitting of commercial applicators by the Dept. of Agriculture and Industry.[24] "Before any person is authorized to purchase and use restricted-use pesticides for application or use thereof, such person shall meet certain qualifications to be prescribed pursuant to rules and regulations...designed to satisfy the requirements of the Federal [FIFRA]...and to determine whether the user or applicator...can use and apply such products in a manner that will not endanger or be injurious to human health and nontarget animals, wildlife, vegetation, crops, and water or be detrimental to the general environment..."[25] The statute provides for penalties and injunctive relief.[26]

Development and Other Earth-Disturbing Activities

No operating requirements are set forth apart from any that may be contained in urban stormwater programs under the Clean Water Act or that may be authorized by general land use regulation such as zoning. Control of pollution from development activities is limited to stormwater permitting for activities over 5 acres.

State law does provide for the formation of watershed management authorities, which include contiguous watershed lands which may lie within one or more soil and water conservation districts.[27] The land included in the authority must be in a single watershed and must encompass at least 50 square miles. The purposes include plans and programs relating to, among other things, "water pollution control...erosion prevention and control of erosion, floodwater and sediment damages."[28] Authority to make and enforce rules and regulations is not clearly among the enumerated powers of these watershed management authorities.[29] Individual local government jurisdictions, particularly in the coastal zone, also have some authorities over runoff and sediment under their general land use powers or the coastal zone program.[30]

Endnotes

1. Ala. Code § 22-22-9(I)(3).

2. Ala. Code § 22-22-1(b)(3); Admin. Code 335-6-6-.02(jj).

3. Admin. Code 335-6-6-.03(a)4. This exception does not apply to concentrated animal feeding operations, concentrated aquatic animal production facilities, and certain silvicultural discharges treated as point sources by regulation.

4. Alabama asserted that these standards are directly enforceable against nonpoint source dischargers in its 1995 submittal under the Coastal Zone Act Reauthorization Amendments.

[5] Admin. Code 335-6-20-.04(3) ("antidegradation policy"); Admin. Code §§ 335-6-10-.09, -.10 ("Outstanding Alabama Waters", "Outstanding National Resource Waters").
[6] Ala. Code §22-38-1 et seq.
[7] Ala. Code § 22-22-9(e).
[8] Ala. Code §§ 22-22-9(I) to (n), 22-22A-5(17) to (19), 22-22-14.
[9] Ala. Code § 22-22-9(m).
[10] Ala. Code 22-22-9(I)(4).
[11] Ala. Code § 9-2-2 et seq.
[12] Ala. Code § 9-2-8.
[13] Ala. Code § 9-11-93.
[14] Ala. Code § 9-11-94.
[15] Ala. Code § 9-3-1 et seq.
[16] Ala. Code 9-3-9 ;Admin. Code 390-X-1-.02.
[17] Ala. Code § 34-12-35; Admin. Code 380-X-3-.01 to .10.
[18] Ala. Code § 9-8-20 et seq.
[19] Ala. Code § 9-8-25(16).
20. Ala. Code § 9-8-26.
[21] Ala. Code § 9-8-26.
[22] Ala. Code § 9-10A-4.
[23] Ala. Code § 9-8-28.
[24] Ala. Code § 2-27-1 et seq.
[25] Ala. Code § 2-27-11(b).
[26] Ala. Code § 2-27-16.
[27] Ala. Code § 9-10A-1 et seq.
[28] Ala. Code § 9-10A-3.
[29] Ala. Code § 9-10A-14.
[30] Ala. Code §§ 9-7-11(7), 9-7-10(6).

ALASKA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Alaska's water pollution control law includes some provisions that may be used to take enforcement action against nonpoint source discharges that pollute the waters of the state.

• Alaska law prohibits a person from "pollut[ing] or add[ing] to the pollution of the air, land, subsurface land, or water of the state."[1] The Alaska Department of Environmental Conservation (DEC) has broad authority to adopt pollution standards and "to determine what qualities and properties of water indicate a polluted condition..."[2]

If an activity presents "an imminent or present danger" to the people of the state or would result in or be likely to result in "irreversible or irreparable damage" to the environment, the DEC may issue an emergency abatement order without a hearing. The affected party may present proof to the contrary or prove that the order would impose "substantial private hardship."[3] In the ordinary case, if the DEC has reason to believe that a violation has occurred or is about to occur, then it may notify the person involved and require a report stating the measures that have been or will be taken to correct or control the conditions. The DEC may issue a compliance order after the time period specified for filing the report.[4] Superior court may also enjoin violations of statute, regulations, orders or permits.[5] Sanctions imposed include civil penalties of between $500 and $10,000 for the initial violation and not more than $5000 for each subsequent day of the violation. The court will determine the amount of the penalty based upon the characteristics of the substance discharged, the "sensitivity of the receiving environment," and the "degree" of environmental degradation. Costs to the state and the economic savings of the violator shall also be considered.[6] If the violation occurs with criminal negligence, then it is a Class A misdemeanor.[7]

Other Discharge Limitations

• A person is guilty of nuisance under Alaska state law if the person puts a "dead animal...excrement, or a putrid, nauseous, noisome, decaying, deleterious, or offensive substance into, or in any other manner ...pollutes...a spring, brook, creek, branch, well or pond of water that is or may be used for domestic purposes." It is a misdemeanor to neglect or refuse to abate a nuisance under this statute.[8] The court may assess damages for costs of abatement.[9] There is a similar nuisance provision for placement of "obnoxious" matter or things on land.[10]

• A discharge limitation is imposed whereby before beginning "to construct a hydraulic project, or use, divert, obstruct, *pollute*, or change the natural flow or bed of a specified river, lake, or stream, the person or governmental agency shall notify the commissioner..."[11] Proceeding without approval is a misdemeanor,[12] and sanctions are calculated based on the cost of restoring a river, lake or stream to its original condition in addition to court penalties.[13]

Fish/Fisheries Laws

• A person is generally liable to the state if the person "violates or disregards an order, permit, or other determination" of the DEC under the Water, Air, Energy, and Environmental Conservation Code and "thereby causes the death of fish, animals or vegetation or otherwise injures or degrades the environment of the state..."[14] The attorney general may recover damages under this provision, and liability includes costs recovered for the restocking of injured land or waters or to replenish a damaged or degraded resource or to otherwise restore the environment to its condition before the injury.[15] It is a class A misdemeanor if criminal negligence is found.[16]

• Obstruction, diversion or pollution of "water of the state, either fresh or salt, utilized by salmon in the propagation of species, by ...casting, passing, throwing, or dumping tree limbs or foliage, underbrush, stumps, rubbish earth, stones, rock or other debris, or passing or dumping sawdust, planer shavings, or *other waste or refuse of any kind in those waters*" is prohibited without a permit.[17] Also a permit is required to render the waters described above "inaccessible or *uninhabitable* for salmon for spawning or propagation."[18] A violation of these provisions is a misdemeanor punishable by a fine of between $100 and $500.[19] The permit may be granted if the purpose is "to develop power, obtain water for civic, domestic, irrigation, manufacturing, mining, or other purposes tending to develop the natural resources of the state."[20]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• With respect to forest resources and practices, the state, with the DEC as lead agency, "should exercise its full responsibility and authority for control of *nonpoint source pollution* with respect to the Federal Water Pollution Control Act."[21] While this policy is not itself an enforceable mechanism, the law further provides that the Commissioner of Natural Resources ("Commissioner") may issue nonpoint source pollution regulations subject to DEC approval.[22]

• On state, municipal, and private forest land, state law provides that "environmentally sensitive areas" shall be recognized "in the development of regulations and best management practices that are designed to implement *nonpoint source pollution* control measures authorized under this chapter."[23] Also "significant adverse effects of soil erosion and mass wasting on water quality and fish habitat shall be prevented or minimized."[24]

• Before operations begin on municipal or private forest land or on state land not managed by the division of forestry, the operator must submit to the state forester (who heads the division of forestry) a "detailed plan of operations" which must be reviewed within thirty days. Unless a stop-work order is issued or the agency extends the review period, the operator may commence work, at the latest, thirty days after submission of the plan.[25] The plan must be renewed annually. The state forester may grant a variance from the statute or regulations if "the harm intended to be avoided by the requirement is not likely to occur because of site-specific circumstances relating to the particular activity and is not likely to cause harm to fish habitat or water quality."[26] Also small commercial operations and primarily noncommercial operations are exempt.[27] The Commissioner may assess civil fines and request that the attorney general seek an injunction for violations of directives or stop-work orders.[28] Upon making a determination that an activity violates this chapter, the state forester may issue a directive ordering the person to cease the violation or repair any resulting damage. If the person requests a hearing, then the activity may continue unless the state forester issues a stop-work order.[29] Where a person violates a directive requiring repair or correction of damage, the Commissioner may proceed with the repair and the violator is liable for the cost.[30] Violation of statute, regulation, directive or stop-work order can result in a maximum civil fine of $10,000.[31] If criminal negligence is found, then the violation is a Class A misdemeanor.[32]

• For each state forest, the Commissioner is required to prepare a forest management plan that considers and permits various forest uses, as well as "soil characteristics, water quality and watershed management."[33] Under the Alaska Lands Act, regardless of whether a forest management plan has been prepared, before the Department of Natural Resources ("DNR") can authorize timber harvest (except for harvests of ten acres or less or timber salvaged from land cleared for nonforest use), the DNR must adopt a forest land use plan that considers, among other factors, fish and wildlife habitat, including retention of riparian, wetland and ocean-shoreline vegetation; water quality and watershed management.[34] Finally, the Commissioner is to adopt regulations to protect riparian areas that provide higher standards of protection for lands managed by the DNR than other public or private land.[35] Specifically, for state lands managed by the DNR, no harvest is permitted within 100 feet of the water body, subject to certain exceptions and depending upon whether the land is located north or south of the Alaska range.[36] Whereas the timber harvest riparian standards for private land located in a coastal spruce or hemlock forest vary depending upon the water classification, distance of the activity from the water body and slope stability standards. For other private forest land, riparian standards are established by regulation.[37] The same exemptions, enforcement mechanisms and sanctions apply here that are discussed above with respect to the general forestry provisions.

Agriculture Requirements

• Generally, Alaska state law regulates the licensing of pesticides.[38] More specifically, "a person may not spray or apply...pesticide or broadcast chemical in a manner that may cause damage to or endanger the health, welfare, or property of another person, or *in a manner that is likely to pollute the air, soil, or water of the state* without prior authorization of the [DEC]."[39] Enforcement and sanctions follow same provisions as outlined above under general discharge limitations.

Development and Other Earth-Disturbing Activities

• Alaska law provides for local land use regulation, planning and zoning, but state law does not prescribe specific nonpoint source duties in this context.

Endnotes

[1] Alaska Stat. 46.03.710.
[2] Alaska Stat. 46.03.070.
[3] Alaska Stat. 46.03.820.
[4] Alaska Stat. 46.03.850(a)-(c).
[5] Alaska Stat. 46.03.765.
[6] Alaska Stat. 46.03.760(a)(1)-(3).
[7] Alaska Stat. 46.03.790(a)(1).
[8] Alaska Stat. 46.03.800(a), (b).
[9] Alaska Stat. 46.03.800(b).
[10] Alaska Stat. 46.03.810.
[11] Alaska Stat. 16.05.870(b).
[12] Alaska Stat. 16.05.870.
[13] Alaska Stat. 16.05.880.
[14] Alaska Stat. 46.03.780(a).
[15] Alaska Stat. 46.03.780(b),(c).
[16] Alaska Stat. 46.03.790(a)(1).
[17] Alaska Stat. 16.10.010(a)(1).
[18] Alaska Stat. 16.10.010(a)(2),(3).
[19] Alaska Stat. 16.10.030.
[20] Alaska Stat. 16.10.020.
[21] Alaska Stat. 41.17.010(5).
[22] Alaska Stat. 41.17.055(d).
[23] Alaska Stat. 41.17.060(b)(2).
[24] Alaska Stat. 41.17.060(b)(5).
[25] Alaska Stat. 41.17.090(c),(e), (i).
[26] Alaska Stat. 41.17.087(a).
[27] Alaska Stat. 41.17.900(c).
[28] Alaska Stat. 41.17.131(a),(d).
[29] Alaska Stat. 41.17.136,138.
[30] Alaska Stat. 41.17.131(e).
[31] Alaska Stat. 41.17.131(a).
[32] Alaska Stat. 41.17.131(b).
[33] Alaska Stat. 41.17.230(a).
[34] Alaska Stat. 38.05.112(a),(c).
[35] Alaska Stat. 41.17.115(b).
[36] Alaska Stat. 41.17.118(a).
[37] Alaska Stat. 41.17.116(a),(b).
[38] Alaska Stat. 46.03.320.
[39] Alaska Stat. 46.03.730.

ARIZONA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Arizona's water pollution law has provisions that authorize development of a program for nonpoint source discharges, which may include, but does not require, development of enforceable mechanisms. It also has a general discharge prohibition applicable to intentional or grossly negligent discharges. Arizona also provides for aquifer protection permits that address some nonpoint source discharges to groundwater.

- Arizona law requires the Department of Environmental Quality (DEQ) to adopt not only permit requirements for point sources and for certain facilities likely to pollute aquifers, but also to adopt a "program to control nonpoint source discharges of any pollutant or combination of pollutants into navigable waters."[1] Thus, enforceable mechanisms could be created by regulation. Enforcement mechanisms available under the law generally include orders, injunctions, and court actions to recover civil penalties not to exceed $25,000 per day.[2]

- Arizona's general discharge prohibition makes it a criminal offense to discharge, with intent or gross negligence, any substance to waters without a required permit or other "appropriate authority," or to violate a water quality standard.[3]

- Arizona has a regulatory program for aquifer protection permits that has some bearing on nonpoint discharges. Facilities that may produce discharges to groundwater require an aquifer protection permit.[4] Some of these include nonpoint source activities, such as mines. The DEQ is further authorized to issue general permits under the aquifer protection program, including general permits requiring use of best management practices and addressing urban runoff, silviculture, and certain other activities.[5]

Other Discharge Limitations

- Nuisance authorities provides some additional enforcement authority where specific health or environmental hazards can be shown. Arizona defines an environmental nuisance as "creation or maintenance of a condition in the soil, air or water that causes harm to the public health or the environment and that is not otherwise subject to regulation under this title."[6] Examples include: "6. the pollution or contamination of any domestic waters" and "7. use of cesspools, septic tanks, or sewage for fertilizing or irrigation without approval."[7] The director of DEQ may serve an abatement order, which becomes final in 30 days. Failure or refusal to comply with order enables DEQ to abate the nuisance itself and recover costs.[8] DEQ may also file an action in superior court for enjoin further violation, compel compliance, or for abatement.[9] Other nuisances, including some water-pollution related actions, are specified by law.[10] Arizona also has a savings clause that preserves other causes of action, including public and private nuisance law.[11]

• Another law provides that "No person shall dump, deposit, place, throw or leave refuse, rubbish, debris, filthy or odoriferous objects, substances or other trash on any waterways or the shorelines of any waterways of the state."[12] Violation is a misdemeanor, and the violator may be ordered to "correct any unlawful condition, issued a written warning or written repair order, or issued a citation."[13]

• The crime of criminal littering or polluting is committed if a person unlawfully "1. Throws, places, drops or permits to be dropped on public property or property of another which is not a lawful dump any litter, destructive or injurious material which he does not immediately remove. 2. Discharges or permits to be discharged any sewage, oil products or other harmful substances into any waters or onto any shorelines within the state..."[14] The offense is a felony if it is a knowing violation, if the material exceeds 300 lbs. or 100 cu.ft., or if it is done for a commercial purpose. It is a misdemeanor if it is not a felony and "involves placing any destructive or injurious material on or within fifty feet of a highway, beach or shoreline of any body of water used by the public."[15]

Fish/Fisheries Laws

• The game and fish commission may bring an action against "any person, corporation, or government agency, to restrain or enjoin the person, corporation, or government agency from discharging or dumping into a stream or body of water in the state any deleterious substance which is injurious to wildlife."[16] It is also unlawful to take a fish by any means other than angling unless otherwise provided by the commission, subject to fine of $10 and misdemeanor penalty.[17] Because there is no intent requirement, this may provide some recourse for fish kills.

OPERATIONAL REQUIREMENTS

Forestry Requirements

State law does not appear to specify operational requirements related to nonpoint source water pollution from forestry activities.

Agriculture Requirements

• Arizona law provides that the director of DEQ shall adopt rules for agricultural general permits consisting of BMPs for "regulated agricultural activities" defined as "application of nitrogen fertilizer or a concentrated animal feeding operation."[18] The agricultural general permits are not subject to the general legal criteria for general permits or BMPs.[19] Individual permits for regulated agricultural activities are generally not required.[20] Agricultural BMPs are those that DEQ has determined "to be the most practical and effective means of reducing or preventing the discharge of pollutants by regulated agricultural activities."[21] The Director shall require "application of all economically feasible" BMPs that are the "most practical and effective means of reducing or preventing the discharge of pollutants by regulated agricultural activities but shall not require application of more stringent practices if such a requirement would result in cessation of the regulated activity."[22] Advisory committees were established to develop appropriate BMPs and recommend them to DEQ. Representatives from DEQ, the state department of agriculture, Dept. of Water

Resources, and college of agriculture at University of Arizona are on the committees.[23] Use of BMPs may be waived in a specific region if DEQ determines that existing regulated agricultural activities will not cause or contribute to violations of water quality standards.[24] Violation of the BMPs can result in revocation of the general permit after notice and opportunity for hearing and a requirement that the operation obtain an individual permit.[25]

• Arizona law also directs the director of DEQ to adopt, by rule, a "surface water quality general grazing permit consisting of *voluntary* best management practices for grazing activities".[26] The rule must be adopted within 180 days after receiving the recommendations of a grazing best management committee.[27] The committee includes representatives of DEQ, the state Dept. of Agriculture, the Dept. of Water Resources, the dean of the University of Arizona College of Agriculture, and 3 cattle ranchers and 1 sheep rancher appointed by the governor. Although the director shall require the application of economically feasible VBMPs that are "the most practical and effective means" of reducing or preventing discharge of pollutants by grazing activities, the director "shall not require application of more stringent practices if such a requirement would result in cessation or significant reduction of grazing activity." "The director may waive the use of voluntary best management practices in a designated region if he determines that existing grazing activities will not cause a violation of the adopted water quality standards for navigable waters."[28] Because the law requires development of and issuance of a permit, it is arguably an enforceable mechanism, but the term "voluntary" may pose impediments to actions beyond simply requiring the permit.

• Arizona regulates pesticides and provides for permits, licensing, and certifications, including training requirements and reporting, buffer zones, pesticide management areas, and enforcement.[29] Registration requirements designed to protect water quality are enforceable.[30] Continued registration, sale, or use of a pesticide is not allowed if it would cause a "violation of water quality standards at the applicable point of compliance."[31]

Development and Other Earth-Disturbing Activities

No operating requirements are set forth, apart from any that may be contained in urban stormwater programs under the federal Clean Water Act or that may be authorized by general land use regulation such as zoning. Boards of supervisors may adopt and enforce standards for excavation, landfill and grading to prevent unnecessary loss from erosion, flooding and landslides.[32]

Endnotes

1. Ariz. Rev. Stat. Ann. § 49-203.A.
2. Ariz. Rev. Stat. Ann. §§ 49-261, 49-262.
3. Ariz. Rev. Stat. Ann. § 49-263.A.
4. Ariz. Rev. Stat. Ann. § 49-241.A.
5. Ariz. Rev. Stat. Ann. § 49-246.
6. Ariz. Rev. Stat. Ann. § 49-141.
7. Ariz. Rev. Stat. Ann. §§ 49-141.6., 7.
8. Ariz. Rev. Stat. Ann. § 49-142.A.

[9] Ariz. Rev. Stat. Ann. § 49-142.C.
[10] Ariz. Rev. Stat. Ann. § 36-601.
[11] Ariz. Rev. Stat. Ann. § 49-206.
[12] Ariz. Rev. Stat. Ann. § 5-348.
[13] Ariz. Rev. Stat. Ann. § 5-391.
[14] Ariz. Rev. Stat. Ann. § 13-1603.A.
[15] Ariz. Rev. Stat. Ann. § 13-1603.B.
[16] Ariz. Rev. Stat. Ann. § 17-237.
[17] Ariz. Rev. Stat. Ann. §§ 17-301, 17-309, 17-314.
[18] Ariz. Rev. Stat. Ann. § 49-247, § 201.29.
[19] Ariz. Rev. Stat. Ann. §§ 49-245, 49-246.
[20] Ariz. Rev. Stat. Ann. § 49-247.A.
[21] Ariz. Rev. Stat. Ann. § 49-247.B.
[22] Ariz. Rev. Stat. Ann. § 49-247.E.
[23] Ariz. Rev. Stat. Ann. § 49-248.
[24] Ariz. Rev. Stat. Ann. § 49-247.B.
[25] Ariz. Rev. Stat. Ann. § 49-247.G.
[26] Ariz. Rev. Stat. Ann. § 49-202.01.
[27] Ariz. Rev. Stat. Ann. § 49-202.02.
[28] Ariz. Rev. Stat. Ann. § 49-202.01.B.
[29] Ariz. Rev. Stat. Ann. § 3-343, 3-352, 3-363 et seq.
[30] Ariz. Rev. Stat. Ann. § 49-302 et seq.
[31] Ariz. Rev. Stat. Ann. § 49-309.D.
[32] Ariz. Rev. Stat. Ann. § 11-251.36.

ARKANSAS

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Arkansas' water pollution control law contains a general discharge prohibition that may be used to take enforcement against nonpoint source discharges that cause water pollution or against the placement of wastes that are likely to cause water pollution.

• The Arkansas Water and Air Pollution Control Act[1] makes it unlawful to "cause pollution ... of any of the waters of this state," or to "place or cause to be placed any sewage, industrial waste, or other wastes in a location where it is likely to cause pollution of any waters of this state."[2] "Pollution" is defined as "such contamination or other alteration of the physical, chemical, or biological properties of any waters of the state, or such discharge of any liquid, gaseous, or solid substance in any waters of the state as will, or is likely to, render the waters harmful, detrimental, or injurious to public health, safety, or welfare; to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses; or to livestock, wild animals, birds, fish, or other aquatic life."[3]

The Arkansas Pollution and Ecology Commission enforces the Act, and is authorized to conduct investigations to determine the existence of violations. The Commission may conduct administrative proceedings, and also may institute civil enforcement actions in the proper court. Except in emergencies, no administrative penalty may be assessed without the opportunity for a hearing, and the Commission must provide public notice and an opportunity to comment. Parties may request an appeal to the court without a jury. Administrative penalties may be no greater than $10,000 per day of violation; civil actions may result in penalties not over $10,000 per day of violation, an order to enjoin violations and/or compel compliance, an order for remedial measures, and recovery of all costs, expenses, and damages.[4]

Any violation of the Act also is a criminal misdemeanor, punishable by imprisonment for not more than one year, a fine of not more than $25,000, or both. A purposeful, knowing, or reckless violation that "creates a substantial likelihood of adversely affecting" human health or the environment is a felony, punishable by imprisonment for not more than 5 years, a fine of not more than $50,000, or both; a purposeful, knowing, or reckless violation that "places another person in imminent danger of death or serious bodily injury" is punishable by imprisonment of not more than 20 years, a fine of not more than $250,000, or both. Further, if pecuniary gains are made from the commission of the offense, the state may seek an additional fine of double the amount of the gain.[5]

Other Discharge Limitations

• In addition to the prohibition under the Water and Air Pollution Control Act, Arkansas' Solid Waste Management Act makes it unlawful to "sort, collect, transport, process, or dispose of solid waste ... in such a manner or place as to cause or be likely to cause water pollution within the meaning of the Arkansas Water and Air Pollution Control Act.[6] Enforcement and penalties are the same as for the process enumerated in the Water Pollution Control Act, above.[7]

• The Litter Control Act makes it unlawful to drop [or] discard ... litter ... into any river, lake, pond, or other stream or body of water within this state."[8] There is no violation of the Act if the property is designated as a permitted disposal site, if the litter is deposited in such a manner as to prevent it from being carried away or deposited by the elements in waters of the state, or if the person is the owner or tenant in lawful possession of the property and the litter does not create a public nuisance, health or fire hazard. Violation of the Act is a misdemeanor; first-time offenses are subject to a $100 fine or 100 hours of community service.[9]

• Various sections of the code refer to nuisance law, but none specifically define "nuisance" or nuisance standards in the context of water pollution.[10] The Department of Pollution and Ecology is among the agencies authorized to pursue legal actions for public nuisance,[11] as is the State Board of Health, which may investigate and report on potential nuisances, order their abatement, or order the local sheriff to compel compliance.[12] Arkansas caselaw reflects instances where water pollution was held to be an actionable nuisance.[13] In addition, the zoning law provides that "every structure, fill, development ... placed within a flood prone area in violation of measures enacted under the authority of this section is a public nuisance."[14]

The Right to Farm Act prevents pre-existing farms from being sued for nuisance, stating that "agricultural facilities running for one year without nuisance will not be held liable for nuisance due to changes in the surrounding locality."[15] However, unlike similar laws in other states, Arkansas' Act makes an exception for pollution, and allows nuisance suits for pollution to be brought even against pre-existing farms:"damages sustained by pollution will not be limited by this section."[16]

. Fish/Fisheries Laws

The Arkansas code contains two separate provisions applicable to protection of fish that may provide enforceable mechanisms for some nonpoint source discharges.

• "Any person who shall poison any lake or stream of water for the purpose of killing fish, stock, *or for any other purpose* shall be deemed guilty of a misdemeanor and upon conviction shall be fined in any sum not less than one hundred dollars ($100) nor more than five hundred dollars ($500)."[17]

• In addition, "it shall be unlawful for any person to deposit, throw, drop, or discharge in any manner in any of the waters of this state any substance, liquid, or gas or anything else that will or does intoxicate or stupefy or in any manner injure any fish therein, whether done for the purpose of catching or taking fish or not."[18] For purposes of this provision, "waters of this state" are defined as "all streams, lakes, ponds, sloughs, bayous, marshes, or other waters, wholly or in part within this state."[19] "Any person violating this section shall be deemed guilty of a felony. Upon conviction, he shall be confined in the state penitentiary for a term of not less than one (1) month nor more than twelve (12) months."[20]

OPERATIONAL REQUIREMENTS

Forestry Requirements

State forestry laws do not appear to contain enforceable provisions directly relating to nonpoint source discharges. There is a single restriction on tree-cutting near river beds.

• "It is unlawful to remove any trees growing below the normal high watermark on any river or stream in this state which has been designated as a navigable river or stream. ... Any person violating the provisions of this section shall be guilty of a misdemeanor and upon conviction shall be punished by a fine of not less than ten dollars ($10.00) nor more than one thousand dollars ($1,000).[21]

Agriculture Requirements

• Soil Conservation Districts are authorized to make regulations to control erosion.[22] If the regulations are violated, directors of the local soil district may bring an action in chancery court, which may order the person to comply or take abatement measures, or authorize the directors of the district to enter the land to abate the violation. If the directors abate the violation, they may apply to the court to order the offender to reimburse the costs of abatement.

• The Arkansas Pesticide Control Act[23] makes it unlawful for any person to "dispose of, discard, or store pesticides or pesticide containers in a manner as to ... pollute any water supply or waterway.[24] Enforcement is handled by the State Plant Board,[25] which may make inspections to determine if violations exist and bring an action in the appropriate court for an injunction.[26] Violations are a misdemeanor, punishable on the first offense by a fine of $100 - $1000, and on subsequent offenses by a fine of $500 - $2000.[27]

• The Arkansas Pesticide Use and Application Act primarily prohibits use of pesticides without a license. However, it also authorizes the State Plant Board to "issue regulations relating to the conditions under which pesticides may be applied and ... restrict or prohibit use of pesticides to prevent unreasonable adverse effects" to plants, wildlife, fish, humans, animals, or beneficial insects.[28] Use of pesticides without a license or violation of the regulations is a misdemeanor, subject to a fine of $100-$2000 for "commercial parties" and $100-$500 for "private parties."[29]

Development and Other Earth-Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act, or that may be authorized under general land use regulation such as zoning, Arkansas has minimal authority potentially applicable to nonpoint sources.

• The zoning law declares that "every structure, fill, development. . . placed within a flood prone area in violation of measures enacted under the authority of this section is a public nuisance."[30] Thus, where municipalities have promulgated zoning ordinances restricting development in floodplains, violators can be prosecuted under nuisance law.

Endnotes

1. Ark. Code Ann. § 8-4-101 et seq.
2. Ark. Code Ann. § 8-4-217.
3. Ark. Code Ann. § 8-4-102.
4. Ark. Code Ann. § 8-4-103.
5. Ark. Code Ann. § 8-4-103.
6. Ark. Code Ann. § 8-6-205.
7. Ark. Code Ann. § 8-6-204.
8. Ark. Code Ann. § 8-6-406.
9. Ark. Code Ann. § 8-6-404.
10. Indeed, the 1993 amendments to the Water Pollution Control Act struck the words "or creates a nuisance" from the definition of "pollution." Ark. Code Ann. § 8-4-102.
11. Ark. Code Ann. § 8-4-107.
12. Ark. Code Ann. § 20-7-113.
13. See, e.g., Ratzlaff v. Franz Foods of Ark., 468 S.W.2d 239 (Ark. 1971) (holding defendant company liable for damages caused by discharge of "noxious wastes" into creek); City of Fayetteville v. Stanberry, 807 S.W.2d 26 (Ark. 1991) and City of Springdale v. Weatherton, 410 S.W.2d 754 (Ark. 1967) (overflow or discharge of sewage from city sewer line into streams); Consolidated Chemical v. White, 297 S.W.2d 101 (Ark. 1957) (stockpile of lignite and other waste material from mining operations causing the "washing" and deposit of wastes on plaintiff's land). But see Downing v. Ficher, WL 551399 (Ark. Ct. App. 1996) (erosion caused by surface waters diverted from construction site held not to constitute a nuisance).
14. Ark. Code Ann. § 14-268-101.
15. Ark. Code Ann. § 2-4-107.
16. Ark. Code Ann. § 2-4-106.
17. Ark. Code Ann. § 5-72-101.
18. Ark. Code Ann. § 15-43-317.
19. Ark. Code Ann. § 15-43-301. The definition also contains an exception: "waters which are confined within a pond, tank, or lake, situated entirely on the premises of a single owner and which, except under abnormal flood conditions, are in no way connected by water or with any other flowing stream or body of water, or with any other body of water not situated on the premises of the owner, are declared to be privately owned waters and shall not be construed to be included in the expression "waters of this state." Id.
20. Ark. Code Ann. § 15-43-317.
21. Ark. Code Ann. § 5-72-102.
22. Ark. Code Ann. § 14-125-501.
23. Ark. Code Ann. §§ 2-16-401 et seq.
24. Ark. Code Ann. § 2-16-411(4).
25. Ark. Code Ann. § 2-16-405.
26. Ark. Code Ann. § 2-16-412.
27. Ark. Code Ann. § 2-16-404.
28. Ark. Code Ann. § 20-20-206.
29. Ark. Code Ann. § 20-20-204.
30. Ark. Code Ann. § 14-268-101.

CALIFORNIA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

California's Porter-Cologne Water Quality Control Act contains enforceable permitting provisions that may be applied to nonpoint source discharges. The law also empowers regional water quality control boards to order the abatement of discharges, including nonpoint source discharges, that create or threaten to create pollution.

• The Porter-Cologne Act requires "[a]ny person discharging waste, or proposing to discharge waste, within any region that could affect the quality of the waters of the state..." to file a "report of waste discharge" with the regional water quality control board.[1] The regional board must then issue waste discharge requirements (WDRs) – essentially a permit -- implementing "any relevant water quality control plans" and taking into consideration the beneficial uses to be protected, the water quality objectives reasonably required for that purpose, other waste discharges, and the need to prevent nuisances.[2] The law prohibits any discharge prior to filing of the report and the issuance of WDRs, or the expiration of prescribed decision times after filing the report, or receipt of a waiver.[3] The law allows regional boards to "conditional[ly]" waive the report of waste discharge and WDRs for specific discharges or types of discharges "where the waiver is not against the public interest." The waiver may be terminated at any time by the board.[4] California uses these provisions in the nonpoint context as a backup to voluntary and incentive based mechanisms, using the regional boards' power to require a report of waste discharge or to grant a conditional waiver. Timber operations conducted under the state's Z-Berg-Nejedly Forest Practices Act are exempt from the waste discharge requirements if the Act's requirements are certified as best management practices (BMP) by EPA, unless the State Water Resources Board makes a finding that compliance by forestry operations is not protecting water quality, or the forestry board requests issuance of WDRs.[5]

• A second provision includes general abatement authority. "Any person who has discharged or discharges waste into the waters of this state in violation of any waste discharge requirement or other order or prohibition issued by a regional board or the state board, *or who has caused or permitted, causes or permits, or threatens to cause or permit any waste to be discharged or deposited where it is, or probably will be, discharged into the waters of the state and creates, or threatens to create, a condition of pollution or nuisance*, shall upon order of the regional board, cleanup the waste or abate the effects of the waste, or in the case of threatened pollution or nuisance, take another necessary remedial action, including, but not limited to, overseeing cleanup and abatement efforts."[6]

Enforcement under Porter-Cologne is by order, injunction, or remedial action with cost recovery.[7] Other sections of the law provide for civil penalties, injunctions, misdemeanor prosecutions, and administrative orders.[8]

• Another provision, with some bearing on enforceable requirements, requires the state Water Resources Board to "establish fees applicable to all point and nonpoint dischargers who discharge to enclosed bays, estuaries, or any adjacent waters in the contiguous zone or the ocean...The fees shaDecember 14, 1998ll create incentives to reduce discharges to the ocean, bays, and estuaries and shall be based on the relative threat to water quality from point and nonpoint dischargers."[9] However, "[n]o fee may be imposed pursuant to this section on any agricultural nonpoint source discharger."[10]

Other Discharge Limitations

California has numerous nuisance law authorities potentially applicable to nonpoint source water pollution, in addition to "nuisance" as defined in Porter-Cologne itself.[11] The remedies against a public nuisance are: criminal "indictment or information...; [a] civil action; or... Abatement."[12]

• "Anything which is injurious to health, or is indecent, or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property by an entire community or neighborhood, or by any considerable number of persons, or unlawfullly obstructs the free passage or use, in the customary manner, of any navigable lake, or river, bay, stream, canal, or basin...is a public nuisance."[13]

• "Anything which is injurious to health..or is indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property, or unlawfully obstructs the free passage or use, in the customary manner, of any navigable lake, or river, bay, stream, canal, or basin..is a nuisance."[14]

• "Every person who litters or causes to be littered, or dumps or causes to be dumped, any waste matter into any bay, lagoon, channel, river, creek, slough, canal, lake, or reservoir, or other stream or body of water, or upon a bank, beach, or shore within 150 feet of the high water mark of any stream or body of water, is guilty of a misdemeanor."[15] For purposes of this offense, littering means the "willful or negligent throwing, dropping, placing, depositing, or sweeping, or causing any such acts, of any waste matter on land or water in other than appropriate storage containers or areas designated for such purposes."[16] "Waste matter" means "discarded, used, or leftover substance including, but not limited to...any garbage, trash, refuse, paper, container, packaging or construction material, carcass of a dead animal, any nauseous or offensive matter of any kind, or any object likely to injure any person..."[17] This offense is punishable by a fine of $100 to $1,000.

• The Health and Safety Code contains other specific prohibitions: "no person shall put the carcass of any dead animal, or the offal from any slaughter pen, corral, or butcher shop, into any river, creek, pond, reservoir, or stream."[18] "No person shall put any water closet, privy, cesspool or septic tank, or the carcass of any dead animal, or offal of any kind, in, or upon the borders of any stream, pond, lake, or reservoir from which water is drawn for the supply of any portion of the inhabitants of this state..."[19] "No person shall allow any ....[of same] to remain in or upon the borders of any stream, pond, lake or reservoir...."[20] contamination of water supply by live stock.[21] It is also unlawful to dump "garbage" "in or upon the navigable waters of this state."[22] Violations

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of these provisions are punishable as misdemeanors.[23] In addition, "Anything done, maintained, or suffered, in violation of any of the provisions of this article is a public nuisance, dangerous to health, and may be summarily abated as such."[24] Nevertheless, "Nothing which is done or maintained under the express authority of a statute can be a nuisance."[25]

However, "No agricultural activity, operation, or facility, or appurtenances thereof, conducted or maintained for commercial purposes, and in a manner consistent with proper and accepted customs and standards, as established and followed by similar agricultural operations in the same locality, shall be or become a nuisance, private or public, due to any changed condition in or about the locality, after it has been in operation from more than three years if it was not a nuisance at the time it began."[26] But the right-to-farm nuisance exemption "shall not invalidate" applicability of provisions of the state's Health and Safety Code, Fish & Game Code, Food & Agriculture Code, or Porter-Cologne-Act, if the activity constitutes a nuisance "specifically defined or described in any of those provisions."[27] The Health & Safety Code further provides that none of its prohibitions "shall be held to prevent the grazing of livestock in areas embracing any stream or watershed where the grazing would not tend to render the waters unwholesome of injurious to the public health."[28]

Fish/Fisheries Laws

• A provision of the Porter-Cologne law is designed to protect commercial shellfish harvesting "from the effects of point and nonpoint pollution sources."[29] Regulation is authorized once an area is "threatened." This is defined as an area that has been downgraded or restricted by the state's Department of Health Services, subjected to closure for more than 30 days per year for 3 previous years, or formally determined by a regional water quality control board, the Department of Fish & Game, or the California Coastal Commission to be threatened.[30] "Once the nature, sources, scope, and degree of the pollution affecting a commercial shellfish growing area have been determined, the regional board, with the advice of the local technical advisory committee, shall *order* appropriate remedial action, including the adoption of best management practices to abate the pollution affecting that area."[31] However, the law further provides that "if *agricultural* sources of pollution have been identified as contributing to the degradation of shellfish growing areas, the regional board shall *invite* members of the local agricultural community representing the type of agricultural discharge affecting the local shellfish growing area, the local resource conserve district, the local soil conservation service.....and affected shellfish growers to develop and implement appropriate short- and long-term remediation strategies that will lead to a reduction in the pollution affecting the commercial shellfish growing area."[32]

• The Fish and Game Code contains several provisions that appear to create enforceable prohibitions applicable to nonpoint discharges. "Except [as authorized by a permit, license or waiver issued by the state water resources control board, a regional board, or federal permit for which a state water quality certification has been issued]..., it is unlawful to deposit in, permit to pass into, or place where it can pass into the waters of this state any of the following: (1) Any petroleum, acid....or residuary product of petroleum, or carbonaceous material or substance. (2) Any refuse, liquid or solid, from any...factory of any kind. (3) Any sawdust, shavings, slabs, edgings. (4) Any factory refuse, lime, or slag. (5) Any cocculus indicus. (6) Any substance or material deleterious to fish, plant life, or bird life."[33]

• A separate provision makes it "unlawful to deposit, permit to pass into, or place where it can pass into the waters of the state, or to abandon, dispose of, or throw away, within 150 feet of the high-water mark of the waters of the state, any cans, bottles, garbage, motor vehicle or parts thereof, rubbish, or the viscera or carcass of any dead mammal, or the carcass of any dead bird."[34]

These Fish & Game Code provisions are enforced as misdemeanors, although the first is also punishable by civil penalty of up to $25,000.[35] Another provision of the Code allows the state to recover damages for unlawful destruction of wildlife or fish.[36]

• The Fish & Game Code requires stream alteration permits; this may be applicable in some instances to some nonpoint source pollution, as it applies where debris, waste or other material may pass into the waters of any river, stream or lake. It is "unlawful for any person to substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake designated by the department, or use any material from the streambeds, without first notifying the department" and obtaining the agreement of the Department (or pursuant to arbitrators' decision if another state agency is involved and agreement is not reached).[37]

OPERATIONAL REQUIREMENTS

Forestry Requirements

The Z'Berg-Nejedly Forest Practices Act contains numerous provisions addression nonpoint source pollution in the operating context of timber practices and harvests.[38] The law provides for the division of the state into 3 districts (coast forest, northern forest, southern forest), with distinct rules established by the state board of forestry.[39]

• The rules must "protect the soil, air, fish, and wildlife, and water resources, including, but not limited to, streams, lakes, and estuaries."[40] The rules must include measures for "soil erosion control, for site preparation that involves disturbance of soil or burning of vegetation following timber harvesting activities..., for water quality and watershed control, for flood control....[etc]." The rules must set forth tree stocking standards.[41] Soil erosion must be controlled, and the board must conduct research and "promulgate regulations for each district to govern timber operations that may cause significant soil disturbance."[42] In addition to these rules, "the board shall adopt rules for control of timber opeartion which will result or threaten to result in unreasonable effects on the benficial uses of the waters of the state" including rules for disposal of petroleum products, refuse, and sanitary wastes, construction of stream crossings to protect free passage of water and fish, minimizing damage to unmerchantable streamside vegetation, minimizing damage to streambeds or banks, control of slash, debris, fill, and side cast earth which may be carried into streams, and minimizing the effects of erosion on watercourses and lakes by installation and maintenance of certain drainage facilities, soil stabilization treatments, and planned abandonment of roads and landings.[43]

• Provisions are implemented through requirements for licensing of foresters and for filing and approval of timber harvest plans. "[N]o person shall engage in timber operations until that person has obtained a license from the board."[44] The license requirements include for first time applicants, completion of an education program and completion of work experience (with the exception of owners operating on their own lands), and liability insurance.[45] Licenses may be denied for misrepresentation, conviction within 1 year of application of unlawfully operating without a license, failure to comply with law and rules within three years prior to date of application, railure to pay a judgment or reimburse state for expenses resulting from violation of law or rules, failure to maintain insurance.[46]

• "No person shall conduct timber operations unless a timber harvesting plan prepared by a registered professional forester has been submitted for such operations to the department [of forestry] pursuant to this article."[47] The plan must include, among other provisions, "An outline of the methods to be used to avoid excessive accelerated erosion from timber operations to be conducted within the proximity of a stream" as well as measures to protect unique areas and information required to meet the rules.[48] The law provides for public comments and review by other agencies.[49] The promulgated rules are the "sole criteria" for review of the timber harvesting plans. [50] Reports of completion of work must be filed within one month after completion of the activity described in the plan, and operations must be inspected within six months.[51]

• California also regulates nonindustrial timberlands, defined as owners with less than 2500 acres and not primarily engaged in manufacture of forest products.[52] The law allows nonindustrial "timber management plans," which are reviewed but then remove the board's discretion to disapprove individual nonindustrial timber harvest notices submitted pursuant to th approved plans. The plan must include "(d) An outline of the methods to be used to avoid excessive accelerated erosion from timber operations to be conducted within the proximity of a stream" as well as measures to protect unique areas and information to meet the rules.[53] The plan is subject to public inspection, is reviewed and approved.

Enforcement measures include license actions, misdemeanor prosecutions (with fines of not more than $1000 per day nor imprisonment for more than 6 months), civil injunction actions, and departmental corrective actions with cost recoveries.[54] As noted above, timber operations conducted pursuant to the Forest Practices Act are, in most instances, exempt from the waste discharge provisions of Porter-Cologne.

• Although local government regulation of forestry is largely preempted,[55] the California Tahoe Regional Planning Agency may adopt rules that are stricter than those provided under the law or Board of Forestry regulations.[56]

Agriculture Requirements

• As noted above, waste discharge requirements may be applied to some agricultural nonpoint discharges. In addition, California's regional water quality control boards specifically require WDRs for confined animal facilities and "may impose additional requirements, if such additional requirements are necessary to prevent degradation of water quality or impairment of beneficial uses of waters of the state"[57]

Regulations include management of manure application, animal contact with surface waters, and other conditions.[58]

• California has a fertilizer law, which like those of many states, is aimed primarily at assuring efficacy and appropriate labeling of the fertilizer; the law includes licensing of manufacturers and distributors, and registration of products.[59] However, registration may be cancelled or refused if the substance is "detrimental or injurious to plants, animals, public safety, or the environment when it is applied as directed..."[60] The law is enforced as a petty criminal infraction, by cancellation of registration, and/or by injunction.[61]

• The Health & Safety Code provides that "No person shall keep any horses, mules, cattle, swine, sheep, or live stock of any kind, penned, corralled, or housed on, over, or on the borders of any stream, pond, lake, or reservoir, in a manner that the waters become polluted, if water is drawn therfrom for the supply of any portion of the inhabitants of this state."[62] In addition, "No person shall cause or permit any horses, cattle, sheep, swine, poultry, or any kind of live stock or domestic animals, to pollute the waters, or tributaries of waters, used or intended for drinking purposes by any portion of the inhabitants of this state."[63] Violation is punishable as a misdmeanor.[64] However, "Nothing in this article shall be held to prevent the grazing of livestock in areas embracing any stream or watershed where the grazing would not tend to render the waters unwholesome or injurious to the public health."[65]

• California has detailed laws governing the use of pesticides, including licensing of applicators and registration for pesticides. A pesticide registration may be cancelled where the material "has demonstrated serious uncontrollable adverse effects either within or outside the agricultural environment", "is of less public value or greater detriment to the environment than the benefit received by its use", or that "when properly used, is detrimental to vegetation, except weed, to domestic animals, or to the public health and safety."[66] The state also may regulate possession and use of restricted use material "injurious to the environment or to any person, animal, crop, or other property".[67] Criteria include "hazard to the environment from drift onto streams, lakes, and wildlife sanctuaries...[or] persistent residues in the soil resulting ultimately in contamination of the..waterways, estuaries or lakes, with consequent damage to fish, wild birds, and other wildlife."[68] A full panoply of license and registration actions, orders, injunctions, civil penalties, and criminal penalties exist under these laws.[69]

California's resource conservation districts do not exercise regulatory enforcement authority over nonpoint source pollution; but may only impose and enforce conditions for the receipt of funding and technical assistance.[70]

Development and Other Earth-Disturbing Activities

• California's land use laws to some extent provide enforceable mechanisms relevant to nonpoint source pollution from the built environment. California provides for comprehensive local land use regulation. Counties and cities must adopt comprehensive plans.[71] Such plans must include a "conservation element" for the conservation, development, and utilization of waters, forests, soils, rivers, harbors, fisheries, etc. "The conservation element may also cover (1) The reclamation of lands and waters. (2) Prevention and control of the pollution of streams and other waters. (3)

Regulation of the use of land in stream channels and other areas required for the accomplishment of the conservation plan. (4) Prevention, control, anc correction of the erosion of soils, beaches, and shores. (5) Protection of watersheds. (6) The location, quantity and quality of the rock, sand and gravel resources. (7) Flood control."[72] Also see the Coastal Act, discussed below, which requires local governments to prepare local coastal programs consistent with Coastal Act policies, and Coastal Commission certification.

Land use plans are implemented through zoning regulations and ordinances.[73] And further regulation is applied through subdivision ordinances. "The ordinance shall specifically provide for proper grading and erosion control, including the prevention of sedimentation or damage to offsite property."[74] A subdivision map must be disapproved if inconsistent with the applicable plans, or if "the design of the subdivision or the proposed improvements are likely to cause substantial environmental damage or substantially and avoidably injure fish or wildlife or their habitat."[75] Local governmental land use planning and zoning, as well as state agency decisions, are subject to the California Environmental Quality Act (CEQA),[76] which provides for the preparation of Environmental Impact Reports, alternatives analysis, mitigation, etc. Enforcement of zoning and subdivision requirements is through local authority, while CEQA is enforceable in court.

• California law addresses enforcement of urban stormwater requirements, technically a point source, but relevant to nonpoint source activities.[77]

• California's Coastal Act[78] regulates many activities in the coastal area. Provisions include the goal of biological productivity and water quality,[79] limits on diking, filling, or dredging of coastal waters, wetlands, estuaries, and lakes, [80] and limits on channelization, dams, alteration of rivers and streams.[81] A specific provision provides "(a) Environmentally sensitive habitat area shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas. (b) Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas."[82] And detailed portions of the law establish provisions for development in the coastal zone,[83] including industrial development.[84] The law provides for preparation of local coastal plans by local governments, and for designation of sensitive coastal resource areas; as well as for submission and approval of local coastal plans, land use plans, zoning ordinances.[85] A coastal development permit must be obtained from a certified local government or from the California Coastal Commission.[86] Enforcement includes orders, injunctions, and civil penalties.

• The McAteer-Petris Act provides for the San Francisco Bay Conservation and Development Commission.[87] A permit is required for fill activities.[88] Enforcement is by order, injunction, and civil penalty.

• The State Lands Commission does permitting for depositing material or removing material from wetlands or other waters owned by the state.[89] Violation is a misdemeanor.

- Stream alteration permits are discussed above under "Fish/Fisheries Laws."

Endnotes
1. Cal. Water Code § 13260(a)(1).
2. Cal. Water Code § 13263.
3. Cal. Water Code § 13264.
4. Cal. Water Code § 13269.
5. Pub. Res. Code § 4514.3.
6. Cal. Water Code § 13304(a).
7. Id.
8. Cal. Water Code §§ 13261, 13265, 13268, 13301, 13304, 13305, 13308, 13323, 13331, 13399.
9. Cal. Water Code §§ 13396.5(a), (b).
10. Cal. Water Code § 13396.5(3).
11. Cal. Water Code 13050(m): "Nuisance" means "anything which meets all of the following requirements: (1) Is injurious to health, or is indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property. (2) Affects at the same time an entire community or neighborhood, or any considerable number of persons, although the extent of the annoyance or damage inflicted upon individuals may be unequal. (3) Occurs during, or as a result of, the treatment or disposal of wastes."
12. Cal. Civil Code § 3491.
13. Cal. Penal Code § 370.
14. Cal. Civil Code § 3479.
15. Cal. Penal Code § 374.7(a).
16. Cal. Penal Code § 374(a).
17. Cal. Penal Code § 374(b).
18. Cal. Health & Safety Code § 116975.
19. Cal. Health & Safety Code § 116980.
20. Cal. Health & Safety Code § 116985.
21. Cal. Health & Safety Code §§ 116990, 116995.
22. Cal. Health & Safety Code §§ 117475-117500.
23. Cal. Health & Safety Code §§117130, 117480.
24. Cal. Health & Safety Code § 117035.
25. Cal. Civil Code § 3482.
26. Cal. Civil Code § 3482.5.
27. Cal. Civil Code § 3482.5. Cal. Civil Code § 3482.6 provides similar protection to agricultural processing activities in operation for more than three years, but allows nuisance actions based on increases in activities occurring after Jan. 1, 1993.
28. Health & Safety Code § 117005.
29. Cal. Water Code § 14950(d).
30. Cal. Water Code § 14954.
31. Cal. Water Code § 14956(a).
32. Cal. Water Code § 14956(b).
33. Cal. Fish & Game Code § 5650.
34. Cal. Fish & Game Code § 5652.
35. Fish & Game Code §§ 5650.1
36. Cal. Fish & Game Code § 2014.
37. Fish & Game Code § 1603.

[38] Pub. Res. Code § 4511 et seq.
[39] Pub. Res. Code §§ 4531, 4551.
[40] Pub. Res. Code § 4551.5.
[41] Pub. Res. Code § 4561.
[42] Pub. Res. Code § 4562.5.
[43] Pub. Res. Code § 4562.7.
[44] Pub. Res. Code § 4571.
[45] Pub. Res. Code § 4572.
[46] Pub. Res. Code § 4573.
[47] Pub. Res. Code § 4581.
[48] Pub. Res. Code § 4582.
[49] Pub. Res. Code § 4582.6.
[50] Pub. Res. Code § 4582.75.
[51] Pub. Res. Code §§ 4585, 4586.
[52] Pub. Res. Code §§ 4593-4594.7.
[53] Pub. Res. Code § 4593.3.
[54] Pub. Res. Code §§ 4601-4609.
[55] Pub. Res. Code § 4516.5.
[56] Pub. Res. Code § 4516.
[57] 23 Cal. Code Reg. § 2560.
[58] 23 Cal. Code Reg. §§ 2561-2565.
[59] Food & Ag. Code § 14501 et seq.
[60] Food & Ag. Code § 14601.
[61] Food & Ag. Code § 14671.
[62] Health & Safety Code § 116990.
[63] Health & Safety Code § 116995.
[64] Health & Safety Code § 117015.
[65] Health & Safety Code § 117005.
[66] Food & Ag. Code § 12825.
[67] Food & Ag. Code § 14001 et seq.
[68] Food & Ag. Code §§ 14004.5(d),(e).
[69] Food & Ag. Code §§ 11401 et seq.
[70] Pub. Res. Code §§ 9401, 9416.
[71] Govt. Code § 65300.
[72] Govt. Code § 65302.
[73] Govt. Code § 65850.
[74] Govt. Code § 66411.
[75] Govt. Code § 66474.
[76] Pub. Res. Code § 21000 et seq.
[77] See AB 2019, adding chapter 5.9 to Div. 7 of the Water Code.
[78] Pub. Res. Code § 30000 et seq.
[79] Pub. Res. Code § 30231.
[80] Pub. Res. Code § 30233.
[81] Pub. Res. Code § 30236.
[82] Pub. Res. Code § 30240.
[83] Pub. Res. Code §§ 30250-30550.
[84] Pub. Res. Code § 30260-30265.5.

[85] Pub. Res. Code §§ 30500, 30502, 30526.
[86] Pub. Res. Code § 30600.
[87] Govt. Code § 66600 et seq.
[88] Govt. Code § 66632.
[89] Pub. Res. Code § 6303.

COLORADO

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Colorado's Water Quality Control Act[1] contains a general policy declaration in favor of preventing the discharge of untreated pollutants. However, the law does not have a general enforceable prohibition that directly applies to nonpoint sources. Instead, the Act confers authority on the water quality control commission to adopt regulations, which may include nonpoint source regulations. The Act specifically requires the use of non-regulatory mechanisms before regulatory approaches may be used for agricultural nonpoint sources. It also places express limitations on the use of permits or other control regulations against agricultural nonpoint source discharges.

• Under the Act, the state water quality control commission may classify state waters,[2] and must set water quality standards.[3] The commission *may* also promulgate "precautionary measures, both mandatory and prohibitory, that must be taken by any person owning, operating, conducting, or maintaining any facility, process, activity, or waste pile that does cause or could reasonably be expected to cause pollution of any state waters in violation of control regulations or...any applicable water quality standard."[4] The Act further declares the public policy of the state "to provide that no pollutant be released into any state waters without first receiving the treatment or other corrective action necessary to reasonably protect the legitimate and beneficial uses of such waters."[5] "Pollutant" is defined as "dredged spoil, dirt, slurry, solid waste, incinerator residue, sewage, sewage sludge, garbage, trash, chemical waste, biological nutrient, biological material, radioactive material, heat, wrecked or discarded equipment, rock, sand, or any industrial, municipal, or agricultural waste."[6] The Act expressly makes this policy enforceable against point sources, prohibiting pollutant discharges from point sources without a permit.[7] It allows, but does not require, adoption of such measures for nonpoint sources of pollution. The Act expressly exempts agriculture return flows and runoff from any permitting requirement except as required by federal law.[8]

• For specific basins not meeting water quality standards, the commission has promulgated special control regulations. For example, special regulations for the Chatfield Reservoir basin[9] allocate phosphorus emission limits to major point sources in the basin and authorize the local basin authority and Water Quality Control Division "to approve phosphorus poundage credits to point source allocations if nonpoint source phosphorus reductions can be verified," and require a two-to-one ratio of actual nonpoint source reduction to point source credit.[10] The regulations also mandate that "counties, municipalities, districts, corporations, proprietorships, agencies, or other entities with responsibility for activities or facilities that cause or could reasonably be expected to cause nonpoint source pollution ... shall implement best management practices for control of erosion and sediments" and that the same entities "which have responsibility for stormwater management shall implement nonpoint source control programs."[11]

• The Act provides that "with regard to nonpoint source water pollution control related to agricultural practices, the commission and division shall pursue incentive, grant, and cooperative programs in preference to the promulgation of control regulations.... Control regulations related to agricultural practices shall be promulgated only if incentive, grant, and cooperative programs are determined by the commission to be inadequate and such regulations are necessary to meet state law or the federal act."[12] The Act further declares that "the commission shall not adopt control regulations which require agricultural nonpoint source dischargers to utilize treatment techniques which require additional consumptive or evaporative use which would cause material injury to water rights."[13]

Enforcement of control regulations or standards includes a written notice of violation, which may include a cease-and-desist order or proposed corrective action.[14] Violators are entitled to a hearing.[15] Administrative sanctions include cease-and-desist orders and clean-up orders.[16] Civil penalties involve administrative and judicial processes. The state agency requests the penalty and sets the initial level up to $10,000 per day of violation, and the penalty determination is subject to administrative appeal; however, the ultimate imposition and collection is through judicial action, and the court may review the amount of the penalty.[17] The state may also ask the district attorney to seek injunctions.[18] Reckless, knowing, intentional, or criminally negligent violations are subject to a criminal fine. Maximum fines are $12,000 for reckless or criminally negligent acts; $25,000 for knowing or intentional acts; and double those amounts for second violations within a two-year period.[19]

Other Discharge Limitations

• Under Colorado's health code, the state department of public health and environment has the power and duty "to abate nuisances when necessary for the purpose of eliminating sources of epidemic and communicable diseases affecting the public health."[20] County and district health departments have similar powers.[21] The department and county and local boards of health are responsible for enforcement. They may order abatement, assess a $100 penalty for failure to act upon a nuisance abatement order within 24 hours, and recoup costs for abatement actions.[22] The health code also empowers courts to order abatement by public authorities at the defendant's expense "whenever any person is convicted of maintaining a nuisance injurious to the public health and safety."[23]

• Another title states that municipalities have the power "to declare what is a nuisance and abate the same".[24] Municipalities also have the power "to provide for the cleansing and purification of water, watercourses, and canals ... when necessary to prevent or abate nuisances."[25] Moreover, the water quality act states "nor shall any provision of this article or anything done by virtue of this article be construed as estopping individuals, cities, towns, counties, cities and counties, or duly constituted political subdivisions of the state from the exercise of their respective rights to suppress nuisances."[26] Municipalities have abatement authority for municipally-declared nuisances, and can impose fines of up to $1000.[27]

• Another law declares "any unlawful pollution or contamination of any surface or subsurface waters" to be a class 3 public nuisance, but provides that "no action shall be brought under this paragraph ... if the state department of public health and environment or any other agencies of state or local government charged by and acting pursuant to statute or duly adopted regulation has assumed jurisdiction by the institution of proceeding on that pollution or contamination."[28] Actions for abatement may be brought by the district attorney or, with the consent of the district attorney, by the attorney general.[29] The sanction is an injunction to abate the nuisance or an order for the sheriff to abate the nuisance at the expense of the owner or operator of the nuisance.[30]

With respect to nuisance actions, evidence of compliance with a state water quality permit "shall constitute a prima facie case that the activity to which the permit pertains is not a public or private nuisance."[31] Further, agricultural operations are exempt from common law nuisance actions and local nuisance ordinances where the operation has been in existence for at least one year, is not being operated negligently, and has not increased substantially in size.[32]

Fish/Fisheries Laws

• The fish and wildlife code appears not to provide enforceable authority against nonpoint source discharges, except as noted below under "Development and Other Earth-Disturbing Activities." However, it provides that "all wildlife within this state not lawfully acquired and held by private ownership is declared to be the property of the state."[33] Such a declaration arguably might serve as the foundation for a tort claim for property damage for fish kills. Violations of the wildlife code are misdemeanors punishable by fines of $50 and "points" in a hunting and fishing license suspension system.[34] Items used in committing a violation are subject to seizure as public nuisances.[35]

OPERATIONAL REQUIREMENTS

Forestry Requirements

The state board of agriculture has the power and duty "to foster and promote the control of soil erosion on ... forest lands."[36] The state forestry laws do not appear to contain enforceable provisions in this area.

Agriculture Requirements

• The soil conservation code creates soil conservation districts, but apparently does not vest them with regulatory powers.[37] However, the Soil Erosion-Dust Blowing Act makes it "the duty of the owner or occupier of any land in this state to prevent soil blowing therefrom, as nearly as can be done."[38] The act gives a right of action to individuals and governments for property damage due to blowing dust.[39] However, it does not apply to any land less than one acre in area.[40] There are two options for enforcement of the act: a civil suit for damages, or in emergency situations, an appeal for administrative action by the county.[41] A written complaint to the county board is a prerequisite to both civil suit and administrative relief. Upon receiving a written complaint, a county board may inspect lands and, if necessary, serve a citation or take corrective action and bill the land owner for costs.[42]

• A 1929 law declares it "the policy of this state to preserve the grasses and vegetation on the public domain ... and to prevent erosion of the soil and thereby conserve the waters and water supply originating on the public domain ranges of this state."[43] It creates a cause of action to seek an injunction reducing use of public range lands when "any such range is overstocked or ... said range is about to be overstocked with the kind of livestock which may be lawfully herded or grazed thereon and ... vegetation is being permanently destroyed or is about to be permanently destroyed and the water supply upon which any person is dependent is about to be diminished or impaired."[44] "[A]ny person using such range and any person having the right to use water from any stream or source of supply fed from the watersheds in any such range may apply to the court," and "all persons using said range shall be made parties defendant."[45] In the court hearing, "if it is fully and satisfactorily established that such range is overstocked or is about to be overstocked, the court may determine the number of livestock that said range or portion of said range is capable of supporting for a period not exceeding two years, enjoining all persons from willfully or intentionally grazing or herding any greater number."[46] The court is to give preference in its order to those who have used the land continuously and customarily for grazing and to neighboring property owners.[47]

• Colorado has promulgated feedlot rules under the rulemaking authority in the water quality control act.[48] Under these rules, "concentrated animal feeding operations are required to operated as no-discharge facilities."[49] The rules set out best management practices, which are enforceable using the department's authority in the water quality act.[50] In addition, the department has extensive rules on the use of sewage sludge ("biosolids") as fertilizer, which were also promulgated under the water quality act.[51] In 1998, Colorado voters adopted further controls on animal feeding operations by referendum.

• A targeted amendment to the water quality act directs the commissioner of agriculture to address groundwater pollution from agricultural chemicals.[52] It requires the commissioner to promulgate rules governing bulk storage and mixing of fertilizers and pesticides.[53] The agriculture department enforces the standards, may issue cease and desist orders against violators, and may also bring a civil suit.[54] It may seek civil penalties of up to $1000 per violation, and in court may seek the same penalties plus attorneys fees.[55]

The same amendment also empowers the commissioner to develop best management practices for "any other activity relating to the use of any agricultural chemical."[56] However, this authority is to some extent undercut by the water quality act, which defines "best management practices," to be "any *voluntary* activity, procedure, or practice established by the department of agriculture" to address pollution.[57] If voluntary practices do not work, the commissioner then can require agricultural management plans.[58] Further, "if continued monitoring reveals that rules and regulations adopted by the commissioner ... are not preventing or mitigating the presence of the subject agricultural chemical to the extent necessary," the water quality control commission effectively has authority to promulgate additional regulations.[59]

• The general state pesticide law gives the commissioner of agriculture the authority to promulgate rules "adopting a list of restricted use pesticides or limited use pesticides for the state or designating areas within the state if the commissioner determines that such pesticides require rules restricting their distribution or use."[60] The department also regulates handling, transportation, storage, display, and disposal of pesticides and their containers.[61] It is unlawful "to use or cause to be used any pesticide contrary to the rules or regulations."[62] The commissioner may issue compliance orders, may bring a civil suit seeking injunctive enforcement of administrative orders, or may bring a civil enforcement suit without prior administrative action.[63] The commissioner also may suspend, revoke, or deny registrations and licenses of violators,[64] and may also assess a civil penalty of up to $5000 per violation, with each day a separate violation.[65]

• The Colorado Chemigation Act governs the addition of agricultural chemicals to irrigation water.[66] This practice requires a permit from the department of agriculture.[67] The commissioner of agriculture can deny, suspend, or revoke permits if the operation does not meet equipment and installation requirements, has contaminated ground or surface water, or has operated in violation of procedural requirements of the law.[68] Chemigating without a permit is a class 6 felony, punishable by a fine of up to $1000, and an additional civil penalty of between $100 and $1000 dollars.[69] The department may also seek an injunction against the violator.[70]

Development and Other Earth-Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act or that may be authorized by general land use regulations such as zoning, state law provides the following authorities potentially applicable to nonpoint source discharges.

• The Colorado Land Use Act provides that "local governments shall be encouraged to designate areas and activities of state interest and, after such designation, shall administer such areas and activities of state interest and promulgate guidelines for the administration thereof"; state agencies are directed to assist local governments in designating areas and developing guidelines for their administration.[71] Potential areas of state interest include "natural hazard areas," which include floodplains, as well as "areas containing, or having a significant impact upon, historical, natural, or archeological resources of statewide importance."[72] As part of the designation process, the local government must adopt local guidelines for administration of the area.[73] Development in areas of state interest is subject to a permit system, and the standard for approving a permit is compliance with the local guidelines and regulations.[74] Local governments designate areas, adopt guidelines, and issue permits.[75] Either the local government or the Colorado Land Use Commission may take action against "any person desiring to engage in development in an area of state interest ... who does not obtain a permit," and violators may be enjoined from engaging in the development.[76]

As applied to floodplains, the Act requires these areas to be "administered so as to minimize significant hazards to public health and safety or to property. ... Activities shall be discouraged which, in time of flooding, would create significant hazards to public health and safety or to property. Shallow wells, solid waste disposal sites, and septic tanks and sewage disposal systems shall be protected from the inundation of floodwaters."[77] Similarly, the Act may extend to other kinds of ecologically sensitive areas, such as wetlands or endangered species habitat.[78] However, the Act may not be construed to affect constitutionally guaranteed property rights or "existing laws or court decrees with respect to the determination and administration of water rights."[79]

• The wildlife code requires state agencies to give notice to the wildlife commission 90 days before any action which would "obstruct, damage, diminish, destroy, change, modify, or vary the existing shape or form of any stream or its banks or tributaries by any type of construction."[80] If the project will "adversely affect" the stream, particularly as fishing waters, the commission can request modifications to the project and ultimately elevate decision on the project to the governor.[81] There are no sanctions beyond the elevation of inter-agency disputes to the governor.

Endotes

1. Colo. Rev. Stat. § 25-8-101 et seq.
2. Colo. Rev. Stat. § 25-8-203.
3. Colo. Rev. Stat. § 25-8-204.
4. Colo. Rev. Stat. § 25-8-205(1)(c).
5. Colo. Rev. Stat. § 25-8-102(2).
6. Colo. Rev. Stat. § 25-8-103(14).
7. Colo. Rev. Stat. § 25-8-501(1).
8. Colo. Rev. Stat. § 25-8-504.
9. 5 Colo. Code Regs. § 1002-19-4.7.0 et seq.
10. 5 Colo. Code Regs. § 1002-19-4.7.3(B)(5).
11. 5 Colo. Code Regs. § 1002-19-4.7.6.
12. Colo. Rev. Stat. § 25-8-205(5).
13. Colo. Rev. Stat. § 25-8-205(5).
14. Colo. Rev. Stat. § 25-8-602.
15. Colo. Rev. Stat. §25-8-603.
16. Colo. Rev. Stat. §§ 25-8-605, -606.
17. Colo. Rev. Stat. § 25-8-608.
18. Colo. Rev. Stat. § 25-8-607.
19. Colo. Rev. Stat. § 25-8-609.
20. Colo. Rev. Stat. § 25-1-107(1)(d).
21. Colo. Rev. Stat. § 25-1-506(1)(e).
22. Colo. Rev. Stat. §§ 25-1-514(1)(d), -615 to -618.
23. Colo. Rev. Stat. § 25-1-619.
24. Colo. Rev. Stat. § 31-15-401(1)(c).
25. Colo. Rev. Stat. § 31-15-710.
26. Colo. Rev. Stat. § 25-8-612(3).
27. Colo. Rev. Stat. §§ 31-15-401(1)(c), 31-16-101.
28. Colo. Rev. Stat. § 16-13-305(1)(e).
29. Colo. Rev. Stat. § 16-13-307.
30. Colo. Rev. Stat. § 16-13-309.
31. Colo. Rev. Stat. § 25-8-611(2).
32. Colo. Rev. Stat. § 35-3.5-102.

[33] Colo. Rev. Stat. § 33-1-101.
[34] Colo. Rev. Stat. §§ 33-6-104, -106.
[35] Colo. Rev. Stat. § 33-6-102.
[36] Colo. Rev. Stat. § 23-30-202(1)(b).
[37] See Colo. Rev. Stat. tit. 35, art. 70.
[38] Colo. Rev. Stat. § 35-72-102(1).
[39] Colo. Rev. Stat. §§ 35-72-106(2), (3).
[40] Colo. Rev. Stat. § 35-72-102(6).
[41] Colo. Rev. Stat. §§ 35-72-102(4), -103(1).
[42] Colo. Rev. Stat. §§ 35-72-103, -105.
[43] Colo. Rev. Stat. § 35-45-106.
[44] Colo. Rev. Stat. § 35-45-106.
[45] Colo. Rev. Stat. §§ 35-45-106(1), (2).
[46] Colo. Rev. Stat. § 35-45-106(2).
[47] Colo. Rev. Stat. § 35-45-106(2).
[48] 5 Colo. Code Regs. § 1002-19-4.8.0; see Colo. Rev. Stat. § 25-8-205.
[49] 5 Colo. Code Regs. § 1002-19-4.8.3(A).
[50] 5 Colo. Code Regs. § 1002-19-4.8.6.
[51] 5 Colo. Code Regs. § 1002-19-4.9.0.
[52] Colo. Rev. Stat. § 25-8-205.5.
[53] Colo. Rev. Stat. § 25-8-205.5(3)(b). The rules, which primarily establish technology-prescribing standards, are found at 8 Colo. Code Regs. § 1203-12.
[54] Colo. Rev. Stat. § 25-8-205.5(h)(IV)-(VI).
[55] Colo. Rev. Stat. § 25-8-205.5(h)(IV)-(VI).
[56] Colo. Rev. Stat. § 25-8-205.5.
[57] Colo. Rev. Stat. § 25-8-103(1.3) (emphasis added). The agriculture code also limits the authority of local governments to regulate the use of agricultural chemicals. Local governments can zone sites for sale and storage, regulate discharges into sewers, act to regulate stormwater runoff, or act to protect drinking water supplies "in accordance with current state or federal applicable law", but they cannot otherwise regulate a broad category of actions relating to use. Colo. Rev. Stat. §§ 35-1.5-101(1)(a), -103.
[58] Colo. Rev. Stat. § 25-8-205.5(d); see Colo. Rev. Stat. tit. 24, art. 4.
[59] Colo. Rev. Stat. §§ 25-8-205.5(6), (7).
[60] Colo. Rev. Stat. § 35-9-118(2)(c)(I).
[61] Colo. Rev. Stat. § 35-9-118(2)(f).
[62] Colo. Rev. Stat. § 35-9-120(1)(d).
[63] Colo. Rev. Stat. §§ 35-9-121(2), (3).
[64] Colo. Rev. Stat. § 35-9-122.
[65] Colo. Rev. Stat. § 35-9-124(1). The criminal penalty provisions of the act do not appear likely to be directly used to address water pollution issues. See Colo. Rev. Stat. § 35-9-125.
[66] Colo. Rev. Stat. tit. 35, art. 11.
[67] Colo. Rev. Stat. § 35-11-103.
[68] Colo. Rev. Stat. § 35-11-112.
[69] Colo. Rev. Stat. § 35-11-115.
[70] Colo. Rev. Stat. § 35-11-116.
[71] Colo. Rev. Stat. § 24-65.1-101(2)(b)-(c).
[72] Colo. Rev. Stat. § 24-65.1-201; see Colo. Rev. Stat. §§ 24-65.1-103(7), (13), (14) (floodplains included in the definition of "natural hazard areas").
[73] Colo. Rev. Stat. § 24-65.1-404.

[74] Colo. Rev. Stat. § 24-65.1-501(3).
[75] See generally Colo. Rev. Stat. § 24-65.1-301.
[76] Colo. Rev. Stat. § 24-65.1-501(6).
[77] Colo. Rev. Stat. § 24-65.1-202(2)(a)(I).
[78] E.g., Colo. Rev. Stat. § 24-65.1-104(12) (defining "natural resources of state importance").
[79] Colo. Rev. Stat. § 24-65.1-106.
[80] Colo. Rev. Stat. § 33-5-102.
[81] Colo. Rev. Stat. §§ 33-5-103 to -105.

CONNECTICUT

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Connecticut's water pollution law includes several provisions that may be used to take enforcement action against nonpoint source discharges.

• The law makes it a violation to discharge any substance to the waters of the state without a permit. "No person or municipality shall initiate, create, originate, or maintain any discharge of water, substance or material into the waters of the state without a permit for such discharge issued by the commissioner [of environmental protection]."[1] "Discharge" means "the emission of any water, substance or material into the waters of the state, whether or not such substance causes pollution."[2] And it is not limited to point sources. In setting standards for permits, the commissioner must consider "best management practices," defined as "practices which reduce the discharge of waste into the waters of the state and which have been determined by the commissioner to be acceptable based on, but not limited to, technical, economic and institutional feasibility."[3]

• It is also a violation to cause water pollution, regardless of the source. "No person or municipality shall cause pollution of any of the waters of the state or maintain a discharge of any treated or untreated wastes in violation of any provision of this chapter."[4] Pollution is defined as "the contamination or rendering unclean or impure or prejudicial to public health of any waters of the state by reason of any wastes or other material discharged or deposited therein by any public or private sewer or otherwise so as directly or indirectly to come in contact with any waters..."[5]

• Connecticut law also authorizes the commissioner to issue an order whenever any person has created or is maintaining a condition "which reasonably can be expected to create a source of pollution to the waters of the state."[6] A separate provision authorizes the commissioner "to investigate or order the person who caused or reasonably may be expected to cause the pollution to investigate all points of existing or potential waste discharge which may directly or indirectly result in pollution of the waters of the state."[7]

Enforcement authorities include orders prohibiting or abating pollution and orders to correct potential sources of pollution.[8] Orders may be issued to the landowner where different from the discharger.[9] Orders may be enforced by injunction.[10] Civil penalties are available up to $25,000 per day.[11] Criminal actions may be brought for willful violations or those with criminal negligence with a sanction of up to $25,000 per day and/or 1 year imprisonment.[12] Water pollution inspection and enforcement is delegable to political subdivisions of the state, subject to retained authority of the commissioner.[13]

Other Discharge Limitations

Connecticut law provides some enforceable mechanisms directed at pollution of sources of water supply, or creation of nuisances.

• The Department of Public Health may investigate any "source of water or ice supply from which water or ice used by the public is obtained, and, if it finds any pollution or threatened pollution which in its judgment is prejudicial to public health, it shall notify the owner or operator of such water company or system of ice supply, or the person or corporation causing or permitting such pollution or threatened pollution, and the Commissioner of Environmental Protection, of its findings and shall make such orders as it deems necessary to protect such water or ice supply and render such water or ice safe for domestic use."[14] Enforcement is by administrative order, which may be enforced by injunction; violation of an order leads to a fine of up to $500 per day.[15]

• "Whenever any land...is so used..that it is a source of pollution to any lake, pond or water from which ice is procured for domestic use or....to the water stored in a reservoir used for supplying residents of a town, city or borough with water or ice, or to any source of supply to such reservoir, or when such water or ice is liable to pollution in consequence of the same, the authorities of such town, city or borough, or the town director of health, or the person, firm or corporation having charge of such reservoir or the right to procure ice therefrom, may apply for relief to the superior court...and said court may make any order...which, in its judgment, may be necessary to preserve the purity of such water or ice." This provision also allows such persons to enter and abate any "nuisance likely to pollute such water or ice" after notice to the owners and upon their refusal to do so.[16]

• "The discharge or exposure of sewage, garbage or any other organic filth into or upon any public place in such a way that transmission of infective material may result thereby..." is a statutory public nuisance.[17]

• "No materials or waste products from any mill, factory, slaughterhouse, rendering or fertilizing works, junk establishment, common carrier or other industry or utility shall be stored or deposited so as to cause the surrounding atmosphere, land or water to be contaminated or polluted in such a manner as to injure the public health or create offensive conditions."[18]

• "Any person who wilfully deposits material in any watercourse where it will naturally be carried to the land of another to his injury shall pay to the party injured thereby double damages and costs, unless, within a reasonable time after notice of the injury, he removes such material from such land."[19]

• "Any person who places, collects or allows to remain upon the surface of land owned or occupied by him, or discharges or allows to be discharged from his premises upon the land of another or upon any public land, any filthy water, garbage or other filthy or noxious matter, whereby the owner or occupant of land in the vicinity thereof is injured or annoyed, or discharges or deposits upon the watershed of any stream or reservoir used to supply water to any community filthy or noxious matter...shall be fined not more than fifty dollars [and charged with any cost of removal, if not removed within three days]."[20]

It is the duty of local health directors to abate "all nuisances and sources of filth injurious to the public health." Abatement orders are issued and are enforceable by injunctive relief, and a civil penalty of $250 per day may be assessed for each day the nuisance is maintained after the time fixed for abatement, and recovery of damages for abatement or removal.[21]

However, farming operations are exempt from nuisance actions under some circumstances: "no agricultural or farming operation...shall be deemed to constitute a nuisance, either public or private, due to alleged objectionable.....(4) use of chemicals, provided such chemicals and the method of their application conform to practices approved by the commissioner of environmental protection or, where applicable, the commissioner of public health, or (5) water pollution from livestock or crop production activities, except the pollution of public or private drinking water supplies, provided such activities conform to accepted management practices for pollution control approved by the commissioner of environmental protection;" provided that the farm has been in operation for one or more years and not substantially changed "and such operation follows generally accepted agricultural practices." "Inspection and approval of the agricultural or farming operation...by the commissioner of agriculture or his designee shall be prima facie evidence that such operation follows generally accepted agricultural practices." The exemption from nuisance liability does not apply "whenever a nuisance results from negligence or wilful or reckless misconduct in the operation...."[22]

Fish/Fisheries Laws

Connecticut does not have a broad prohibition related to fisheries that may serve as an enforceable mechanism, but has some laws of limited utility in this context.

- The law provides that "No person shall place in any lake, pond or stream any lime, creosote or cocculus indicus or any other drug or poison injurious to fish" and imposes a fine of not more than $100 per fish taken.[23] The law does not require an intent to take fish; however, the types of substances listed, coupled with the need to show intent to place the injurious substances, limit this section's potential usefulness in the nonpoint context.

- State law also allows the state to recoup restoration costs and damages, such as damage to fish and habitat, resulting from knowing or negligent violation of environmental laws, including the water pollution laws.[24]

OPERATIONAL REQUIREMENTS

Forestry Requirements

- Connecticut law requires any person engaged in commercial forest practices to obtain and maintain a state certificate. There are three classes of certificate: forester, supervising forest products harvester, and forest products harvester. Examinations are required, and the certificate is valid for not more than five years; there is a requirement of continuing education biennially to maintain certificate.[25] Certified foresters, supervisors, and harvesters are required to file annual reports of their activities and continuing education.[26] These laws can provide a basis for assuring that commercial forest practices are conducted in accordance with the prevention of nonpoint source water pollution.

• State law authorizes the Commissioner of Environmental Protection to adopt regulations "governing the conduct of forest practices including, but not limited to, the harvest of commercial forest products and other such matters as the commissioner deems necessary to carry out the provisions [of this chapter]." "Such regulations shall provide for a comprehensive statewide system of laws and forest practices regulations which will achieve the following purposes and policies: (1) Afford protection to and improvement of air and water quality..."[27] The law also authorizes municipalities to regulate forest practices in a manner consistent with the state law; municipal regulations are effective only if they are approved by the Commissioner.[28] In addition, zoning regulations may restrict clear-cutting in areas with a "traprock ridge."[29] Enforcement tools include civil penalties of up to $5,000 per day per offense, compliance orders, injunctions, and denial, suspension, or revocation of a certificate.[30]

Agriculture Requirements

In addition to the exemption from nuisance liability the use of accepted agricultural practices provides under Connecticut law, state law also contains some other enforceable requirements.

• The Commissioner of Agriculture must adopt regulations "concerning acceptable management practices of intensive poultry farming," defined as more than 20,000 fowl confined within pens or buildings, and may issue "such orders as he deems necessary" to correct noncompliance.[31] The Commissioner may take action where intensive poultry operation is "causing, engaging in or maintaining, or is about to cause, engage in or maintain, any condition or activity which in his judgment may result in the introduction or spread of an environmental or health hazard" including issuance of an immediately effective abatement order without prior hearing. A hearing must be held within ten days. The Commissioner may also expend funds to abate an activity and recover such funds via a lien on the property.[32] Civil penalties are available for violations.[33]

• "No pigsty shall be built or maintained on marshy ground or land subject to overflow..."[34]

• State pesticide laws provide authority to prescribe regulations concerning the time, place, manner, methods, materials, amounts, and concentrations of application of pesticides to prevent damage to plants, wildlife, fish and other aquatic life, beneficial insects, animals, and humans.[35]

Development and Other Earth-Disturbing Activities

• The Soil Erosion and Sediment Control Act[36] declares state policy to establish a "state-wide coordinated erosion and sediment control program which shall reduce the danger from storm water runoff, minimize nonpoint sediment pollution from land being developed and conserve and protect the land, water, air and other environmental resources of the state."[37] The statewide Council on Soil and Water Conservation develops guidelines for soil erosion and sediment control and land being developed, including model regulations that may be used by municipalities.[38] The zoning and subdivision regulations[39] adopted and enforceable by a municipality must require that "(1) Proper provision be made for soil erosion and sediment control; (2) a soil erosion and sediment control plan be submitted with any application for development when the disturbed area of such development is more than one-half acre; and (3) the municipality or the soil and water conservation district shall certify that the plan complies with regulations adopted pursuant to said sections."[40] However, a single family dwelling that is not part of a subdivision of land is exempt from soil erosion and sediment control regulations.[41]

• Certain targeted conservation and development planning requirements,[42] including protection of Long Island Sound from "hypoxia, pathogens, toxic contaminants and floatable debris,"[43] and conservation zones along the Connecticut and Niantic Rivers,[44] provide zoning standards that can allow local governments to establish enforceable practices relevant to nonpoint source pollution. Coastal management law also provides for regulation of earth-disturbing activities by municipalities subject to state policies.[45] Connecticut also provides for additional municipal regulation along protected river corridors and multiple use river corridors.[46]

Endnotes

1. Conn. Gen Stat. Ann. § 22a-430(a) (West 1995 & Supp. 1997).
2. Conn. Gen. Stat. Ann. 22a-423 (West 1995 & Supp. 1997).
3. Conn. Gen. Stat. Ann. § 22a-430(b).
4. Conn. Gen. Stat. Ann. § 22a-427 (West 1995 & Supp. 1997).
5. Conn. Gen. Stat. Ann. 22a-423 (West 1995 & Supp. 1997). "Wastes" is broadly defined; and "sewage" expressly includes animal excretions.
6. Conn. Gen. Stat. Ann. § 22a-432 (West 1995 & Supp. 1997).
7. Conn. Gen. Stat. Ann. § 22a-424(m).
8. Conn. Gen. Stat. Ann. §§ 22a-424(f), 22a-430(d), 22a-431, 22a-432; see also Conn. Gen. Stat. Ann. § 22a-7 (cease and desist order for "condition or activity...likely to result in imminent and substantial damage to the environment, or to public health").
9. Conn. Gen. Stat. Ann. § 22a-433.
10. Conn. Gen. Stat. Ann. §§ 22a-432, 22a-435.
11. Conn. Gen. Stat. Ann. § 22a-438.
12. Conn. Gen. Stat. 22a-438.
13. Conn. Gen. Stat. Ann. § 22a-2a.
14. Conn. Gen. Stat. Ann. § 25-34 .
15. Conn. Gen. Stat. Ann. §§ 25-34, 25-36, 25-37.
16. Conn. Gen. Stat. Ann. § 25-51.
17. Conn. Gen. Stat. Ann. § 19-13-B1(d).

[18] Conn. Gen. Stat. Ann. § 19-13-B22.
[19] Conn. Gen. Stat. Ann. § 19a-337.
[20] Conn. Gen. Stat. Ann. § 19a-340.
[21] Conn. Gen. Stat. § 19a-206. Health directors of municipalities adjacent to streams and bodies of water have jurisdiction over them for public health purposes. § 19a-209.
[22] Conn. Gen. Stat. Ann. § 19a-341.
[23] Conn. Gen. Stat. § 26-119.
[24] Conn. Gen. Stat. Ann. § 22a-6a.
[25] Conn. Gen. Stat. § 23-65h. An applicant for the "forest products harvester" certificate is exempt from the examination requirement if the applicant has engaged in commercial forest practices at least once per year for the ten years preceding Oct. 1, 1991. Conn. Gen. Stat. § 23-65h(3).
[26] Conn. Gen. Stat. § 23-65i.
[27] Conn. Gen. Stat. § 23-65j.
[28] Conn. Gen. Stat. § 23-65k.
[29] Conn. Gen. Stat. § 8-2(c). However, selective timbering is permitted as of right in ridgeline setback areas. § 8-2(c)(3).
[30] Conn. Gen. Stat. §§ 23-65n, 23-65*l*, 23-65m, 23-65*o*.
[31] Conn. Gen. Stat. § 22-323a. A permit is required. § 22a-326f.
[32] Conn. Gen. Stat. §§ 22-326d, 22-326e.
[33] Conn. Gen. Stat. § 22-326. $500 per day up to a maximum of $25,000.
[34] Conn. Gen. Stat. § 19-13-B23.
[35] Conn. Gen. Stat. § 22a-66.
[36] Conn. Gen. Stat. §§ 22a-325 to -329.
[37] Conn. Gen. Stat. § 22a-325.
[38] Conn. Gen. Stat. § 22a-328.
[39] Conn. Gen. Stat. §§ 8-2, 8-25; see § 22a-327(6).
[40] Conn. Gen. Stat. § 22a-329.
[41] Conn. Gen. Stat. § 22a-329.
[42] Conn. Gen. Stat. § 8-23.
[43] Conn. Gen. Stat. §§ 8-23, 8-35a.
[44] Conn. Gen. Stat. §§ 25- 102a to -102*l* (lower Connecticut River), §§ 102aa to -102jj (upper Connecticut River), § 25-109(c) (Niantic River).
[45] Conn. Gen. Stat. §§ 22a-90 et seq., esp. §§ 22a-101 to -109 (municipal programs and regulation).
[46] Conn. Gen. Stat. §§ 25-200 to -210 (Protected Rivers Act), §§ 25-230 to -238 (Multiple Use Rivers Act).

DELAWARE

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Delaware's water pollution law prohibits discharge of a pollutant to the waters of the state without a permit. This provision may be used to address pollution events caused by nonpoint source discharges; however, the regulations exempt certain agricultural and other activities.

• "No person shall, without first having obtained a permit from the Secretary [of Natural Resources and Environmental Control] undertake any activity...(2) In a way which may cause or contribute to discharge of a pollutant into any surface or ground water..."[1] The adopted permitting regulations are aimed at point sources, but the state also can use this statutory authority to deal with nonpoint source pollution events.[2] Regulations provide that numerous nonpoint activities do not require a permit, however. These include activities involving existing drainage ditches; uncontaminated stormwater discharges; application of fertilizer "using recognized methods"; transportation of fertilizers; application of herbicides, pesticides and plant growth regulators; plowing or cultivating for agricultural or horticultural purposes; irrigation practices utilizing uncontaminated water; snow and ice removal; movement of earth for building excavations; regrading of earth "unless otherwise regulated"; and salting and sanding of roadways for the express purpose of snow and ice control.[3] Enforcement includes civil penalties, orders, and injunctions.[4]

Other Discharge Limitations

• A separate law addresses pollution of public water supplies. "No person shall cast, put, place, discharge in or permit or suffer to be cast, put, discharged in or to escape into any running stream of water within the limits of this State, from which stream the inhabitants of any borough, town or city within this State are supplied wholly or in part with water for and as drink or beverage, any dye-stuffs, drugs, chemicals or other substance or matter of any kind whatsoever whereby the water so supplied...becomes noxious to the health or disagreeable to the senses of smell or taste."[5] This offense is punishable by a fine of $1000-$5000.

• Under nuisance-type legislation, Delaware law provides that a local board of health may abate "noisome matter."[6] And "a person is guilty of criminal nuisance when...[b]y conduct either unlawful in itself or unreasonable under all the circumstances, the person knowingly or recklessly creates or maintains a condition which endangers the safety or health of others." Criminal nuisance is punishable by fine of up to $575 and up to 30 days in jail.[7] However, with respect to nuisances, "No agricultural or forestal operation within this State which has been in operation for a period of more than 1 year shall be considered a nuisance, either public or private, as the result of a changed condition in or about the locality where such agricultural or forestal operation is located. This section shall not apply when the nuisance is determined to exist as the result of the negligent or improper operation of any agricultural or forestal operation or when such operation is being operated in violation of state or federal law or any local or county ordinance."[8]

• Littering legislation may also be usable to address pollution resulting from waste material or other discarded materials. It is unlawful to "dump, deposit, throw or leave, or cause or permit the dumping, depositing, placing, throwing or leaving of litter on any public or private property of this State, or any waters in this State."[9] "Litter" includes "all rubbish, waste material, refuse, cans, bottles, garbage, trash, debris, dead animals or other discarded materials of every kind and description."[10] This is a petty offense punishable by fine of $25-$50.[11]

Fish/Fisheries Laws

The state laws directed at fish and fisheries do not appear to provide independent enforcement mechanisms for nonpoint source pollution.

OPERATIONAL REQUIREMENTS

Forestry Activities

Delaware has a detailed enforcement order authority, or "bad actor" authority, to address nonpoint sediment pollution from forestry operations.

• "The Forestry Administrator shall provide for the protection of the waters of the State from pollution by sediment deposits resulting from silvicultural activities."[12] "Pollution" is defined as "such alteration of the physical, chemical or biological properties of any waters of the State resulting from *sediment deposition* that will or is likely to create a nuisance or render such waters (a) harmful or detrimental or injurious to the public health, safety or welfare, or to the health of animals, fish or aquatic life; (b) unsuitable with reasonable treatment for use as present or possible future source of public water supply; or (c) unsuitable for recreational, commercial, industrial, agricultural or other reasonable uses."[13]

The statute contemplates informal attempts to abate the problem initially. "If the Forestry Administrator...determines that an owner or operator is conducting or allowing the conduct of any silvicultural activity in a manner which is causing or is likely to cause pollution, the Forestry Administrator ...may advise the owner or operator of corrective measures needed to prevent or cease the pollution. Failure of the Forestry Administrator...to advise an owner or operator of such corrective measures shall not impair the Forestry Administrator's authority to issue special orders."[14]

The enforcement mechanism is the special order. "Special orders can be issued if the Forestry Administrator...finds that any owner or operator is conducting any silvicultural activity in a manner which is causing or is likely to cause alteration of physical, chemical or biological properties of any state water, resulting from sediment deposition presenting an *imminent and substantial danger* to (a) the public health, safety or welfare, or the health of animals, fish or aquatic life; (b) a public water supply; or (c) recreational, commercial, industrial, agricultural or other reasonable uses." The order may direct the owner or operator "to cease immediately all or part of the silvicultural activities on the site and to implement specified corrective measures within a stated period of time."[15] However, "[t]he Forestry Administrator shall not issue a special order to any owner or operator who has incorporated generally acceptable sediment control and stormwater management techniques and guidelines developed by the Forestry Administrator, which techniques have failed to prevent pollution, if the Forestry Administrator determines that the pollution is the direct result of unusual weather events which could not have been reasonably anticipated."[16]

Special orders are issued after notice and hearing and are effective not less than 5 days after service, except for emergency special orders which may be issued immediately provided there is a rapid post-issuance hearing. Sanctions are civil penalties of $200 to $2,000 per violation per day; but intentional and knowing violations of orders after written notice to comply are subject to fines of $500 to $10,000 per violation per day.[17]

Agricultural Activities

Delaware appears to have few enforceable nonpoint source provisions directed at agricultural practices, apart from manure management provisions for CAFOs.

• An older public health provision provides that "No person shall put or place, or permit to be put, place or used, any...hogpen or slaughterhouse over or so near that the excrement or offal therefrom shall escape or run into any stream of running water within the limits of this State from which the inhabitants of any town, borough or city are wholly or in part furnished with water as a drink or beverage."[18] This offense is punishable by a $100 fine.

• The state also has pesticide applicator regulations.[19] The law provides that the Department of Agriculture "may prescribe the methods to be used in application of pesticides, and may relate to the time, place, manner, materials and amounts and concentrations, in connection with the application of the pesticides, and may restrict or prohibit use of pesticides in designated areas during specified periods of time and shall encompass all reasonable factors which the Department deems necessary to prevent damage or injury by drift or misapplication to...plants...or adjacent or nearby lands...fish and other aquatic life in waters in reasonable proximity to the areas to be treated..."[20]

Development and Other Earth-Disturbing Activities

• Delaware's law on erosion and sedimentation control addresses some nonpoint issues in addition to the basic urban stormwater program.[21] "[U]nless exempted, no person shall engage in land disturbing activities without submitting a sediment and stormwater management plan to the appropriate plan approval authority and obtaining a permit to proceed."[22] "Projects which do not alter stormwater runoff characteristics may be required to provide water quality enhancement even if the predevelopment runoff characteristics are unchanged. Criteria will be detailed in the regulations regarding level of water quality control and variance procedures."[23] Local governments are authorized to adopt their own programs for DNREC approval.[24]

"Land disturbing activity" means "any land change or construction activity for residential, commercial, industrial and institutional land use which may result in soil erosion from water or wind or movement of sediments or pollutants into state waters or onto lands in the State, or which may result in accelerated stormwater runoff, including, but not limited to, clearing, grading, excavating, transporting and filling of land...."[25] Regulations exempt construction or development that disturbs less than 5,000 square feet.[26] The law also "does not apply to commercial forestry practices."[27] This exemption, and the deletion of "silvicultural" from the list of regulated activities occurred in 1994. Also, "The provisions of this chapter shall not apply to agricultural land management practices unless the conservation district or the Department determines that the land requires a new or updated soil and water conservation plan, and the owner or operator of the land has refused either to apply to a conservation district for the development of a plan, or to implement a plan developed by a conservation district."[28]

Standards are set by DNREC, providing minimum standards for delegation to local governments, and establishing required provisions and regulations.[29] Regulations require all plans to comply with the Delaware Erosion and Sediment Control Handbook dated 1989 and all supplements (subject to public review and comment prior to adoption of supplements).[30] Regulations identify other specifics of plans.[31] General permits apply for certain structures - such as certain individual residences with disturbed area less than 1 acre, highway shoulder and swale maintenance, commercial and industrial projects when disturbed area is less than ½ acre, modification of tax ditch when no change in water quantity, quality.[32] Based on certain criteria, the person engaged in the activity may be required to provide for construction review by a state-certified construction reviewer; the reviewer is responsible for weekly review of site activities, informing of violations, and referral to DNREC if person fails to correct items identified in review report.[33]

The law further provides that watersheds or subwatersheds proposed by a conservation district, county, municipality, or state agency and approved as "designated" shall have "regulatory requirements clearly specified through a watershed approach to nonpoint pollution control or flood control. The watershed approach shall result in a specific plan, developed or approved by the Department..." "Upon approval of the designated watershed or subwatershed plan, all projects...shall have stormwater requirements placed upon them that are consistent with the...plan."[34]

Enforcement provisions include local enforcement and/or referral to DNREC; also the law provides for DNREC cease and desist orders, and requests by DNREC to local authorities to deny any further building or grading permits until a violation is corrected.[35] Injunctions,[36] and criminal fines are also available.[37]

• The Delaware Land Protection Act also provides some possible basis for local enforceable mechanisms.[38] It requires each county government to adopt "overlay zoning ordinances, guidelines and specific technically based environmental performance standards, design, criteria and mitigation requirements, where appropriate" to protect open space. The guidelines shall include but not be limited to setback and design requirements, and the establishment of technically based specific environmental performance standards and design criteria that shall apply in and may apply adjacent to state resource areas in order to protect the values of said lands.[39] However, the law does not apply to lands producing agricultural commodities. Enforcement is under local laws and ordinances.

• The state's Wetlands Act applies to tidal and connected wetlands.[40] It requires a permit for any "activity in the wetlands" unless exempted by law; the secretary must consider environmental impacts including "impact of the site preparation and proposed activity on land erosion; effect of site preparation and proposed activity on the quality and quantity of tidal waters, surface, ground and subsurface water resources and other resources..."[41] No permit may be granted unless local government has first approved it by local zoning procedures. Fines and civil penalties apply; and enforcement includes orders, injunctions, and prosecutions.[42]

• A permit from DNREC is also required to deposit material upon or remove materials from, or construct or modify structures or facilities on, submerged lands or tidelands.[43] The regulations provide that no "project which may potentially...contribute to water pollution...shall be undertaken on public or private subaqueous lands unless approval has been obtained from the Department."[44] Enforcement is via orders, injunctions, civil and criminal penalties.[45]

Endnotes

1. Del Code Ann. tit. 7, § 6003(a).
2. 70 500 Del. Code Regs. 005 §§ 3-4 (1996).
3. 70 500 Del. Code Regs. 005 § 13.
4. Del. Code Ann. tit. 7, §§ 6005 et seq.
5. Del. Code Ann. tit. 16, § 1301(a).
6. Del. Code Ann. tit. 16, § 310.
7. Del. Code Ann. tit. 11, § 1322(1); sanction in tit. 11, § 4206.
8. Del. Code Ann. tit. 3, § 1401.
9. Del. Code Ann. tit. 16, § 1604.
10. Del. Code Ann. tit. 16, § 1603(1).
11. Del. Code Ann. tit. 16, § 1605.
12. Del. Code Ann. tit. 7, § 2977.
13. Del. Code Ann. tit. 7, § 978(3).
14. Del. Code Ann. tit. 7, § 2979.
15. Del. Code Ann. tit. 7, § 2980.
16. Del. Code Ann. tit. 7, § 2980.
17. Del. Code Ann. tit. 7, § 2982.
18. Del. Code Ann. tit. 16, § 1302.
19. Del. Code Ann. tit. 3, § 1201 et seq.
20. Del. Code Ann. tit. 3, § 1203(b).
21. Del. Code Ann. tit. 7, §§ 4001-4016.
22. Del. Code Ann. tit. 7, § 4003(a).
23. Del. Code Ann. tit. 7, § 4003(b).
24. Del. Code Ann. tit. 7, § 4007.
25. Del. Code Ann. tit. 7, § 4002(3).
26. SS Regulation 3.1B.

[27] Del. Code Ann. tit. 7, § 4002(3).
[28] Del. Code Ann. tit. 7, § 4004(a).
[29] Del. Code Ann. tit. 7, § 4006.
[30] SS 10.2.B.
[31] SS Regulation 10.
[32] SS Regulation 11.
[33] Del. Code Ann. tit. 7, § 4013. SS Reg. 12 requires such reviewers for all projects exceeding 50 acres.
[34] Del. Code Ann. tit. 7, §§ 4011(a), (b).
[35] Del. Code Ann. tit. 7, § 4016.
[36] Del. Code Ann. tit. 7, § 4015.
[37] Del. Code Ann. tit. 7, § 4015.
[38] Del. Code Ann. tit. 7, § 7501 et seq.
[39] Del. Code Ann. tit. 7, § 7508.
[40] Del. Code Ann. tit. 7, §§ 6601-6620.
[41] Del. Code Ann. tit. 7, § 6604.
[42] Del. Code Ann. tit. 7, §§ 6614-6617.
[43] Del. Code Ann. tit. 7, §§ 7201-7216, § 7205 (permit).
[44] See USL Regulation 1 for details and regulated activities. USL 1.07.
[45] Del. Code Ann. tit. 7, §§ 7214-7215.

DISTRICT OF COLUMBIA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

District water pollution control laws contain some provisions that may allow enforcement against nonpoint discharges if the mayor chooses to imposes limits, or in cases where there is an imminent and substantial danger. Another provision prohibits discharges that create a detrimental effect on receiving waters.

• "Except as provided in § 6-926, no person shall discharge a pollutant to the waters of the District."[1] "Discharge" is defined as "the spilling, leaking, releasing, pumping, pouring, emitting, emptying, or dumping of any pollutant or hazardous substance, including a discharge from a storm sewer, into or so that it may enter District of Columbia waters."[2] The cross-referenced provision states that: "(a) the Mayor may:...(2) Limit pollution from nonpoint sources to a feasible degree."[3] It further provides that "If the Mayor limits pollution from nonpoint sources under subsection (a)(2) of this section, then the regulation of the nonpoint sources shall apply to real estate construction and development."[4] The requirements for such permitting, if adopted, are spelled out: "Before any real estate construction takes place, the person performing the construction or the development shall obtain a permit for controlling pollution from the nonpoint source."[5] Enforcement mechanisms include administrative orders, civil penalties of up to $50,000, injunctive relief; and criminal prosecution for willful or negligent violations.[6]

• There is also a general authority to protect the public health and welfare that is applicable to nonpoint source discharges. "Whenever there is a discharge or a substantial threat of discharge into the waters of the District of a hazardous substance, or...of a pollutant which may present an imminent and substantial danger to the public health or welfare...the Mayor is authorized to act to remove or arrange for the removal of the pollutant and the Corporation Counsel of the District may bring suit ...to restrain immediately any person causing or contributing to a discharge or threat of discharge, to recover any costs or removal incurred by the District, to impose civil penalties or to seek any other relief as the public interest may require."[7]

• Finally, District laws prohibit certain discharges to sewers or via natural outlets to receiving waters including, apparently nonpoint discharges.[8] For example, one provision states that "discharge of any waters into any storm or combined sewer or to a natural outlet is prohibited if the discharge will create a detrimental effect upon the receiving water."[9] This provision is enforceable by order, injunction, civil penalty of up to $1,000 per day, and criminal prosecution.[10]

Other Discharge Limitations

• "For purposes of this chapter [which imposes liability and defines remedies], the term 'nuisance' means a condition or circumstance violative of the provisions listed in §6-2902(a)."[11] The referenced section lists local laws and rules relating to litter and discarded material, such as "No person shall deposit, throw or place...any solid waste in any alley, street, catch basin, or other public space, or into the Potomac River or other waters in the District, or onto any premise under the control of others."[12] The provision is enforced by notices of violation, civil fines, and abatement orders.[13]

• It is unlawful for any person to "cast, throw, drop, or deposit any stone, gravel, sand, ballast, dirt, oyster shells, or ashes in the water in any part of the Potomac River or its tributaries in the District of Columbia, or on the shores of said river below highwater mark," or to deposit into the river or its tributaries any dead fish, dead animals, shavings, straw or "filth of any kind whatsoever."[14] Violation is a misdemeanor punishable by a fine up to $100 and/or imprisonment up to 6 months.[15]

• It is also unlawful to allow "any waste product whatever of any mechanical, chemical, manufacturing, or refining establishment to flow into" Rock Creek, the Potomac River or its tributaries, or any pipe or conduit leading to the same. Violation is punishable by a fine of up to $300 and/or imprisonment up to 90 days.[16]

• The existence of "miscellaneous materials or debris of any kind" on a parcel of land, including substances accumulated as a result of repairs to yards of buildings, is a nuisance "insofar as they affect the public health, comfort, safety and welfare." These conditions are subject to orders to abate, fines of up to $50 per day after issuance of an order, or summary abatement by the District with recovery of twice the costs incurred.[17]

Fish/Fisheries Laws

District laws relating to fish or fisheries do not appear to contain enforceable provisions relating to nonpoint source discharges.

OPERATIONAL REQUIREMENTS

Forestry Requirements

None.

Agriculture Requirements

• Pesticide application must be made "in a manner to prevent harmful effects to the environment."[18] And no person shall "transport, store, discard, or dispose of any pesticide...in a manner that...pollutes any waterway in a way harmful to any wildlife in the waterway," nor "handle...any pesticide in a manner that endangers man and the environment."[19] Enforcement is via injunction, criminal prosecution with fine of not more than $300 and up to 90 days imprisonment, suspension of applicator's certificate, stop sale/use/removal orders.[20]

Development and Other Earth-Disturbing Activities

• As noted above, the city has power to regulate nonpoint sources, and if such regulation is imposed it "shall apply to real estate construction and development," including permitting.[21] Erosion control regulations require permit for land disturbing activities contingent upon submission and approval of erosion and sedimentation plan.[22] "In instances where erosion is occurring as a result of natural forces or past land disturbing activities, but in the absence of current land disturbing activities, the Department [of Community and Regulatory Affairs] shall have the authority to inspect the site and to order the property owner to correct the erosion problem."[23] Failure by a permittee to comply with a plan results in a notice and then permit revocation, denial of occupancy permit, injunctive relief, or misdemeanor sanction of up to $300 and/or ten days imprisonment.[24]

E ndnotes

1. D.C. Code Ann. § 6-922.
2. D.C. Code Ann. § 6-921(5).
3. D.C. Code § 6-926(a)(2).
4. D.C. Code § 6-926(c)(1).
5. D.C. Code § 6-926(c)(2).
6. D.C. Code Ann. §§ 6-936 to 6-938.
7. D.C. Code Ann. § 6-928(b). In addition to the other relief noted in this section, violation of this provision is a misdemeanor. D.C. Code Ann. § 6-936(c).
8. D.C. Code Ann. §§ 6-927, 6-956.
9. D.C. Code Ann. § 6-956(d).
10. D.C. Code Ann. §§ 6-960 to 6-964.
11. D.C. Code Ann. § 6-2903(a).
12. 21 DCMR 700.4.
13. D.C. Code Ann. §§ 6-2903 to 6-2907.
14. D.C. Code § 22-1702(a),(b).
15. D.C. Code § 22-1702(d).
16. D.C. Code §§ 22-1703, 22-1703a.
17. D.C. Code § 5-604.
18. 21 DCMR 1010.5
19. 21 DCMR 1011.1, 1011.3
20. D.C. Law 2-70; 21 DCMR 1302.
21. D.C. § 6-926.
22. 21 DCMR 500 et seq.
23. 21 DCMR 504.
24. 21 DCMR 506.4, 508.

FLORIDA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Florida's water pollution control laws include provisions that may be used to take enforcement action against nonpoint source discharges resulting in pollution that harms human health or welfare or biological resources or property; and against certain unpermitted nonpoint source discharges that contribute to violation of water quality standards.

• Florida's water pollution control law, administered by the Department of Environmental Protection (DEP) has a general prohibition on pollution that is applicable to nonpoint sources: "It shall be a violation of this chapter, and it shall be prohibited for any person...[t]o cause pollution, except as otherwise provided in this chapter, so as to harm or injure human health or welfare, animal, plant, or aquatic life or property.[1]

• It is also a violation "[t]o fail to obtain any permit required by this chapter or by rule or regulation, or to violate or fail to comply with any rule, regulation, order, permit or certification adopted or issued by the department pursuant to its lawful authority..."[2] This provision may apply to some nonpoint source discharges because permits are required for discharges of materials that contribute to violations of water quality standards: "No person, without written authorization of the department, shall discharge into waters within the state any waste which, by itself or in combination with the wastes of other sources, reduces the quality of the receiving waters below the classification established for them...."[3] "Waste" means "sewage, industrial wastes, and all other liquid, gaseous, solid, radioactive, or other substances which may pollute or tend to pollute any waters of the state."[4] This permit requirement is not limited to point sources. However, agricultural activities (including all "normal and customary" farming and forestry operations) and agricultural water management systems do not require permits.[5]

• A separate law defines violations and provides similar enforcement authorities for Florida's five water management districts (WMDs).[6] Like the law referenced above, the law they administer defines a violation as "To cause pollution, as defined in [the law referenced above], except as otherwise provided in this part, so as to harm or injure human health or welfare, animal, plant, or aquatic life or property", and another violation failure to obtain a required permit or to comply with rules or orders.[7]

The Department of Environmental Protection (DEP) has "the power and the duty to control and prohibit pollution of air and water in accordance with the law and rules and regulations adopted and promulgated by it, and for this purpose, to:...(8) Issue such orders as are necessary...and enforce the same by all appropriate administrative and judicial proceedings....(28) Perform any other act necessary to control and prohibit air and water pollution, and to delegate any of its responsibilities, authority, and powers, other than rulemaking powers, to any state agency now or hereinafter established."[8] Counties and municipalities may also be delegated functions, with oversight and backup enforcement by DEP. Local programs have access to both their own enforcement processes and those provided to DEP.[9] DEP enforcement powers include civil actions for damages; actions for civil penalties up to $10,000 per day; administrative actions for damages; and administrative orders for abatement or other corrective action, subject to administrative hearings.[10] The law also provides for injunctions,[11] and for criminal prosecution for violations committed with intent.[12] The state's Environmental Protection Act also allows the attorney general, any political subdivision, or any citizen to enforce laws and regulations for the protection of the air, water, and other natural resources of the state in court.[13]

Water pollution laws are administered by the DEP and the WMDs;[14] areas within WMDs may be further divided into basins with basin boards.[15] Each WMD establishes a list, updated every 3 years, prioritizing water bodies of regional or statewide significance using criteria "based on their need for protection and restoration"; then WMDs develop plans, including identification of land uses, "point and nonpoint sources of pollution" and lists of sources operating without permit and sources presently violating effluent limits or water quality standards, recommendations and schedules for compliance, measures needed to restore and maintain water quality.[16] The proposed plans must be reviewed by DEP, Dept. of Ag and Consumer Services, Game and Freshwater Fish Commission, Dept. of Community Affairs, and local governments.[17] Plans adopted by the WMD are then reviewed by DEP for "consistency" with the state water plan and state comprehensive plan.[18] While the plans are not themselves enforceable mechanisms, they can serve to identify where such mechanisms may be used.

Other Discharge Limitations

• It is unlawful to "dump litter in any manner or amount...(b) In or on any freshwater lake, river, canal, or stream or tidal or coastal water of the state, including canals"[19] Litter is defined as any "garbage; rubbish; trash; refuse:...sludge from a waste treatment facility, water supply treatment plant, or air pollution control facility; or substance in any form resulting from domestic, industrial, commercial, mining, agricultural, or governmental operations."[20] The statute provides for civil penalties of $50 to $5,000 based on the amount and purpose of the dumping; and criminal prosecution.[21]

• State law protects water supplies, and provides that "in coordination with the Department of Health and Rehabilitative Services, the department [of Environmental Protection], upon receipt of information that a contaminant which is present in, or is likely to enter, public or private water supplies may present an imminent and substantial danger to the public health, may take such actions as it may deem necessary in order to protect the public health..." including corrective action orders and injunctions.[22] Criminal prosecution is available for willfully or maliciously corrupting a spring or reservoir.[23]

• "Any person...who shall deposit, or who shall permit or allow any person or persons in their employ or under their control, management, or direction to deposit in any of the waters of the lakes, rivers, streams, and ditches in this state, any rubbish, filth, or poisonous or deleterious substance or substances, liable to affect the health of persons, fish, or livestock, or place or deposit any such deleterious substance or substances in any place where the same may be washed or infiltrated into any of the waters herein named, shall be guilty of a misdemeanor of the second degree" punishable by a fine of up to $500 and/or 60 days imprisonment.[24]

• "A sanitary nuisance is the commission of any act...or the keeping, maintaining, propagation, existence, or permission of anything...by which the health or life of an individual, or...individuals, may be threatened or impaired, or by which or through which, directly or indirectly, disease may be caused."[25] "The following conditions..shall constitute prima facie evidence of maintaining a nuisance injurious to health: (a) Untreated or improperly treated human waste, garbage, offal, dead animals, or dangerous waste materials from manufacturing processes harmful to human or animal life....(f)Any other condition determined to be a sanitary nuisance...."[26] Nuisances may be enjoined, abated by the Dept. of Health and Rehabilitative Services, and/or prosecuted as misdemeanors of the second degree.[27] Farm operations in existence for one or more years are not nuisances if they conform to "generally accepted agricultural and management practices."[28]

Fish/Fisheries Laws

• State law provides that "No person, except as provided herein, shall take...freshwater fish...within this state without first having obtained a license, permit, or authorization..."[29] "Take" is defined as "taking, attempting to take, pursuing, hunting, molesting, capturing, or killing any...freshwater fish... whether or not such actions result in obtaining possession..."[30]

• The law also provides that "No person may throw or place, or cause to be thrown or places any dynamite....acids, filtration discharge, debris from mines, Indian berries, sawdust, green walnuts, walnut leaves, creosote, oil, or other explosives or deleterious substance or force into the freshwaters of this state whereby fish therein are or may be injured..."[31]

• "It shall be unlawful for any person..to cause any dyestuff, coal tar, oil, sawdust, poison or deleterious substances to be thrown, run or drained into any of the fresh running waters of this state in quantities sufficient to injure, stupefy, or kill fish..."[32]

Violations of these pollution provisions are misdemeanors of the second degree punishable by fine of up to $500 and/or 60 days imprisonment.

• State law also provides for recovery of money damages for injury to "air, waters, or property, including animal, plant, and aquatic life...and for reasonable costs and expenses of the state in tracing the source of the discharge, in controlling and abating the source and the pollutants, and in restoring the air, waters, and property, including animal, plant, and aquatic life, of the state to their former condition" as well as for a civil penalty of up to $10,000 per day. It also provides for a table of dollar amounts recoverable per fish killed.[33]

OPERATIONAL REQUIREMENTS

Forestry Requirements

The state relies on voluntary BMPs; enforcement, if necessary, is under the water pollution discharge laws identified above. Forest harvest operations also must file a "notice of general permit" with a Water Management District, where applicable.

Agriculture Requirements

Agricultural operations are not required to obtain permits under the water pollution law for nonpoint source activities. CAFOs are regulated as point sources.

• Florida has a program that operates collectively to reduce phosphorous loading in the Everglades watershed. The law provides for a scheduled phased-in increase in agricultural taxes over the course of a long period, but if the collective loadings are reduced by certain targets, agricultural operators do no not have to pay the scheduled increases. In addition part of the program provides individual credits against these taxes for operators that take actions themselves on identified parcels. Sanctions in the form of higher taxes are imposed automatically on identified entities where prescribed results are not achieved.[34]

• Florida imposes special requirements on dairy farms in the Lake Okechobee drainage basin. These include enforceable requirements to fence all dairy cattle out of watercourses, requirements for setbacks, and the regulation of the land application of manure.[35]

• The state provides for certifications and licensing with respect to pesticide dealers and applicators.[36] "Prohibited acts" include "apply[ing] any pesticide directly to, or in any manner cause any pesticide to drift onto, any person or area not intended to receive the pesticide", as well as handling, distributing, etc in a manner "as to endanger human beings or the environment"[37] Violations are addressed by orders, license revocation or suspension, administrative fines and misdemeanor prosecution.[38]

Development and Other Earth-Disturbing Activities

• There are regional and state comprehensive planning requirements.[39] Local governments are required to do local plans and land regulation consistent with these: "comprehensive plans or elements thereof shall be implemented...by the adoption and enforcement of appropriate local regulations on the development of lands and waters within an area."[40]

• State law also provides for designation of "areas of critical state concern" which, if designated, must be taken into account and protected by state and local agency regulations and decisions.[41] Such areas must include, or have a significant impact upon, "environmental or natural resources of regional or statewide importance."

Local land use regulations must be conformed to the designation. Developments of regional impact must be evaluated under these standards as well if located in an area of critical state concern.[42]

• Stormwater permitting requires permitting of facilities by DEP or as delegated to local governments or by the Water Management District; it includes general permits for certain types of facilities.[43] State law sets out provisions for stormwater and wetlands permitting (environmental resource permitting) under jurisdiction of water management districts.[44]. Stormwater plans are required from water management districts; local governments must cover in comprehensive plans.[45] Sedimentation and erosion controls are covered under Water Management District regulations. Enforceable mechanisms are those available to DEP under the water pollution law, to Water Management Districts, or to local governments under local authorities.

Endnotes

1. Fla. Stat. 403.161(1)(a). "Pollution" is broadly defined. Fla. Stat. 403.031(7).
2. Fla. Stat. 403.161(1)(b).
3. Fla. Stat. 403.088.
4. Fla. Stat. 403.031(12).
5. Fla. Stat. 403.927.
6. Fla. Stat. §§ 373.083, 373.103.
7. Fla. Stat. §§ 373.430(1)(a), (b).
8. Fla. Stat. 403.061.
9. Fla. Stat. 403.182.
10. Fla. Stat. §§ 403.121, 403.161.
11. Fla. Stat. § 403.131.
12. Fla. Stat. § 403.161.
13. Fla. Stat. § 403.412.
14. Fla. Stat. § 373.069.
15. Fla. Stat. § 373.0693.
16. Fla. Stat. § 373.453.
17. Fla. Stat. § 373.455.
18. Fla. Stat. § 373.456.
19. Fla. Stat. § 403.413(4).
20. Fla. Stat. § 403.413(2)(a).
21. Fla. Stat. § 403.413.
22. Fla. Stat. § 403.855.
23. Fla. Stat. § 387.07.
24. Fla. Stat. § 387.08.
25. Fla. Stat. § 386.01.
26. Fla. Stat. § 386.041(1).
27. Fla. Stat. §§ 60.05, 373.433, 386.02, 386.03, 823.01.
28. Fla. Stat. § 823.14(4).
29. Fla. Stat. § 372.57.
30. Fla. Stat. § 372.001(10).
31. Fla. Stat. § 372.75.
32. Fla. Stat. § 372.85(1).

[33] Fla. Stat. § 403.141.
[34] Fla. Stat. § 373.4592.
[35] Fla. Admin. Code r. 62-670.500.
[36] Fla. Stat. Ch. 487.
[37] Fla. Stat. § 487.031.
[38] Fla. Stat. §§ 487.101, 487.159, 487.175.
[39] Fla. Stat. Ch. 186, 187.
[40] Fla. Stat. § 163.3201.
[41] Fla. Stat. § 380.05.
[42] Fla. Stat. 380.06(5)(a)(2); see also 380.06(13), compare (14).
[43] Fla. Stat. Chap. 403; Regulations at FAC 62-25.
[44] Fla. Stat 373.400 series (Part 4).
[45] Fla. Stat. § 403.0891.

GEORGIA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Georgia's water pollution control law authorizes a permit program to control nonpoint sources that may impair water quality. It also includes a separate provision allowing the state to recover damages for intentional or negligent discharges (including nonpoint point source discharges) resulting in a polluted condition, or that consist of particularly harmful substances in harmful amounts.

• Georgia law requires a permit for anyone seeking to "erect or modify facilities or commence or alter an operation of any type which will result in the discharge of pollutants from a nonpoint source into the waters of the state, which will render or is likely to render such waters harmful to the public health, safe, or welfare, or harmful or substantially less useful for domestic, municipal, industrial, agricultural, recreational, or other lawful uses, or for animals, birds, or aquatic life."[1] The regulations limit this provision. They require only "written approval" and use of BMPs "under the circumstances described" in the statute, but not application for or issuance of a permit unless the Director of the Environmental Protection Division (EPD) "has issued one to the same person for a point source discharge."[2] Injunctive relief and civil penalties of up to $50,000 per day are provided for, as are criminal penalties of $2,500 to $25,000 and/or imprisonment.[3]

• A person who "intentionally or negligently causes or permits any sewage, industrial wastes, or other wastes, oil, scum, floating debris, or other substance or substances to be spilled, discharged, or deposited in the waters of the state, resulting in a condition of pollution . . . shall be liable in damages . . . for any and all costs, expenses, and injuries." The amount of damages includes costs of abatement and "expenses reasonably incurred in replacing aquatic life."[4] A person who "intentionally, negligently, or accidentally causes or permits any toxic, corrosive, acidic, caustic, or bacterial substance or substances to be spilled, discharged, or deposited" in harmful amounts is strictly liable.[5]

Other Discharge Limitations

• Nuisance law also applies to water pollution.[6] But agricultural facilities may not be deemed a nuisance based on changed conditions; however, the exemption is not available if the nuisance results from a negligent, improper, or illegal operation.[7]

Fish/Fisheries Laws

• It is unlawful to "throw, dump, drain, or allow to pass into any waters of this state which belong to the department or which are being utilized by the department for fish propagation any sawdust, dyestuff, oil, chemicals, or other deleterious substances that will or may tend to injure, destroy, or drive away from such waters any fish or aquatic organisms which may inhabit such waters." Damages are available for unlawful or negligent injury or destruction of fish; the measure of damages is the "amount which will compensate for all the detriment proximately caused by the destruction or injury of such fish or aquatic organism."[8] In addition, any person who takes wildlife in violation of the Game and Fish Code is guilty of the offense of theft by taking.[9] Civil penalties are available up to $1,000 per violation, administrative orders and enforcement of administrative orders in superior court are available, as is misdemeanor prosecution.[10]

OPERATIONAL REQUIREMENTS

Forestry Requirements

Georgia's forestry laws do not appear to contain enforceable provisions relating directly to nonpoint source pollution. But Georgia does require registration of professional foresters, with continuing education and relicensing. Forest practices for hire must be conducted by a professional forester.[11] Enforcement of licensing requirements include injunction, license revocation, and misdemeanor prosecution.[12]

Agriculture Requirements

• Supervisors of each soil and water conservation district have authority to adopt enforceable regulations "governing the use of lands within the district, in the interest of conserving soil and soil resources and preventing and controlling soil erosion."[13] District regulations may include: 1) provisions requiring engineering operations, including terrace construction, dams, dikes, etc; 2) provisions requiring particular cultivation methods, including "contour cultivating; contour furrowing; lister furrowing; sowing; planting; strip cropping; changes in cropping systems, seeding, and planting of lands to water-conserving and erosion-preventing plants, trees, and grasses; forestation; and reforestation" and 3) provisions requiring highly erosive areas to be retired from cultivation.[14] However, supervisors may adopt such enforceable regulations only with the approval by referendum of the owners of the lands within the district. The regulations are binding on all landowners within the district.[15] Enforcement is by injunctive relief. If an injunction is not obeyed, the district may go on the land to perform the work and recover its expenses with interest.[16]

• It is unlawful to transport, store, or dispose of any pesticide in manner to "cause injury to humans, vegetation, crops, livestock, wildlife, or beneficial insects or in such a manner as to pollute any waterway in a way harmful to any wildlife therein." In determining standards governing the storage and disposal of such pesticides, commissioner shall consider any regulations issued by U.S. EPA or state DNR.[17] Licensing of contractors and applicators is required.[18] Violations of the pesticide statute are enforced by injunction, civil penalty, criminal prosecution, and license revocations/suspensions.[19] However, no one engaged in "agricultural, silvicultural, farming, horticultural, or similar operation . . . who has applied or used or arranged for the application or use of any fertilizer, plant growth regulator, or pesticide" as defined in FIFRA, the Georgia labeling and registration statute, or the Georgia pesticide application statute "shall be responsible or liable under this title, without proof of negligence or lack of due care, for any damages, response costs, or injunctive relief relating to any direct or indirect discharge or releaser into, or actual or threatened pollution of, the land, waters, air, or other resources of the state that is or may be associated with or resulting from such application of use." The application must have been consistent with the labeling, in accord with acceptable agricultural practices; the item must have been properly licensed or registered. Causes of action against agricultural or farming operations for injury to person or property are not affected.[20]

• Irrigation systems used for application of fertilizers, pesticides, or chemicals "must be equipped with an anti-siphon device adequate to protect against contamination of the water supply." Enforcement is via administrative order and civil penalty of up to $1,000.[21]

Development and Other Earth-Disturbing Activities

• Georgia's Erosion and Sediment Control Act establishes a permit process for land-disturbing activities. County and municipalities are directed to adopt comprehensive ordinance to establish procedures governing land-disturbing activities; local authorities may delegate responsibilities to local planning and zoning commission.[22] If a county or municipality enacts ordinances that meet or exceed standards and which are enforceable, EPD may certify the local entity to be an "issuing authority."[23] BMPs are required for all land-disturbing activities. BMPs must include "sound conservation and engineering practices to prevent and minimize erosion and resultant sedimentation" consistent with a manual published by the soil and water conservation commission, and including specific requirements protecting waters from nonpoint source pollution.[24] Permits are not required for some activities, such as construction of individual single-family residences and land-disturbing activities conducted by public utilities so long as they conform to BMPs. Activities on sites of 1.1 acres or less are exempt from both permit and BMP requirements unless they are within 200 feet of lakes or perennial streams. Agriculture and forestry operations are wholly exempt.[25] Enforcement is by EPD or the issuing authorities, using administrative orders, injunctions, and civil penalties. Civil penalties for non-certified counties and municipalities are authorized up to $2,500 per day. Permit revocation, suspension, modification, and bond forfeiture are also enforcement sanctions.[26]

• Georgia has a river corridor protection law. The DNR is authorized to develop minimum standards for the "protection of the natural resources, environment, and vital areas of the state, including, but not limited to, the protection of mountains, the protection of river corridors, the protection of watersheds of streams and reservoirs which are to be used for public water supply, for the protection of the purity of ground water, and for the protection of wetlands, which minimum standards and procedures shall be used by local governments in developing" comprehensive plans.[27] The minimum standards for watershed protection shall include buffer areas along streams and reservoirs, land development densities, and land use activities. Minimum standards for protection of ground water shall include land use activities and development densities. Minimum standards for protection of wetlands shall include land use activities, land development densities, and activities involving alteration of wetlands.[28] Standards for protection of river corridors shall include natural vegetative buffer areas for a distance of 100 feet on both sides of stream as measured from stream banks.[29] Local governments are mandated to identify existing river corridors and adopt river corridor protection plans.[30] Local governments may exempt certain activities from requirements of river corridor protection plans: existing land uses; permitted mining activities; utilities, from buffer criteria; specific forestry and agricultural activities, from buffer criteria, if activity is consistent with BMPs established by forestry commission or soil and water conservation commission and the activity will not impair drinking quality of stream water.[31] Enforcement is under local ordinances.

• The Metropolitan River Protection Act requires governing authorities to adopt ordinances protecting the Chattahoochee and its tributaries, including buffer areas prohibiting land-disturbing activities, and soil erosion and sediment provisions consistent with the above Act. Failure to enforce these provisions can give rise to enforcement action by EPD upon request by the Atlanta Regional Commission or Georgia Mountains Regional Development Center.[32]

• The Shore Protection Act also provides some authority affecting activities along the shoreline that may result in nonpoint source water pollution. Permitting and other requirements are enforceable by local governments or the state.[33] The Coastal Marshlands Protection Law also provides enforceable mechanisms, including permitting and order authority relevant to some forms of nonpoint source pollution in the estuarine area of the state.[34]

Endnotes

1. Ga. Code Ann. § 12-5-30(b).
2. Ga. Comp. R. & Regs. r. 391-3-6-.06(3).
3. Ga. Code Ann. §§ 12-5-48, 12-5-52, 12-5-53.
4. Ga. Code Ann. § 12-5-51(b).
5. Ga. Code Ann. § 12-5-51(b).
6. Ga. Code Ann. §§ 41-1-2 to 6.
7. Ga. Code Ann. § 41-1-7.
8. Ga. Code Ann. § 27-4-4.
9. Ga. Code Ann. § 27-1-3(f).
10. Ga. Code Ann. §§ 27-1-36(a), 27-1-37, 27-1-38.
11. Ga. Code Ann. § 12-6-42, 12-6-49, 12-6-56. 12-6-61.
12. Ga. Code Ann. § 12-6-60, 12-6-62.
13. Ga. Code Ann. § 2-6-35.
14. Ga. Code Ann. § 2-6-37(a).
15. Ga. Code Ann. §§ 2-6-36, 2-6-38.
16. Ga. Code Ann. § 2-6-39.
17. Ga. Code Ann. § 2-7-106.
18. Ga. Code Ann. § 2-7-99.
19. Ga. Code Ann. § 2-7-102.
20. Ga. Code Ann. § 2-7-170.
21. Ga. Code Ann. § 2-1-4.
22. Ga. Code Ann. § 12-7-4.
23. Ga. Code Ann. § 12-7-8(a).
24. Ga. Code Ann. § 12-7-6.
25. Ga. Code Ann. § 12-7-17.

[26] Ga. Code Ann. §§ 12-7-12, 12-7-14, 12-7-15, 12-7-11, 12-7-7.
[27] Ga. Code Ann. § 12-2-8(b).
[28] Ga. Code Ann. § 12-2-8(d)-(f).
[29] Ga. Code Ann. § 12-2-8(g)(1)(A).
[30] Ga. Code Ann. § 12-2-8(g)(2).
[31] Ga. Code Ann. § 12-2-8(g)(2).
[32] Ga. Code Ann. § 12-5-453.
[33] Ga. Code Ann. §§ 12-5-41, 12-5-235 et seq.
[34] Ga. Code Ann. § 12-5-282 et seq.

HAWAII

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Hawaii's water pollution control law includes some provisions that may be used to take enforcement action against nonpoint source discharges that are not permitted or that result in water quality violations.

• Hawaii law prohibits discharges of "any water pollutant into state waters" except in compliance with the law or a permit or variance thereunder.[1] This prohibition is not limited to point source discharges. The director of the Department of Health ("DoH") shall issue a permit for a term of up to five years, if "issuance is in the public interest."[2] Under this statute, "water pollution" is broadly defined as "discharge of any liquid, gaseous, solid...or other substances into any state waters... likely to create a nuisance or render such waters....harmful....to public health...including harm...to public water supplies, fish and aquatic life and wildlife...or as will or is likely to violate any water quality standards, effluent standards..."[3] Where a violation occurs, DoH sends written notice to alleged violator and, if the violation continues, another notice containing an order for corrective action.[4] DoH may also modify, suspend or revoke a permit.[5] Administrative and civil (up to $10,000 for each offense) penalties are authorized.[6] Criminal sanctions are more stringent if the violation was "knowing" rather than "negligent."[7]

Other Discharge Limitations

• Under Hawaii's Nonpoint Source Pollution Management and Control statute, DoH has explicit authority to "reduce, control and mitigate nonpoint source pollution,"[8] which is defined as "water pollution not originating from a point source."[9] This law is in addition to the broad water pollution law described above and "should not be construed or interpreted to diminish the scope of that law."[10] DoH is to adopt "water quality standards for specific areas, types of nonpoint source pollution discharges, or management measures..."[11] The Director may enforce the rules, enter and inspect areas to investigate sources of nonpoint pollution and determine compliance.[12] Civil penalties of up to $10,000 are authorized for each separate offense and each day of violation.[13]

• State law authorizes the Department of Land and Natural Resources ("DLNR") to adopt rules that prevent "the discharge or throwing into ... ocean waters and navigable streams..." substances that are likely to affect the quality of the water or contribute to making these areas "unsightly, unhealthful, or unclean."[14] DLNR has authority to conduct searches and seize equipment used in violation of the title. Fines of up to $10,000 are authorized.[15] A violator is guilty of a misdemeanor with fines and/or imprisonment, if he fails to appear at the time and place specified under a DLNR summons or citation.[16]

• The statutory nuisance laws direct that DoH examine "all nuisances... ...and...any and all conditions created or existing which cause or tend to cause sickness or disease or to be dangerous or injurious to health, and shall cause the same to be abated, destroyed, removed, or prevented."[17] Although there are exceptions to the nuisance provision under the Hawaii Right to Farm Act, the exceptions do not apply to water pollution.[18] If a landowner does not comply with a DoH abatement order, then DoH may apply for a judicial order of abatement. DoH may recover expenses incurred for abatement, removal, destruction or prevention of a nuisance. Administrative civil penalties up to $20,000 for each offense are authorized.[19]

• Counties have the authority to maintain channels to carry off storm waters and "to remove from the channels, and from the shores and beaches, any debris that is likely to create an unsanitary condition or become a public nuisance."[20] Counties also have the authority to enact and enforce ordinances that "prevent or summarily remove nuisances...and to enforce liens upon the property for the cost to the county of completing the necessary work" where owners fail to comply.[21]

Fish/Fisheries Laws

General discharge limitations described above define "water pollution" as including discharges that cause harm to "fish and aquatic life and wildlife."[22] Other fisheries provisions appear limited to prohibiting the introduction of certain substances into state waters "for the purpose of taking aquatic life." [23]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• Hawaii laws relating to forestry do not appear to contain enforceable provisions with respect to nonpoint source discharges.

Agriculture Requirements

• County governments, in cooperation with soil and water conservation districts and other state and federal agencies, are to enact ordinances to control soil erosion and sediment, including standards for soil and land uses that identify "criteria, techniques, and methods for the control of erosion and sediment resulting from land disturbing activities."[24] See the Other Discharge Limitations section for authorized sanctions pursuant to DLNR authority.

• Hawaii law has general pesticide licensing and labeling requirements.[25] In addition, every person who sells or distributes restricted use pesticides is required to obtain an annual permit.[26] Refusal to license or cancellation or suspension of licenses are authorized,[27] in particular, when pesticide usage is determined to have unreasonable adverse effects on the environment, specifically when pesticide residues are detected in drinking water.[28] Administrative civil penalties and criminal penalties may result.[29]

Development and Other Earth-Disturbing Activities

• Hawaii law requires all county ordinances to control soil erosion and sediment from land disturbing activities, and the standards are deemed to be met if the land is managed in accordance with practices acceptable to the local soil and water conservation districts.[30] See the Other Discharge Limitations section for authorized sanctions pursuant to DLNR authority.

• No development is allowed in any county within a "special management area" without a permit, although use of land for activities such as cultivating, planting, or harvesting plants and crops for agricultural or forestry purposes is exempt.[31] Variances are authorized for certain activities "that are clearly in the public interest."[32] Civil fines may be imposed, and injunctive relief is available.[33]

Endnotes
[1] Hawaii Rev. Stat. 342D-50(a).
[2] Hawaii Rev. Stat. 342D-6(c).
[3] Hawaii Rev. Stat. 342D-1.
[4] Hawaii Rev. Stat. 342D-9.
[5] Hawaii Rev. Stat. 342D-6.
[6] Hawaii Rev. Stat. 342D-30 - 33.
[7] Hawaii Rev. Stat. 342D-32 - 33.
[8] Hawaii Rev. Stat. 342E-3(a)(1).
[9] Hawaii Rev. Stat. 342E-1.
[10] Hawaii Rev. Stat. 342E, note.
[11] Hawaii Rev. Stat. 342E-3(a)(2).
[12] Hawaii Rev. Stat. 342E-3(b).
[13] Hawaii Rev. Stat. 342E-4(a).
[14] Hawaii Rev. Stat. 200-4(a)(6).
[15] Hawaii Rev. Stat. 200-14.
[16] Hawaii Rev. Stat. 199-6, 199-7(b).
[17] Hawaii Rev. Stat. 322-1.
[18] Hawaii Rev. Stat. 165-2,4.
[19] Hawaii Rev. Stat. 322-2, 322-8.
[20] Hawaii Rev. Stat. 46.1.5(5).
[21] Hawaii Rev. Stat. 46-1.5(8).
[22] Hawaii Rev. Stat. 342D-1.
[23] Hawaii Rev. Stat. 188-23(b)(1)-(4).
[24] Hawaii Rev. Stat. 180C-2.
[25] Hawaii Rev. Stat. 149A-11.
[26] Hawaii Rev. Stat. 149A-17.
[27] Hawaii Rev. Stat. 149A-14.
[28] Hawaii Rev. Stat. 149A-32.5.
[29] Hawaii Rev. Stat. 149A-41.
[30] Hawaii Rev. Stat. 180C-1, 180C-2.
[31] Hawaii Rev. Stat. 205A-22, 205A-28.
[32] Hawaii Rev. Stat. 205A-46(a).
[33] Hawaii Rev. Stat. 205A-32, 205A-33.

IDAHO

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Idaho's water pollution control law includes a few provisions that may authorize enforcement against nonpoint source discharges that adversely affect water quality in outstanding resource waters and in certain impaired waters for which Total Maximum Daily Loads (TMDLs) have been developed.

• Idaho law provides that "no person shall conduct a new or substantially modify an existing nonpoint source activity that can reasonably be expected to lower the water quality of an *outstanding resource water*, except where the nonpoint source activities are temporary or short-term and do not alter the essential character of a stream segment."[1] Prior agency approval is required to conduct any new nonpoint source activities affecting such waters.[2]

• Where total maximum daily loads (TMDLs) are required -- for example, in high-priority impaired waters where there is significant risk to the designated water uses[3] -- the state must develop "pollution control strategies for both point sources and nonpoint sources for reducing those sources of pollution."[4] For "reasonably foreseeable nonpoint source activities," the agency is to develop and implement best management practices (BMPs).[5] For medium and low priority waters, where there are "risks" or "minimal risks" to the designated uses, nonpoint source BMPs must be adjusted to stop further impairment of water quality.[6]

However, BMPs may not be required for agricultural operations, except on a "voluntary basis," even in cases where TMDLs are required.[7] And, unless a TMDL is required to be developed and nonpoint strategies have been prescribed, there is no requirement for persons who conduct nonpoint activities to meet water quality standards other than those necessary to support the *existing* beneficial use of the water body.[8]

If a person fails to obtain new nonpoint source approval in those few instances where it is required (outstanding resource waters), or fails to implement BMPs and violations of water quality result, the agency may institute a civil action.[9] Nonpoint source activities that are conducted according to BMPs are, moreover, not subject to enforcement action, unless the discharge is causing an imminent or substantial danger to public health. Nonpoint source activities not conducted according to BMPs may be subject to compliance schedules, administrative and civil relief including injunctive relief.[10] The statute contains general penalty authority for environmental violations, including administrative and civil actions.[11] Also, where a TMDL has been developed, normal enforcement practices by other designated agencies are available under the state's water quality management plan.[12]

Other Discharge Limitations

• Public nuisance is defined as anything that is "injurious to health" or "unlawfully obstructs the free passage or use...of any navigable lake, or river, stream, canal or basin..."[13] Idaho's Right to Farm Act and its Right to Conduct Forest Practices Act limit the circumstances under which agricultural operations and forest practices, respectively, may be deemed a nuisance,[14] specifically exempting agricultural operations from nuisance claims if they have been in operation for more than one year and operation is not "improper" or "negligent."[15] Also, local government entities are prohibited from enacting any laws that declare generally recognized agricultural practices to be a public or private nuisance.[16]

Fish/Fisheries Laws

• Idaho law prohibits the placing in waters of any "...toxicants, chemicals, poisonous...or other material which may tend to destroy, kill, disable, or drive away fish..." Violation of this provision is punishable by fines and/or prison sentence.[17]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• Under Idaho law, the Forest Board is required to "develop methods for controlling watershed impacts resulting from cumulative effects" of forest practices.[18] Under the Idaho Forestry Act ("Act"), a BMP is defined as practices that the Forest Board determines to be the "most effective and practicable means of preventing or reducing the amount of nonpoint pollution generated by forest practices,"[19] and the rules under the Act establish site-specific BMPs for stream segments of concern.[20] If under the rules, implementation of BMPs is insufficient to protect beneficial uses, the forest activity may be deemed "an imminent or substantial threat."[21] The Act implements this language by requiring that operators post a notice of intent to engage in forestry practices.[22] An operator will be required to post an operating bond where an operator has failed to apply BMPs or willfully caused degradation of water resources.[23] The forestry rules and practices are enforced through issuance of notice of violation and cease and repair orders. Relevant sanctions include suits for reparations, attachment of liens, bond forfeiture and injunctive relief.[24] Variances from these rules and practices can be obtained for approved alternatives that provide equivalent or better results.[25] The Right to Conduct Forest Practices Act limits the circumstances under which forest practices may be deemed a nuisance.[26]

Agriculture Requirements

• Due to provisions under Idaho's Right to Farm Act (see supra nuisance section and the prohibition against enactment of a zoning ordinance that forces the closure of an agricultural operation operating in accordance with recognized practices[27]) and due to the general water pollution control law provision exempting agricultural operations from BMPs not adopted on a voluntary basis[28] (see supra general discharge prohibitions), there are relatively few general enforceable agriculture requirements under Idaho state law. Similarly, the Idaho Local Land Use Planning Act ("LLUPA") prevents county commissioners from enacting any law that "deprives any owner of full and complete use of agricultural land..." Idaho law does establish soil conservation districts with authority to develop comprehensive plans and provides for the adoption of "appropriate soil-conserving land-use practices."[29] Rules require these districts to adopt BMPs and incorporate them into a five-year plan that protects water quality.[30] But these are not enforceable except as conditions on receipt of assistance. Similarly, rules for the agricultural water quality program provide financial assistance that may be conditional on implementation of BMPs, to the districts for the control and abatement of water pollution from agricultural lands.[31]

• Idaho law requires the department of health and welfare to promulgate a state nutrient management plan for surface waters.[32] State and local governments enforce the plans using their "police powers."[33]

• The state's chemigation law establishes design standards for use of irrigation systems for application of fertilizers and pesticides.[34] The Department of Agriculture ("DOA") can enter and inspect to determine compliance with chemigation standards.[35] Conducting chemigation without a license is subject to civil penalties ranging from $1-25,000, and other chemigation-related violations are subject to fines and a misdemeanor charge.[36]

• Idaho law also has general pesticide registration, labelling and application requirements and prohibits "applying pesticides in a faulty, careless or negligent manner."[37] The Department of Agriculture ("DOA") can enter and inspect to determine compliance with general pesticide use requirements.[38] Any individual claiming damage from pesticide use must file a report with the DOA. Applying pesticides without a license is subject to fines and injunction, and other violations are subject to up to $3000 in civil penalties.[39]

Development and Other Earth-Disturbing Activities

No operating requirements are set forth apart from any that may be authorized by general land use regulation such as zoning.

• The LLUPA establishes planning goals that include ensuring that the important environmental features of the state and localities are protected and enhanced; protecting fish, wildlife and recreation resources; and avoiding undue air and water pollution.[40] Exemptions from uses that are otherwise prohibited under the LLUPA are provided through issuance of special use permits.[41] Also, the LLUPA states that county commissioners are not empowered to enact to enact any law that "deprives any owner of full and complete use of agricultural land..."[42]

• Idaho regulations defining the development of comprehensive state water plan include provisions for designation of protected rivers and designation of interim protected rivers while the plan is being developed.[43] No enforcement provisions or sanctions specific to these regulations exist.

Endnotes

[1] I.C. 39-3618.
[2] I.C. 39-3620.
[3] I.C. 39-3610(1).
[4] I.C. 39-3611.
[5] I.C. 39-3620.
[6] I.C. 39-3610(2),(3).
[7] I.C. 39-3610(1).
[8] I.C. 39-3604.
[9] I.C. 39-3622.
[10] IDAPA 16.01.02.350.01 &.02.
[11] I.C. 39-108.
[12] I.C. 39-3612.
[13] I.C. 18-5901.
[14] I.C. 22-4501, I.C. 38-1401.
[15] I.C. 22-4503.
[16] I.C. 22-4504.
[17] I.C. 36-902.
[18] I.C. 38-1305(8).
[19] I.C. 38-1303(15).
[20] IDAPA 20.02.01.080.01.
[21] IDAPA 20.02.01.080.07.
[22] I.C. 38-1306.
[23] I.C. 38-1306B(1).
[24] I.C. 38-1307.
[25] IDAPA 20.02.01.020.01.a.
[26] I.C. 38-1401.
[27] I.C. 22-4501, 22-4504.
[28] I.C. 39-3610.
[29] I.C. 22-2716, 22-2722.
[30] IDAPA 20.05.02.
[31] IDAPA 16.01.14.001.
[32] I.C. 39-105.
[33] IDAPA 16.01.16.100.09.
[34] I.C. 22-1401.
[35] I.C. 22-1404.
[36] I.C. 22-1408, 22-1411.
[37] I.C. 22-3401, 22-3420.
[38] I.C. 22-3414.
[39] I.C. 22-3417, 22-3422 - 23.
[40] I.C. 22-6502(d),(j), & (k).
[41] I.C. 67-6512.
[42] I.C. 67-6529.
[43] IDAPA 37.02.01.

ILLINOIS

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Illinois' water pollution control law includes some provisions that may be used to take enforcement action against nonpoint source discharges that pollute the waters of the state or that violate state regulations or standards.

• The general discharge prohibition in Illinois states that "No person shall cause or threaten or allow the discharge of any contaminants that would cause or tend to cause water pollution, or that would violate regulations or standards adopted" by the Illinois Pollution Control Board (hereafter "IPCB").[1]

• Another general provision restricts a person from depositing "any contaminants upon the land in such place and manner so as to create a water pollution hazard."[2]

While these statutory provisions are not specifically limited to point sources, another provision which restricts a person from causing, threatening or allowing the "discharge of any contaminant into the waters of the State without a permit" applies only to point source discharges, and specifically only to those sources for which a federal permit is required.[3]

There are several avenues of enforcement. Following an investigation, the Agency may issue a notice and complaint and hold a hearing, or the Board may enforce an order by injunction, mandamus, or other appropriate remedy and/or civil penalties.[4] Civil penalties of a maximum of $50,000 for the violation and $10,000 for each continuing day may be assessed,[5] and it is a class A misdemeanor to violate the Act or regulations.[6] In addition, the Attorney General has broad authority to seek an injunction "to prevent air, land or water pollution within this State," notwithstanding any proceeding before any administrative agency.[7]

Other Discharge Limitations

• The organization of a *conservancy district* is authorized under the Illinois River Conservancy Districts Act (as distinguished from the Soil and Water Conservation Districts Act under Agriculture Requirements *infra*) "whenever the unified control of a lake or...river system...shall be deemed conducive to the prevention of stream pollution development, conservation and protection of water supply...development of irrigation, conservation of soil...and the promotion of the public health..."[8] State law endows the conservancy board with the right "to prevent pollution of ..." and "cause any and all parties, person,...to cease any and all pollution of" any stream or any other body of water in the district, although it cannot supersede the authority of the IPCB.[9] Although not specified in this section of the state statute, the Illinois Municipal Code authorizes sanctions of up to $750 or imprisonment of up to six months.[10]

• The Illinois Metropolitan Water Reclamation District Act authorizes the establishment of local districts, such as a "sanitary district" which has the authority to prevent the pollution of a public water supply.[11] If the district Superintendent determines that "sewage or industrial wastes or other wastes" are causing "pollution," then it may bring an action in circuit court for mandamus or injunction, or issue a cease and desist order with accompanying fines.[12] "Other wastes" include "oil, tar and chemicals." "Pollution" means "such alteration of ...properties of any waters of the State, or such discharge of any contaminant into any waters as will or is likely to create a nuisance or render such waters harmful..." A violation of an order is considered a nuisance.[13] The state Water Authorities Act[14] also authorizes creation of a "water authority" which has the broad power to make regulations that "protect public health, welfare, and safety and to prevent pollution of its water supply" and may by ordinance "prevent pollution of waters which feed its reservoir for a distance of five miles upstream from the headwaters of its reservoir and may abate any cause of pollution...as a nuisance."[15]

• The state authorizes municipalities to adopt local land resource management plans to protect the land, air, water, natural resources and environment of the state to "ensure good quality and quantity of water resources," among other things and to adopt implementing ordinances.[16] Municipalities further have the power to pass laws that specifically protect from pollution any "reservoir or artificial lake constructed or maintained by the municipality for water supply purposes."[17] These local ordinances are enforced through local law enforcement and criminal prosecutions.[18] Civil and criminal penalties are authorized.[19]

Other state discharge prohibitions are narrowly defined by an express limitation on the specific substances that can be discharged.

• One Illinois statute prohibits the discharge of oil in quantities greater than standards set by the IPCB. However, this same provision also prohibits the discharge of "*other pollutants* directly or indirectly into the waters...,"[20] and "other pollutants" are defined as "any floating materials which may cause unsightly appearance on the surface of such waters or are detrimental to aquatic life or the water quality of such waters."[21] Read broadly, this provision could be interpreted as a general discharge prohibition.

• Another discharge prohibition applies to "litter." It prohibits a person from dumping, depositing, dropping, throwing, discarding, leaving, causing of litter or permitting any of the above on public or private property or into "a river, lake, pond, or other stream or body of water in this state" (except in an emergency situation or for designated litter disposal areas).[22] "Litter" includes but is not limited to "garbage, trash, refuse, debris, rubbish, grass clippings or other lawn or garden waste...any nauseous or offensive matter of any kind...or anything else of an unsightly or unsanitary nature, which has been discarded, abandoned or otherwise disposed of improperly."[23]

• It is a public nuisance "to throw or deposit offal, other offensive matter or the carcass of a dead animal in a water course, lake, pond, spring, well or common sewer..." and "to corrupt or render unwholesome or impure the water of a spring, river, stream, pond, or lake to the injury or prejudice of others."[24] It is enforced locally with a maximum fine of $100 for a first offense and a class B misdemeanor for subsequent offenses.[25]

Illinois law provides that no farm is a nuisance because of changed circumstances in the surrounding area where it has been in operation more than one year and was not a nuisance when it began operation, unless the nuisance results from "negligent or improper operation of the farm."[26] However, even this exception from nuisance liability does not prevent recovery of damages resulting from water pollution.[27]

Fish/Fisheries Laws

Illinois laws relating to fish and fisheries do not appear to contain enforceable provisions applicable to nonpoint source discharges.

OPERATIONAL REQUIREMENTS

Forestry Requirements

- Illinois laws relating to forestry do not appear to contain enforceable operating requirements with respect to nonpoint source discharges.

Agriculture Requirements

- Illinois statutes authorize the organization of soil and water conservation districts that have the power to formulate land-use regulations, including soil erosion measures, requirements for cultivation and other soil and erosion management methods, and provisions prohibiting the clearcutting of trees within thirty feet of any navigable waters, except for trees in a forestry management plan or other licensed activities.[28] Three-fourths of the landowners must approve the regulations in order for them to enforceable as a local ordinance within the district, and the regulations are binding upon all of the landowners in the district.[29] The state municipal code grants these districts authority to pass ordinances that impose $750 maximum civil penalties and/or up to six years imprisonment.[30]

- With respect to regulating pesticides, the IPCB may adopt "standards and conditions regarding the sale, offer, or use of any pesticide, detergent or any other article determined...to cause a water pollution hazard," provided that regulations related to pesticides are adopted in accordance with the Illinois Pesticide Act.[31] The state statute also states that "it is unlawful to store, display, use or distribute pesticides in such manner as to endanger man and his environment."[32] Under this provision, the Director may issue an order to stop use or regulate removal of a pesticide or related substance, or the Director may seek an injunction in circuit court.[33]

Development and Other Earth-Disturbing Activities

No operating requirements are set forth, apart from any that may be contained in urban stormwater programs under the Clean Water Act or that may be authorized by general land use regulation such as zoning.

Endnotes

[1] 415 Ill. Cons. Stat. 5/12(a).
[2] 415 Ill. Cons. Stat. 5/12 (c).
[3] 415 Ill. Cons. Stat 5/12 (f).
[4] 415 Ill. Cons. Stat. 5/30-32, 415 Ill. Cons. Stat. 5/42.
[5] 415 Ill. Cons. Stat. 5/42.
[6] 415 Ill. Cons. Stat. 5/44.
[7] 15 Ill. Cons. Stat. 215/2.
[8] 70 Ill. Cons. Stat. 2105.
[9] 70 Ill. Cons. Stat. 2105/26.
[10] 65 Ill. Cons. Stat. 5/1.
[11] 70 Ill. Cons. Stat. 2605/7aa.
[12] 70 Ill. Cons. Stat. 2605/7bb.
[13] 70 Ill. Cons. Stat. 2605/7bb.
[14] 70 Ill. Cons. Stat. 3715/24.
[15] 70 Ill. Cons. Stat. 3715/26.
[16] 50 Ill. Cons. Stat. 805.
[17] 65 Ill. Cons. Stat. 5/11-126-4.
[18] 65 Ill. Cons. Stat. 5/1/2-7, 5/1-2-1.1.
[19] 65 Ill. Cons. Stat. 5/1-2-1.
[20] 415 Ill. Cons. Stat. 25/3.
[21] 415 Ill. Cons. Stat. 25/2.
[22] 415 Ill. Cons. Stat. 105/4.
[23] 415 Ill. Cons. Stat. 105/3(a).
[24] 720 Ill. Cons. Stat. 5/47-5.
[25] 70 Ill. Cons. Stat. 5/47-25.
[26] 740 Ill. Cons. Stat. 70/3.
[27] 740 Ill. Cons. Stat. 70/4.
[28] 70 Ill. Cons. Stat. 405/23.
[29] 70 Ill. Cons Stat. 405/23.
[30] 65 Ill. Cons. Stat. 5/1-2-1.
[31] 415 Ill. Cons Stat. 5/13(a)(6).
[32] 415 Ill. Cons. Stat. 60/14.
[33] 415 Ill. Cons. Stat. 60/15-17.

INDIANA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Indiana's water pollution control law includes several provisions that may be used to take enforcement action against nonpoint source discharges that contribute to a polluted condition of the state's waters.

• "A person may not: (1) throw, run, drain, or otherwise dispose into any of the streams or waters of Indiana; or (2) cause, permit, or suffer to be thrown, run, drained, allowed to seep, or otherwise disposed into any waters; any organic or inorganic matter that causes or contributes to a polluted condition of any waters, as determined by a rule of the [water pollution control] board."[1] The water pollution control board is authorized to adopt rules to determine what constitutes a "polluted condition" of the water in any stream or water of the state.[2] Whenever the commissioner of the environment "determines that a person: (1) is in violation; or (2) is about to violate [this prohibition]" the department of environmental management must issue an order to abate the violation.[3]

• The board has power to "adopt rules restricting the polluting content of any waste material and polluting substances discharged or sought to be discharged into any of the streams or waters of Indiana."[4] This authority is not limited to point sources. The board also has authority to establish requirements for permits "to control or limit the discharge of contaminants into state waters;" while this is not limited to point sources, the current regulations cover permitting for point sources[5] and do not require permits for "any introduction of pollutants from nonpoint source agricultural and silvicultural activities."[6]

• In addition to the prohibition on causing or contributing to a polluted condition, and the permitting provisions, the commissioner of the environment has general authority to "take appropriate steps to prevent any pollution that is determined to be unreasonable and against public interests in view of the condition in any stream or other waters of Indiana."[7]

• Another provision prohibits the discharge of any contaminant or waste into the environment in "any form that causes or would cause pollution that violates or would violate rules, standards, or discharge or emission requirements" adopted by the board.. and prohibits deposit of a contaminant on the land that "creates or would create a pollution hazard that violates or would violate a rule" and prohibits deposit of "solid waste...in or immediately adjacent to a lake or stream"[8]

• A separate provision of the water pollution law requires reporting of spills, including those not reported under federal spill response requirements.[9] "Spill" for purposes of this law includes "any unexpected, unintended, abnormal, or unapproved dumping, leakage, drainage, seepage, discharge, or other loss of...oil, a hazardous substance; or *other objectionable substance* that enters or threatens to enter the waters of Indiana"[10]

These laws are enforced by the commissioner by administrative order, civil penalties of up to $25,000 per day, and injunctions.[11] Failure to comply with an order or discharge a duty imposed by the water pollution control laws is a Class B misdemeanor.[12] Minor violations that do not present an immediate or reasonably foreseeable danger to the public health or environment, and that do not include violation of a numerical limit or permit condition applicable to a business required to correct the violation before disclosure, and that are not failure to possess a required permit, may result in a reduced penalty limited to $500 if the business corrects the violation within 90 days.[13]

Other Discharge Limitations

• Indiana also has broad general authorities applicable to pollution events. The governor may issue an emergency order if contamination of air, water, or land presents a "clear and present danger" to the "health and safety of persons in any area," and the commissioner may file suit if a pollution source is presenting "an imminent and substantial endangerment" to health or livelihood.[14] An environmental enforcement law authorizes the attorney general, a political subdivision of the state, a citizen or a corporation or association to bring actions in the name of the state "for the protection of environment from significant pollution, impairment, or destruction" after notice to the state and failure of the appropriate state agency to act.[15]

• Nuisance law may apply to some nonpoint source pollution events. Indeed, the water pollution law defines "water pollution" as including discharges of contaminants that can "create a nuisance or make the waters harmful, detrimental, or injurious" to public health, safety or welfare, legitimate uses of water, or animals, fish or aquatic life.[16] Indiana law also provides that "Whatever is injurious to health, or indecent, or offensive to the senses, or an obstruction to the free use of property, so as essentially to interfere with the comfortable enjoyment of life or property is a nuisance, and the subject of an action."[17] However agricultural and industrial operations are insulated from public and private nuisance actions by virtue of changed conditions in the vicinity if they have operated for more than one year, were not a nuisance when they began, and there was no significant change in the operation; the exception does not apply if the nuisance results from "negligent" operation.[18]

• Indiana's Flood Control Act prohibits any person from putting contaminants or solid waste in, upon, or within 15 feet of a lake or within a floodway.[19] Violations may be abated by injunction and by civil penalty of up to $1,000 per day.[20] But this provision does not apply to persons using chemicals in a normal manner in the production of agricultural products, nor to persons acting in accordance with discharge permits issued by IDEM or DNR.[21]

• Indiana expressly prohibits "discharge of a nonpoint source of pollution to waters of the United States" from municipal solid waste land fills, if such discharge "violates any requirement of an area wide or state wide water quality management plan...under § 208" of the federal Clean Water Act.[22]

• Indiana's recreational rivers law provides that any person who "throws, dumps, or leaves refuse in the water or on the banks" of a designated stream, is guilty of a misdemeanor, punishable by fine of up to $1,000 and/or imprisonment for up to 180 days.[23]

Fish/Fisheries Laws

Indiana's fisheries laws do not appear to contain enforceable provisions relating to nonpoint source discharges.

OPERATIONAL REQUIREMENTS

Forestry Requirements

State law does not appear to include enforceable requirements aimed specifically at controlling nonpoint source pollution from forestry on private lands.

Agriculture Requirements

• Although soil and water conservation districts and conservancy districts can develop comprehensive plans and adopt rules and regulations, no enforcement powers are provided; they have the power to condition receipt of benefits on agreements with landowners.[24]

• The state does regulate water pollution from confined animal feeding operations similarly to federal requirements, but with somewhat different size limits and including operations in violation of water pollution laws or rules.[25] Prior approval from IDEM is required before commencing construction of a CAFO, but not a construction permit.[26] Enforcement is via administrative orders, injunctions, and penalties.[27]

• The pesticide law includes registration of pesticides, requirements for certifications and licensing of applicators and others. Enforcement mechanisms include registration and licensing actions, injunctions, orders, and civil penalties.[28]

• The Drainage Board Act establishes county drainage boards[29] does not provide for much environmental protection; however, IDEM approval is needed if connection of a drain to a regulated drain would result in a discharge of liquid wastes that "would cause or contribute to pollution of the receiving waters."[30] The Ditch Act requires a permit for ditching or drain activities within ½ mile of freshwater lake of more than 10 acres; DNR may issue the permit only if it finds that the proposed action "will not result in unreasonably detrimental effects upon fish, wildlife, or botanical resources."[31] The Ditch Act is enforceable by injunction, notice of violation, civil penalty, or petty criminal prosecution.[32]

Development and Other Earth-Disturbing Activities

Indiana has several provisions apart from regulation of urban stormwater under the federal Clean Water Act.

• Although construction activities affecting 5 or more acres must control erosion, including filing a notice of intent and preparing an erosion control plan, local regulation under zoning codes can reach smaller sites.[33]

• It is unlawful to build any structure, place any obstruction, or "...make any deposit or excavation" in any floodway without a permit from the Dept. of Natural Resources. A permit may be issued only if the action will not, among other things, result in "...unreasonable detrimental effects upon fish, wildlife, or botanical resources..."[34] However permits are not required for drain reconstruction or maintenance if the stream or drain is 10 miles or less in length, [35] nor for production of crops, or for pasture, forests, and park and recreational uses provided they do not involve any structure, obstruction, deposit, or excavations.[36] Enforcement is by injunction, criminal prosecution, and civil penalty of up to $1,000 per day.[37]

• A person may not substantially affect "natural or scenic qualities of a [designated natural, scenic, or recreational] river that is the subject of a river commission unless the person has secured a permit to do so from the river commission.[38] Enforcement is by injunction, and civil penalty of $10 to $300 per day.[39]

Endnotes

1. Ind. Code § 13-18-4-5.
2. Ind. Code § 13-18-4-1.
3. Ind. Code § 13-18-4-6.
4. Ind. Code § 13-18-4-3.
5. Ind. Code § 13-15-1-2; Ind. Admin. Code tit. 327, sec. 5-2-1 et seq.
6. Ind. Admin. Code tit. 327, sec. 5-2-4(4).
7. Ind. Code § 13-18-4-4.
8. Ind. Code § 13-20-2-1.
9. Ind. Code Ann. § 13-18-6-1.
10. Ind. Code Ann. § 13-11-2-217.
11. Ind. Code Ann. §§ 13-14-2-1, 13-14-2-6, 13-14-2-7, 13-30-3-3, 13-30-3-4, 13-30-4-1.
12. Ind. Code Ann. § 13-18-8-9.
13. Ind. Code Ann. § 13-30-7.
14. Ind. Code Ann. §§ 13-14-10-1, -2.
15. Ind. Code Ann. 13-30-1-1.
16. Ind. Code Ann. § 13-11-2-260.
17. Ind. Code Ann. § 34-1-52-1.
18. Ind. Code Ann. § 34-1-52-4.
19. Ind. Code Ann. § 14-28-1-27.
20. Ind. Code Ann. §§ 14-28-1-35, 14-28-1-36.
21. Ind. Code Ann. § 14-28-1-27.
22. Ind. Admin. Code tit. 329, sec. 10-20-26.
23. Ind. Code Ann. § 14-29-8-5.
24. Ind. Code Ann. §§ 14-32-3, 14-32-5-1; see also 14-33-1 et seq.

25. Ind. Code Ann. § 13-18-2-40.
26. Ind. Code Ann. § 13-18-10-1; Ind. Admin. Code tit. 327, sec. 3-1-4.
27. Ind. Code Ann. §§ 13-18-10-3(b), -5, -6.
28. Ind. Code Ann. §§ 15-3-3.5-1 et seq.; 51-3-3.6-1 et seq.
29. Ind. Code Ann. §§ 36-9-27-1 et seq; also see 14-27-8-1 et seq.
30. Ind. Code Ann. § 36-9-27-23.
31. Ind. Code Ann. § 14-26-5-1 et seq.
32. Ind. Code Ann. § 14-26-5-16; 14-10-2-6; 14-26-5-17.
33. Ind. Admin. Code tit. 327, sec. 15-5-1 et seq.
34. Ind. Code Ann. §§ 14-28-1, 14-28-1-22.
35. Ind. Code Ann. § 14-28-1-22.
36. Ind. Admin. Code tit. 310, sec. 6-1-9.
37. Ind. Code Ann. §§ 14-28-1-32 to -36.
38. Ind. Code Ann. § 14-29-7-18.
39. Ind. Code Ann. § 14-29-7-25.

IOWA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Iowa's water pollution law contains a general prohibition against unpermitted discharges of pollutants (defined as "wastes") into waters, which may be used to reach some types of nonpoint source discharges.

• "A pollutant shall not be disposed of by dumping, depositing, or discharging such pollutant into any water of the state...."[1] This prohibition, which is generally applicable, does not apply to the discharge of adequately treated sewage, industrial waste, or other waste pursuant to a permit. Pollutant is defined as "sewage, industrial waste, or other waste." [2] "Other waste" is defined as "heat, garbage, municipal refuse, lime, sand, ashes, offal, oil, tar, chemicals and all other wastes which are not sewage or industrial waste."[3] In addition, "[a] pollutant, whether treated or untreated shall not be discharged into any state-owned natural or artificial lake."[4]

Enforcement is primarily through cease and desist orders, civil penalties up to $5,000 per day, injunctions, and criminal (serious or aggravated misdemeanor) prosecution.[5] Cities and counties are authorized to assess a civil penalty equal in amount to the penalty assessed by the state.[6]

Other Discharge Limitations

• "A person shall not discard solid waste onto or in any water...of the state...."[7] Enforcement of this provision is by civil penalty not to exceed $500 for each violation.[8]

• "No person shall discard any litter onto or in any water... of this state...." Discard means "to place, cause to be placed, throw, deposit or drop," while litter is defined as "any garbage, rubbish, trash, refuse, waste materials or debris."[9] Enforcement is by criminal (simple misdemeanor) prosecution. The court may also direct and supervise litter gathering in addition to or in lieu of any other sentence.[10]

• In 1987, Iowa adopted the Groundwater Protection Act, which authorizes the adoption of health-related groundwater standards. Although it expressly imposed no new legal liabilities, the Act created a linkage between the requirements of the state's water quality law and the Act's goal of preventing "contamination of groundwater from point and nonpoint sources of contamination to the maximum extent practical, and if necessary [restoring] the groundwater to a potable state, regardless of present condition, use, or characteristics."[11] The Act states generally that the "discovery of any groundwater contamination shall require appropriate actions to prevent further contamination. These actions may consist of investigation and evaluation or enforcement actions if necessary to stop further contamination as required under the water quality law.[12] More specifically, the Act states that "documentation of any contaminant which presents a significant risk to human health, the environment, or the quality of life shall result in either passive or active cleanup," as defined in the law.[13] The Groundwater Protection Act also provides an exemption from liability for certain agricultural activities - providing that liability shall not be imposed upon an agricultural producer for active cleanup costs or damages resulting from the detection of any quantity of nitrates if "application [of the fertilizer] has been in compliance with soil test results and...the applicator complied with label instructions for the application of the fertilizer."[14] Liability also may not be imposed for pesticides in the groundwater provided the applicator had a license and complied with the label.[15]

• Under Iowa law, some nonpoint source discharges may be abatable as a nuisance. "Whatever is injurious to health, indecent, or offensive to the senses, or an obstruction to the free use of property, so as essentially to interfere with the comfortable enjoyment of life or property, is a nuisance...."[16] The law also specifically lists a number of nuisances, including: "the obstructing or impeding without legal authority the passage of any navigable river, harbor, or collection of water," and "the corrupting or rendering unwholesome or impure the water of any river, stream or pond, or unlawfully diverting the same from its natural course or state, to the injury or prejudice of others."[17]

If no other punishment is specifically provided for, those convicted of causing a public nuisance are guilty of an aggravated misdemeanor, and the court may order the nuisance abated and issue a warrant.[18]

Iowa law specifically provides that an animal feeding operation is not a nuisance under common law. But this provision does not apply if the person bringing an action proves either that an injury to the person or damage to the person's property is caused by failure to comply with a federal or state statute or rule applicable to such operation, *or* that the operation unreasonably interferes with the person's comfortable use and enjoyment of life and property and such operation failed to use existing prudent generally accepted management practices reasonable for the operation.[19] Iowa law also provides that a farm operation located in a defined agricultural area is not a nuisance; however, this provision was recently struck down by the Iowa Supreme Court as an infringement on the property rights of neighboring property owners.[20] In any event, the exemption did not apply to actions involving negligence, nor did it affect or defeat the right to recover damages for "pollution or change in condition of the waters of a stream, the overflowing of the person's land, or excessive soil erosion onto another person's land."[21] The exemption also did not restrict nuisance actions based on a structure, dam obstruction, deposit or excavation in a floodway in an agricultural area.[22]

Fish/Fisheries Laws

State fisheries laws do not appear to contain enforceable provisions relating to nonpoint source discharges.[23]

OPERATIONAL REQUIREMENTS

Forestry Requirements

State forestry laws do not appear to contain enforceable provisions relating to nonpoint source discharges.

Agriculture Requirements

• Iowa's Soil Conservation Districts Law provides that in order to "conserve the fertility, general usefulness, and value of the soil and soil resources of this state, and to prevent the injurious effects of soil erosion," owners of real property in the state must establish and maintain soil and water conservation practices or erosion control practices, pursuant to regulations adopted by the commissioners of the respective soil and water conservation districts.[24] Unless the claim is based on gross negligence, a landowner may not be liable for a claim based on a negligent soil or water conservation practice if that practice was in accordance with generally recognized engineering standards, or in compliance with the district's rules.[25]

• The commissioners must adopt reasonable regulations to establish a soil loss limit for the district. The commissioners may require the owners of real property in the district to employ either soil and water conservation practices or erosion control practices. The law places certain limits on the type of controls that may be required.[26] An owner of agricultural land is not required to establish any new permanent or temporary soil and water conservation practice unless cost-share or other public moneys have been specifically approved for that land and made available to the owner.[27]

• The state Soil Conservation Districts Law also requires that prior to initiating a "land-disturbing activity" a person must file a signed affidavit that the project will not exceed the soil loss limits. Land-disturbing activity is defined as land changes such as the tilling, clearing, grading, excavating, transporting or filling of land which may result in soil erosion from water or wind and the movement of sediment and sediment related pollutants into the waters of the state. However, the definition excludes a number of activities, including the tilling, planting or harvesting of agricultural, horticultural or forest crops.[28]

If, upon inspection, the commissioners find that sediment damages are occurring to the land of the complainant, the commissioners are to issue an administrative order to the landowner. The order states the time framework for establishing or maintaining soil and water conservation practices or erosion control measures.[29]

• Iowa law, substantially expanded in 1998, addresses animal feeding operations, which are defined as "a lot, yard, corral, building or other area in which animals are confined and fed and maintained for forty-five days or more in any twelve-month period, and all structures used for the storage of manure from animals in the operation....An animal feeding operation does not include a livestock market."[30] State law authorizes the department of natural resources to adopt rules relating to the construction or operation of animal feeding operations. The law mandates that these rules include minimum manure control requirements, requirements for obtaining permits, and departmental evaluations of animal feeding operations.[31] Construction permits are required for such operations, and must include provision of an indemnity fee, a manure management plan, notice and comment managed by the county board of supervisors, and other requirements.[32] Iowa law expressly provides that no permit may be issued if an enforcement action is pending or if the applicant is a "habitual violator" and the violation occurred within the past five years. The department is instructed to conduct an annual review of each feeding operation of a habitual violator.[33]

Other statutory requirements relating to the construction and operation of animal feeding operations include:

(1) Manure controls. "A confinement feeding operation shall not discharge manure directly into water of the state or into a tile line that discharges directly into water of the state."[34] The law requires that manure be disposed of in a manner that will not cause surface or groundwater pollution. An owner who discontinues a confinement feeding operation must remove all manure within at least six months.[35] The applicant for a permit must submit a manure management plan, the requirements of which are outlined in the law.[36] The law also sets out detailed requirements for commercial manure applicator certification, and requirements governing application of manure to land.[37]

(2) Separation distance requirements. State law prescribes the minimum separation distance between an animal feeding operation constructed and a residence not owned by the owner of the operation, or a commercial enterprise, religious institution or educational institution.[38] In addition, an animal feeding operation structure must be located 500 or more feet away from a major water source (meaning any navigable lake, reservoir, river, or stream), and from a surface intake, wellhead, or cistern of an agricultural drainage well or known sink hole; and it most be located more than 200 feet away from any watercourse that is not a major water source.[39]

Enforcement of the animal feeding operation requirements is through cease and desist orders, civil penalties up to $5,000 per day, and injunctions. The law provides additional penalties ($500 per day) for violation of a court order mandating compliance with an order issued by the department. In addition, the law provides for civil penalties up to $25,000 per day for "habitual violators."[40]

• Under Iowa law, "(a) pesticide shall not be applied to any water of this state which has been classified by the department [of natural resources] as a class "A" or class "C", high quality, or high quality resource water, except that this section shall not...prohibit the application of such a pesticide by a certified applicator who is trained in aquatic applications and who has received a permit from the department."[41] This provision may be enforced through the same mechanisms used to enforce the general pollutant discharge provisions described above.

• The department of agriculture is required by law to adopt rules establishing the proper use of pesticides, including their formulations, times, and methods of application, and other conditions of use.[42] The law also provides that commercial applicators must comply with certification requirements. The department of agriculture is required to adopt rules for the assessment of civil penalties up to $500 for violations by commercial applicators.[43]

Development and Other Land-Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act or that may be authorized by general land use regulation such as zoning, state law provides the following authorities applicable to nonpoint source discharges.

- The state's soil conservation law, described above, applies to "land-disturbing activities," defined to include land changes such as "tilling, clearing, grading, excavating, transporting or filling of land which may result in soil erosion from water or wind and the movement of sediment and sediment related pollutants into the waters of the state...."[44] Among the excluded activities are preparation of single family homes (unless as part of a subdivision development) and disturbed land areas of less that 25,000 square feet (unless a local ordinance provides otherwise).

- State law prohibits the building of "any pier, wharf, sluice, piling, wall, fence, obstruction, building, or erection of any kind upon or over any state-owned land or water under the jurisdiction of the [Conservation] commission, without first obtaining from the commission a written permit."[45] Enforcement of this provision is by criminal (simple misdemeanor) prosecution. In addition, the commission may order removal of the structure, or the commission may remove the structure and recover costs from the owner.[46]

- "Where operations are entirely on private property adjacent to a public lake or stream the natural bank between the state and privately owned areas shall not be removed except by permission of the commission."[47] Violation is a simple misdemeanor.[48]

Endnotes

1. ICA 455B.186.
2. ICA 455B.171(18).
3. ICA 455B.171(15).
4. ICA 455B.186.
5. ICA 455B.175, 455B.191(1)-(4).
6. ICA 455B.192.
7. ICA 455B.307A.
8. ICA 455B.307A.
9. ICA 455B.363, 455B.361.
10. ICA 455B.364.
11. ICA 455E.4.
12. ICA 455E.5(2).
13. ICA 455E.5(5);ICA 455E.2(1),(8).
14. ICA 455E.6.
15. *Id.*
16. ICA 657.1.
17. ICA 657.2.

[18] ICA 657.3.
[19] ICA 657.11.
[20] Bormann v. Board of Supervisors (Iowa S. Ct. Sept. 23, 1998).
[21] ICA 352.11.
[22] ICA 455B.275.
[23] *Cf.* ICA 481A.76 (prohibits "use" of poisonous or stupefying substances "in the taking of fish.")
[24] ICA 161A.43.
[25] ICA 161A.43.
[26] ICA 161A.44.
[27] ICA 161A.48.
[28] ICA 161A.64. Also excluded are: preparation of single family residence; minor activities such as home gardening; surface or deep mining; installation of utility lines; septic tanks; construction of tracks; emergency work; disturbed land areas of less than 25,000 square feet unless an ordinance states otherwise; and certain public road projects.
[29] ICA 161A.47.
[30] ICA 455B.161(3), 455B.171(2).
[31] ICA 455B.173(13); 455B.200.
[32] ICA 455B.200A.
[33] *Id.*
[34] ICA 455B.201(1).
[35] ICA 455B.201.
[36] ICA 455B.203.
[37] ICA 455B.203A, 445B.203B.
[38] ICA 455B.162, 455B.163.
[39] ICA 455B.204.
[40] ICA 455B.175; 455B.191(1),(4),(7); ICA 455B.182.
[41] ICA 455B.186(2).
[42] ICA 206.19.
[43] ICA 206.5, 206.19.
[44] ICA 161A.64.
[45] ICA 461A.4.
[46] ICA 461A.5, 461A.6.
[47] ICA 461A.56.
[48] ICA 461A.57.

KANSAS

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Kansas' water pollution law contains enforceable permitting provisions that may be applied to some nonpoint source discharges. The law also directs the state's attorney general to pursue abatement of pollution of surface waters affecting animal or aquatic life.

• "No person shall place or permit to be placed or discharge or permit to flow into any of the waters of the state any sewage, except pursuant to a permit."[1] The Kansas Department of Health and Environment may require nonpoint sources to obtain a permit. The law states that the "secretary...may establish...procedures for issuance of general permits to...(1) a category of point and nonpoint sources of sewage such as storm water; (2) other categories of point and nonpoint sources of sewage...."[2] For purposes of the above provisions, sewage is defined as "any substance that contains any of the waste products or excrementitious or other discharges from the bodies of human beings or animals, or chemical or other wastes from domestic, manufacturing, or other forms of industry."[3]

• "The secretary of health and environment shall make such rules and regulations, including registration of potential sources of pollution, as may...be necessary to...(2) control the disposal, discharge or escape of sewage...and (3) establish water quality standards for the waters of the state to protect their beneficial uses."[4]

• "If the secretary finds that...refuse in any surface pond is causing or is likely to cause pollution of soil or waters of the state, the secretary shall issue an order prohibiting such surface pond."[5]

• In addition, if the secretary of health and environment finds evidence of "abatable pollution of the surface waters detrimental to the animal or aquatic life in the state," it is the duty of the attorney general to take such action as may be necessary to secure the abatement of such pollution.[6]

Enforcement of these provisions is by corrective action orders, civil penalties of up to $10,000 and criminal prosecutions.[7] Where a violation results in the "death of, or injury to, fish, animals, vegetation or other resources of the state, or otherwise causes a reduction in the quality of the waters of the state below the standards set by the secretary," the violator is liable to the state for damages in an amount equal to that necessary to "restock such waters, replenish or replace such resources and otherwise restore the water."[8]

Other Discharge Limitations

• State nuisance law potentially addresses some activities that may result in nonpoint source pollution. "The secretary of health and environment and the county or joint boards of health shall have the power and authority to examine into all nuisances, sources of filth and causes of sickness that in their opinion may be injurious to the health of...inhabitants. Whenever any such nuisance, source of such filth or cause of sickness is found to exist on any private property or upon any watercourse in this state...[the health authorities] shall have the power and authority to order, in writing, the owner or occupant thereof at his or her own expense to remove the nuisance or source of filth or cause of sickness within 24 hours, or within such reasonable time thereafter" as ordered.[9] Failure to obey an order results in a fine of not less than $10 nor more than $100 per day.[10]

Kansas' solid waste law provides an exemption from nuisance actions for agricultural activities. "Agricultural activities conducted on farmland, if consistent with good agricultural practices and established prior to surrounding nonagricultural activities, are presumed to be reasonable and do not constitute a nuisance, public or private, unless the activity has a substantial adverse effect on the public health and safety. If such agricultural activity is undertaken in conformity with federal, state, and local laws and regulations, it is presumed to be good agricultural practice and not adversely affecting the public health and safety."[11] The law also prohibits open dumping, but exempts normal farming operations provided the practice does not create a public nuisance or adversely affect public health. Violation is a Class A misdemeanor.[12]

Fish/Fisheries Laws

The state's fisheries laws do not appear to contain enforceable provisions relevant to nonpoint source discharges.

OPERATIONAL REQUIREMENTS

Forestry Requirements

State forestry laws do not appear to contain enforceable provisions relating to nonpoint source discharges.

Agriculture Requirements

• Kansas' agriculture law regulates CAFOs of different sizes than the federal regulations. "Prior to any new construction of a confined feeding facility with an animal unit capacity of 300 to 999, such facility shall register with the secretary of health and environment. Facilities with less than 300 units may register...."[13] Within 30 days, the department of health and environment must identify any significant water pollution potential or separation distance violations; if water pollution potential is identified, the facility is required to obtain a permit. If no water pollution potential is found, the secretary is to certify that no permit is required. Confined feeding facility means any

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lot, pen, pool or pond: which is used for the confined feeding of animals or fowl for food, fur or pleasure purposes; which is not normally used for raising crops; and in which no vegetation intended for animal food is growing.[14] Violators are subject to a civil penalty of up to $10,000 per day.[15]

•State agriculture law also requires licenses and sets standards of operation for livestock feedlots or feed yards having more than 1,000 head of livestock at one time. Other livestock feedlots may elect to come under the act. Operating standards contained in the law include requiring that the feedlot provide adequate drainage to control pollution of streams and lakes.[16] Enforcement is through revocation or suspension of licenses, or by criminal prosecution.[17]

•Kansas' pesticide law addresses disposal and storage practices that might result in nonpoint source pollution. "It shall be unlawful for any person to...discard or store any pesticide or pesticide container in such a manner as to cause injury to humans, vegetation, crops, livestock, wildlife, pollinating insects or waterways and wildlife therein...or to fail to comply with" regulations adopted under the law.[18] Enforcement of the pesticide law is through criminal (Class A misdemeanor) prosecution and, in the case of violations by certified applicators, through civil penalties of between $100 and $500 per day.[19]

•The pesticide law also authorizes the board of agriculture to develop pesticide management areas if a pesticide poses a serious threat to the public health, safety and welfare or the natural resources of the state.[20] "Pesticide management plans may include provisions for the handling or release of pesticides, including, but not limited to, the application, mixing, loading, storage, disposal or transportation and guidelines for best management practices.[21] Enforcement is by civil penalty of between $100 and $5,000, and by criminal (Class A misdemeanor) prosecution.[22]

•State agriculture law requires that any person who applies any chemical by the chemigation process in an irrigation system must register and use anti-pollution devices specified under state law. Chemigation is defined as "any process whereby pesticides, fertilizers or other chemicals or animal wastes are added to irrigation water applied to land or crops, or both, through an irrigation distribution system." Registration must include, among other things, a plan for handling tail water or accumulations of water.[23] It is unlawful for any person to use the chemigation process without registration or refuse or neglect to comply with restrictions, and enforcement is through permit suspension or revocation, civil penalties of between $100 and $5,000, and criminal prosecution.[24]

•Other provisions of Kansas law relating to irrigation practices include the requirement that "(a)ny person who is using a ditch, conduit, or reservoir for irrigation purposes shall be responsible that no injury be done to the embankment thereof, or the fence enclosing it, or other parts of it, and that the waters thereof be not fouled or polluted by any animal driven to or watered there."[25]

Development and Other Earth-Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act or that may be authorized by general land use regulation such as zoning, state law provides the following authority applicable to nonpoint sources.

- Kansas law authorizes the regulation of land development activities around some water bodies for the purpose of preventing water pollution. The secretary of health and environment may adopt regulations designating "sanitation zones" to regulate and control development of areas of the state surrounding certain impoundments of water to prevent pollution of such impoundments.[26] A sanitation zone is the land designated by the secretary that is not more than 3 miles from the waterline of any existing or proposed state or federal reservoir that is more than 100 acres in surface area.[27] Owners of land in the zone must obtain approval to construct a building, structure or facility.[28] Exempted from these requirements are (1) land used for agricultural purposes or land under the control of the department of wildlife and parks; (2) subdivisions approved prior to Aug. 1, 1965; and (3) land subject to sanitary codes controlling the subsurface disposal of sewage enforced by the local health department.[29] County attorneys are authorized to enforce these requirements through appropriate actions of injunction, mandamus or quo warranto.[30]

Endnotes

1. Kansas Statutes Annotated 65-164(a).
2. KSA 65-165(b).
3. KSA 65-164(c).
4. KSA 65-171d(a).
5. KSA 65-171d(e).
6. KSA 65-171b.
7. KSA 65-164(d), 65-170d, 65-167.
8. KSA 65-171u.
9. KSA 65-159.
10. KSA 65-159.
11. KSA 2-3201-3204.
12. KSA 65-3409.
13. KSA 65-171d(g).
14. KSA 65-171d(c)(2).
15. KSA 65-170d(a).
16. KSA 47-1501, 47-1503, 47-1505.
17. KSA 47-1506, 47-1509.
18. KSA 2-2453.
19. KSA 2-2461.
20. KSA 2-2472.
21. KSA 2-2473.
22. KSA 2-2461, 2-2478.
23. KSA 2-3302, 2-3303.
24. KSA 2-3308, 2-3310, 2-3313, 2-3317.
25. KSA 42-312.
26. KSA 65-184 -- 65-189f.
27. KSA 65-185(a).

[28] KSA 65-189c.
[29] KSA 65-189e.
[30] KSA 65-188.

KENTUCKY

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Kentucky's water pollution control provisions may be enforced against nonpoint source discharges that pollute state waters in violation of applicable standards or regulations. However, violations that are traceable to specific agricultural sources must be addressed under a separate law.

• "No person shall, directly or indirectly, throw, drain, run or otherwise discharge into any of the waters of the Commonwealth, or cause, permit, or suffer to be thrown, drained, run or otherwise discharged into such waters any pollutant, or any substance that shall cause or contribute to the pollution of the waters of the Commonwealth in contravention of the standards adopted by the cabinet or in contravention of any rule, regulation, permit or order or in contravention of any provision of the statute."[1] The Natural Resources and Environmental Protection Cabinet's Office of Legal Services or the Attorney General may institute an action to recover penalties or bring an action seeking an injunction.[2] Violators are subject to a civil penalty not to exceed $25,000 per day for each violation.[3] Knowing violations are a Class D felony punishable by a fine not to exceed $25,000, imprisonment of one to five years, or both.[4] However, where there is documented evidence that a violation of water pollution laws or administrative regulations is traceable to a specific agriculture operation, then the provisions of the Agriculture Water Quality Act (discussed below) govern resolution of the violation.[5]

Other Discharge Limitations

• Kentucky law has restated and codified the common law of nuisance as it existed in the Commonwealth on May 24, 1991.[6] The codification defines what would constitute permanent and temporary nuisances; private and public nuisances; and how damages should be determined. The section does not specify what actions, such as polluting, constitute a nuisance. However, no agricultural or silvicultural operation is abatable as a nuisance or may be deemed in violation of any zoning ordinance that would restrict the right of the operator to utilize "normal and accepted practices" after it has been in operation for more than one year, provided that the operation was not a nuisance at the time it began.[7] This provision does not apply if the violation or nuisance results from negligence. Nor does it affect the right of any person to recover damages for any injuries or damages sustained by them on account of pollution of the waters of any stream or groundwater.[8]

• Kentucky law also makes it a violation if any person "places or causes to be placed in any stream, dam, pool or pond any substance that renders the water unfit for use or produces a stench."[9] This violation is punishable by a fine of $10 to $100 and imprisonment for a period of 30 days to six months.

• A person is guilty of "criminal littering," a Class A misdemeanor, if he or she knowingly and willfully places or throws litter in any public or private water.[10] For purposes of this provision, litter is defined as "rubbish...waste material...or any foreign substance."[11]

Fish/Fisheries Laws

• Under the wildlife code, "no person shall place or cause to be placed in any public waters any substance that might injure, interfere with, or cause the waters to be unfit for the support of wildlife."[12] Further, "no person shall willfully place or attempt to place in any public waters any substance which has a poisonous or intoxicating effect upon wildlife."[13] The section is enforced by the Department of Fish and Wildlife Resources.[14] Violators may be fined not less than $100 nor more than $500, imprisoned for not more than 6 months, or both. Violators are also liable to the Department for the replacement value of the fish and wildlife killed.[15]

• Similarly, the water quality code requires that "where the injury, death, or destruction of fish or other wildlife results from pollution or from any violation of the orders, rules, regulations, or other determinations of the Cabinet, the person responsible shall be liable to the Commonwealth in an amount reasonably necessary to restock or replenish."[16] The Commonwealth may seek civil penalties of up to $1000 plus actual damages in any court of competent jurisdiction.[17]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• In 1998 Kentucky enacted a Forest Conservation Act, which establishes some enforceable mechanisms applicable to commercial timber harvesting practices.[18] The law does not apply to cutting firewood or Christmas trees, to removal of trees incidental to mining and mineral extraction activities, to right-of-way construction or maintenance, or to the cutting of trees by "an individual, nonindustrial landowner on his own property" if the cutting is done by the owner.[19]

The new law requires that after July 15, 2000, no person shall conduct commercial timber harvesting operations within the Commonwealth unless there is a certified "master logger" on site who has completed the required educational and training requirements (including continuing education every three years).[20]

Such timber harvesting operations must use "appropriate best management practices" which are defined as "effective practical, economical structural, or nonstructural methods that prevent or reduce the movement of sediment, nutrients, pesticides, and other pollutants from the land to surface or groundwater, or that otherwise protect water quality from potential adverse effects of timber harvesting operations."[21] Best management practices are to be defined by the Division of Forestry and approved by the Agriculture Water Quality Authority (see below), and are to be reviewed by a newly created Forestry Best Management Practices Board, which is to be convened by July 15, 1999 and given one year to review such BMPs. The Board is to review the BMPs not more often than every five years thereafter.[22]

In addition, "no logger or operator shall conduct any timber operation in a manner that is causing or will likely cause water pollution."[23]

If the Commonwealth's Natural Resources and Environmental Protection cabinet determines that a logger or operator is failing to use the appropriate best management practices or is causing water pollution, it must give the operator a written warning and prescribe "a reasonable period for abatement and compliance." If the logger or operator fails to comply after the time specified for abatement, the logger or operator will then be provided "an opportunity for an informal conference with the district forester." If, after this opportunity, the logger or operator has failed to comply, then the cabinet must issue a notice of violation and order the implementation of corrective measures "within a specified period of time." If, after the notice, the logger or operator fails to comply, then the cabinet must issue a "special order" mandating the immediate implementation of the corrective measures, and may order cessation of all or a portion of the timber harvesting operation. This special order is reviewable in an administrative hearing, to be held within 5 working days of receipt of a request for hearing.[24] However, notwithstanding the previous provisions, if the cabinet finds that the logger or operator is conducting timber harvesting without a master logger or in a manner "that is causing or is likely to cause water pollution that is presenting or will likely present an imminent and substantial danger" to public health, safety or welfare, or to the health of animals, fish or aquatic life, or to a public water supply or other beneficial uses of water, the cabinet may issue an emergency order requiring immediate cessation of the activity and implementation of corrective measures within a reasonable time; this order, too, is subject to hearing within 5 working days.[25] If the logger or operator fails to comply with a special order or emergency order, he or she is deemed a "bad actor" and is subject to civil penalties of up to $1,000, assessable after an opportunity for administrative hearing, and recoverable in court.[26]

• The Agriculture Water Quality Act,[27] discussed below, establishes enforceable best management practices (BMPs) that apply to farm operations of ten or more acres, including silviculture conducted on such operations. This law can reach some non-industrial private timber harvesting activities not subject to the Forest Conservation Act.

Agriculture Requirements

• The Agriculture Water Quality Act[28] created Kentucky's Agriculture Water Quality Authority, which shall "evaluate the adoption and effectiveness of best management practices for agriculture operations," and develop "statewide agriculture water quality plans to address identifiable water pollution problems from agriculture operations."[29] The plans establish applicable requirements to be used by agriculture operations, defined as "any farm operation on a tract of land ... situated on ten (10) contiguous acres or more of land used for the production of livestock, livestock products, poultry, poultry products, milk, milk products, or silviculture products, or for the growing of crops such as, but not limited to, tobacco, corn, soybeans, small grains, fruit and vegetables; or devoted to and meeting the requirements and qualifications for payments to agriculture programs under an agreement with the state or federal government."[30]

Within five years of approval of the statewide plan, persons engaged in agriculture operations across the state are required to implement its applicable requirements.[31] It is a violation to conduct or allow the conduct of any agriculture operation in a manner which results in water pollution or to fail to implement the provisions of the plan.[32] The Division of Water, working with the Agriculture Water Quality Authority, must designate water priority protection regions where it is documented that agriculture is contributing to water quality pollution problems. In those regions, the Water Quality Authority shall reevaluate the effectiveness of the best management practices in the plan.[33] A person engaging in agriculture operations in a water priority protection region where water pollution has been documented shall be presumed to be in compliance with the Act if the person has implemented the practices required by the plan.[34]

If the Division of Water documents a violation, the Division shall notify the person in writing, setting forth a reasonable period for compliance.[35] If any person engaged in agriculture operations fails or refuses to comply or respond to a written notice on noncompliance with the plan, the person shall be deemed a "bad actor" and subject to enforcement action, as well as loss of eligibility for financial assistance.[36] The Cabinet's Office of Legal Services or the Attorney General shall institute an action for the recovery of any penalties and costs and shall bring an action for injunction.[37] Violation of the statute is punishable by civil penalty not to exceed $1000;[38] compliance with the statewide and any regional agriculture water quality plan is a mitigating factor in determining whether to impose civil penalties.[39]

• A soil conservation district may be created if the Conservation Commission determines that the operation of the district is administratively practicable and feasible, and if there has been a majority vote of landowners in favor of creation.[40] Soil conservation districts are authorized to propose land-use regulations for lands within the soil conservation district whenever the Board of Supervisors of a conservation district determines that uncontrolled soil erosion on some lands within the district is causing damage to other lands.[41] These regulations may be adopted by the Board after a referendum in which at least 90% of the landowners have approved.[42]

Land use regulations may include: 1) requirements for the construction of terraces, terrace outlets, check dams, dikes, ponds, ditches and other structures; 2) requirements for particular methods of cultivation, including contour cultivating, contour furrowing, lister furrowing, sowing, planting, strip cropping, seeding and plants of land to conserve water; 3) specifications of cropping programs and tillage practices; 4) requirements on the retirement of highly erosive areas; and 5) other measures and programs as may assist conservation of soil resources and prevent or control soil erosion.[43]

The Board may file a petition in circuit court to compel observance with the land-use regulations if it determines that nonobservance tends to increase erosion on those lands and is interfering with the prevention or control of erosion on other lands within the district.[44] The board may provide by ordinance that any landowner who sustains damages from a land-use violation may recover from the violator.[45] The court may require the violator to perform the work or, if the violator fails to do so within the time specified, the board may perform the work and recover costs and expenses with interest of 5% per annum.[46]

• The pesticide law establishes licensing requirements, and states that the Department of Agriculture may "restrict or prohibit the use of pesticides in designated areas during specified times and the storage of fertilizer ... to prevent damage or injury by drift or misapplication to ... fish and other aquatic life in waters in reasonable proximity to the area to be treated."[47] Further, "no person shall discard or store any pesticide or pest containers so as to pollute any waterway in a way harmful to any wildlife therein."[48] Individual farmers are not subject to any liability or response costs unless there is a finding of negligence.[49]

A notice of violation is issued to the licensee for violation of the statute or regulations.[50] If the violation is not abated, the Agriculture Commissioner must issue an order for immediate compliance and may assess civil penalties. If the order is not complied with, the applicator's license may be revoked, with an opportunity to appeal to circuit court.[51] Civil penalties may be recovered in an action brought by the Attorney General or the Department of Agriculture; the Attorney General also may bring an action for injunction for violation of the act, or a violation or threat of violation of an order.[52] Violations of the act or an order are punishable by a civil penalty not to exceed $1000 per day; failure to abate is punishable by a civil penalty of not less than $100; and willful violation of the act or an order is a misdemeanor punishable by a fine of not less than $100 and up to $1000, imprisonment for not more than one year, or both.[53]

Development and Other Earth-Disturbing Activities

Apart from any programs for the control of urban stormwater or that may be authorized by general land use regulation such as zoning, Kentucky law provides the following enforceable authorities potentially relevant to nonpoint source discharges.

• "No person shall commence the filling of any area with earth, debris ... or place a building, barrier or obstruction of any sort on any area located adjacent to a river or stream or in the floodway of the stream so that such filling, raising or obstruction will in any way affect the flow of water in the channel or in the floodway of the stream" unless a permit has been issued by the Natural Resources and Environmental Protection Cabinet.[54] However, the Cabinet has no jurisdiction or control over the construction, improvement, maintenance or operation of any drainage district, ditch or system established for agricultural purposes, nor can it require approval of the same, except where it determines the obstruction of the stream or floodway is a detriment or hindrance to the beneficial use of water resources in the area.[55]

If this provision or a regulation has been violated, the Cabinet may issue a written notice of violation and require the person to answer the charges at a hearing not less than 30 day from the notice. Appeals may be taken from all final orders of the Cabinet by filing a petition for review in Circuit Court.[56] The Cabinet's Department of Law or the Attorney General may bring an action for the recovery of penalties and bring an action for an injunction to prevent or correct a condition constituting or threatening to constitute a violation of the chapter.[57] Violators are subject to a civil penalty of not more than $1000 and may be enjoined from continuing.[58]

• Streams that meet certain criteria are eligible for inclusion in the Wild Rivers System.[59] Criteria for inclusion include streams that are free-flowing, with unchanged shorelines and scenic vistas; their waters "shall not be polluted beyond feasible correction and shall be kept unpolluted once corrected according to standards established by the natural resources and environmental protection cabinet."[60] Land use restrictions for wild rivers include prohibitions on dredging and strip mining. Select cutting or timber or other resource removal and agricultural use may be allowed by permit only pursuant to regulation.[61] The restrictions on land uses do not apply to uses already existing at the time the stream is included in the system,[62] and the law also states that existing agricultural areas in the boundaries may continue.[63] The Attorney General shall bring an action to recover civil penalties or for an injunction to prevent or correct a condition that is or threatens to violate the provisions of the law.[64]

Endnotes

1. Ky. Rev. Stat. § 224.70-110.
2. Ky. Rev. Stat. § 224.99-020.
3. Ky. Rev. Stat. § 224.99-010(1).
4. Ky. Rev. Stat. § 224.99-010(4).
5. Ky. Rev. Stat. § 224.120(10).
6. Ky. Rev. Stat. §§ 411.500 to .570.
7. Ky. Rev. Stat. § 413.072.
8. Ky. Rev. Stat. § 413.072.
9. Ky. Rev. Stat. § 438.060.
10. Ky. Rev. Stat. § 512.070.
11. Ky. Rev. Stat. § 512.010(1).
12. Ky. Rev. Stat. § 150.460(1).
13. Ky. Rev. Stat. § 150.460(3).
14. Ky. Rev. Stat. § 150.021.
15. Ky. Rev. Stat. § 150.990.
16. Ky. Rev. Stat. § 224.01-070.
17. Ky. Rev. Stat. § 224.01-070.
18. S.B. 214 (1998), to be codified at Ky. Rev. Stat. Ch. 149.
19. SB. 214 § 1(8).
20. S.B. 214 § 7.
21. S.B. 214 §§ 8(1), 1(1).
22. S.B. 214 § 11.
23. S.B. 214 § 8(2).
24. S.B. 214 § 8(3)-(5).
25. S.B. 214 § 8(6).
26. S.B. 214 §§ 8(8), 9, 10.
27. Ky. Rev. Stat. §§ 224.71-100 et seq.
28. Ky. Rev. Stat. §§ 224.71-100 et seq.
29. Ky. Rev. Stat. § 224.71-110(4)(c), (d).
30. Ky. Rev. Stat. § 224.71-100(1).
31. Ky. Rev. Stat. § 224.71-120(3).
32. Ky. Rev. Stat. § 224.71-130(1).
33. Ky. Rev. Stat. § 224.71-120(3).
34. Ky. Rev. Stat. § 224.71-120(9).
35. Ky. Rev. Stat. § 224.71-130(1).
36. Ky. Rev. Stat. §§ 224.71-130(2), 224.71-100(2).

[37] Ky. Rev. Stat. § 224.99-020.
[38] Ky. Rev. Stat. § 224.99-010(8).
[39] Ky. Rev. Stat. §§ 224.71-130(3).
[40] Ky. Rev. Stat. § 262.140.
[41] Ky. Rev. Stat. § 262.350.
[42] Ky. Rev. Stat. §§ 262.360, .390.
[43] Ky. Rev. Stat. § 262.350.
[44] Ky. Rev. Stat. § 262.430.
[45] Ky. Rev. Stat. § 262.430.
[46] Ky. Rev. Stat. § 262.440.
[47] Ky. Rev. Stat. § 217B.050.
[48] Ky. Rev. Stat. § 217B.190.
[49] Ky. Rev. Stat. § 217B.195.
[50] Ky. Rev. Stat. § 217B.193.
[51] Ky. Rev. Stat. § 217B.200.
[52] Ky. Rev. Stat. § 217B.990.
[53] Ky. Rev. Stat. § 217B.990.
[54] Ky. Rev. Stat. § 151.250(2).
[55] Ky. Rev. Stat. § 151.250(3).
[56] Ky. Rev. Stat. §§ 151.182 to .186.
[57] Ky. Rev. Stat. § 151.460.
[58] Ky. Rev. Stat. § 151.990.
[59] Ky. Rev. Stat. §§ 146.200 to .360.
[60] Ky. Rev. Stat. § 146.230.
[61] Ky. Rev. Stat. § 146.290.
[62] Ky. Rev. Stat. § 146.290(1).
[63] Ky. Rev. Stat. § 146.290(2).
[64] Ky. Rev. Stat. §§ 146.350, .990.

LOUISIANA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Louisiana's water pollution control law includes some provisions that may be used to take enforcement action against nonpoint source discharges that are not permitted or that pollute the waters, but the provisions do not apply to unintentional nonpoint source discharges from agriculture. Agricultural or silvicultural nonpoint sources do not require permits, and are not subject to enforcement under the unpermitted discharge provisions.

• The Louisiana Environmental Quality Act prohibits any person from conducting an activity "which results in the discharge of any substance into the waters of the state without the appropriate permit, variance, or license..."[1]

• The statute also prohibits any person from discharging "any waste or any other substance of any kind that will tend to cause water pollution in violation of any rule, order or regulation" or "any substance" that violates the terms or conditions imposed by a permit.[2]

Neither of these provisions is applicable to "unintentional nonpoint source discharge resulting from or in connection with the production of raw agricultural, horticultural, or aquacultural products."[3] The Louisiana regulations also exclude from the permitting requirement "introduction of pollutants from nonpoint sources resulting from normal agricultural and silvicultural activities."[4]

A civil enforcement action may be brought by the Department of Environmental Quality ("DEQ"). Where a violation is determined to have occurred, the court may assess costs or where the violation is on-going, the Secretary may issue a cease and desist order. The violator may be subject to civil penalties of not more than $25,000 for each day of violation where the substance does not endanger human life or health and where the substance does endanger human life or health, then a person may be liable for not more than one million dollars.[5]

Other Discharge Limitations

• Louisiana has a general nuisance statute[6] which may apply to some forms of nonpoint source pollution. Louisiana's Right to Farm statute prohibits any agricultural operation from being deemed a public or private nuisance if it is conducted "in accordance with generally accepted agricultural practices" and the person bringing the action acquired the interest in the affected land after the date the operation was established or the operation was established prior to any change in character of the property in the vicinity of the operation.[7] Illegal acts or actions based on negligence or intentional injury are exempt from this prohibition.[8]

Fish/Fisheries Laws

• "A person who [unlawfully] kills ...takes ...or injures any fish, wild birds, wild quadrupeds, and other wildlife and aquatic life...is liable to the state for the value of each..."[9] Civil penalties, civil suits for recovery of value, fines, and criminal prosecution are permissible.[10]

• Louisiana law that provides for regional watershed districts (see Development and Other Earth-Disturbing Activities section) prohibits any person from knowingly or willingly draining from any pumps, reservoirs, wells, or oil fields into any stream or watershed "any oil...noxious or poisonous gases or substances which would render the water unfit for irrigation purposes or would destroy aquatic and fish life in the stream." Each day substances flow into the watershed waters constitutes a separate offense. Sanctions include fines of $100-200 or imprisonment of three months or less.[11]

OPERATIONAL REQUIREMENTS

Forestry Requirements

Louisiana law has few enforceable provisions relating to forestry operations that may be relevant to nonpoint source requirements.

• Louisiana law provides that any person who cuts standing cypress trees on water bottoms owned by the state of Louisiana, except in the exercise of rights under a state lease, right-of-way, or permit, is subject to a fine (up to $5000) and/or imprisonment (up to six months).[12]

• The Louisiana Natural and Scenic Rivers Act allows the agency to regulate pollution of waters and provides for civil penalties of up to $1000 per day for each violation.[13] The Act also prohibits commercial harvesting of timber within 100 feet of the low water mark, with exceptions including selective harvesting of trees, cutting to control disease or insects, and harvesting timber for personal use by the person who owns or leases the property.[14]

Agriculture Requirements

• Conservation district supervisors may formulate regulations governing the use of lands within the district in the interest of conserving soil and soil resources and preventing and controlling soil erosion.[15] The regulations to be adopted may include specifications of cropping programs and tillage practices; provisions requiring terminating cultivation in highly erosive areas; and provisions to assist in the conservation of soil resources and prevent or control soil erosion in the district.[16] The regulations require approval by at least 2/3 of the landowners in the district in order to be effective and enforceable.[17]

• Louisiana law requires certification of private applicators of restricted use pesticides, commercial pesticide applicators and pesticide salespersons, licenses for pesticide dealers, and both licenses and certifications for all commercial agricultural consultants.[18] For violations, the commissioner may assess civil penalties, suspend or revoke a license or certificate or institute civil proceedings to enforce his rulings or seek injunctive relief.[19] When the commissioner of agriculture ("commissioner") determines that the concentrations of pesticides exceed promulgated federal or state standards or pose a threat to human health or the environment, the commissioner may take appropriate action.[20] The commissioner is empowered to issue a stop order "prohibiting the distribution, sale, offer for sale, application, movement or disturbance of the pesticide, pesticide wastes or contaminated agricultural commodities or material."[21] Upon determining that the pesticide concentrations exceed government standards, the commissioner may also issue protective orders to limit restrict or prohibit application of a pesticide; issue a remedial order directing any responsible person to take prompt action to correct any situation causing any waters of the state to be affected; communicate his determination to any appropriate agency; and/or issue a public communication.[22] The commissioner may seek and obtain injunctive relief to prevent violation of the above orders, and he may impose civil penalties not to exceed $25,000 per offense pursuant to an adjudicatory hearing. Each day is considered a separate offense.[23]

• Discharges from concentrated animal feeding operations are subject to the LWDPS permit program, which is similar to federal NPDES regulation of these entities as point sources.[24] A concentrated animal feeding operation is designated as such on a case-by-case basis upon determining that it is a "significant contributor of pollution to the waters of the state," based on such factors as the size and location of the operation, the amount of wastes reaching the state waters, and the means of conveyance of animal wastes and process waste waters into the waters of the state.[25]

Development and Other Earth-Disturbing Activities

Louisiana has several potentially applicable enforceable provisions in addition to any that may be contained in urban stormwater programs under the Clean Water Act or that may be authorized by general land use regulation.

• Louisiana law allows parishes to create environmental protection districts "to insure the prudent development of the land areas adjacent to and bordering the Mississippi River..." The powers of the board of commissioners of such a district include establishing and maintaining a master plan for the subdivision and development of those lands and preserving the natural environment of the lands along the river through the restriction of land usage.[26] Penalties include a $5000 fine and imprisonment for not more than 30 days for each day of the violation.[27]

• Louisiana law provides for regional watershed districts in which the board of commissioners may make and enforce rules that prevent damage to the district by solid or liquid pollution or substance or misuse of the waters of the district or any water course therein.[28]

• "No industrial wastes...nor any noxious or harmful matter, solid, liquid or gaseous, shall be discharged into the side or cross ditches or placed upon the state highways without the prior written consent of the chief engineer...and the secretary of the department of health and hospitals.[29]

• Coastal use permits are required for a variety of enumerated uses and activities, but this law excludes activity occurring wholly on lands five feet above mean sea level or activities occurring within fast lands, except for an activity that is found to have "direct and significant impact on coastal waters." Also excluded are agricultural, forestry and aquaculture activities on lands consistently used in the past for such activities.[30] Enforcement actions include injunctive, declaratory or other relief brought by the state (secretary or attorney general), district attorney or local government. The Secretary and local government with approved program have the authority to suspend, revoke, or modify coastal use permits. Sanctions include civil liability, damages, fines and/or imprisonment, and the Secretary may assess costs and administrative penalties.[31]

• Also see the Louisiana Natural and Scenic Rivers Act allowing the agency to regulate pollution of waters[32] (described above under the forestry requirements section).

Endnotes

1 30 LRS 2075.
2 30 LRS 2076(A)(1).
3 30 LRS 2076(A)(2).
4 33 LAC Pt. IX, Sec. 301(D).
5 30 LRS 2025.
6 Civil Code Article 669; 40 LRS 14.
7 3 LRS 3603.
8 3 LRS 3606.
9 56 LRS 40.1.
10 56 LRS 40.3-.8.
11 38 LRS 3087.9(B).
12 3 LRS 4278.1(F).
13 56 LRS 1850, 1851.
14 56 LRS 1854.
15 3 LRS 1209.
16 3 LRS 1209 (c), (d), & (e).
17 3 LRS 1209.
18 3 LRS 3241-46.
19 3 LRS 3252.
20 3 LRS 3306(A).
21 3 LRS 3205(A).
22 3 LRS 3308.
23 3 LRS 3309.
24 33 LAC Pt. IX, Sec. 301(J)(1).
25 33 LAC Pt. IX, Sec. 301(J)(3)(a).
26 33 LRS 7555.
27 33 LRS 7559(G).
28 38 LRS 3087.8.
29 48 LRS 385.
30 49 LRS 214.34(a).
31 49 LRS 214.35.
32 56 LRS 1850, 1851.

MAINE

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Maine's water pollution control law includes several provisions that may be used to take enforcement action against nonpoint source discharges.

• "No person may directly or indirectly discharge or cause to be discharged any pollutant without first obtaining a license therefor from the department."[1] "Discharge" means "any spilling, leaking, pumping, pouring, emptying, dumping, disposing or other addition of any pollutant to water of the State." "Pollutant" is broadly defined and includes "rock, sand, dirt and industrial, municipal, domestic, commercial or agricultural wastes of any kind." This prohibition includes nonpoint source discharges. It further provides, however, that "No person may be deemed in violation of this section for the discharge of rock, sand, dirt, or other pollutants resulting from erosion related to agricultural activities [if]... A. The appropriate soil and water conservation district has recommended an erosion and sedimentation control plan or conservation plan for the land where this erosion originates. B. The commissioner has certified that the plan meets the objectives of this chapter. [and] C. The commissioner determines that the agricultural activities are in compliance with the applicable portion of the plan, or the soil and water district has certified that funds from existing federal and state programs are not available to implement the applicable portion of the plan."[2]

• Maine law also prohibits violations of water quality "notwithstanding any exemptions or licenses," but requires establishment of a mixing zone "prior to the commencement of any enforcement action to abate a classification violation."[3]

• A narrower prohibition on discharges or placement of certain materials may apply to some forms of nonpoint source pollution: "No person, firm, corporation or other legal entity may place, deposit or discharge, directly or indirectly into the inland waters or tidal waters of this State, or on the ice thereof, or on the banks thereof in such a manner that it may fall or be washed into these waters, or in such manner that the drainage from any of the following may flow or leach into these waters, except as otherwise provided by law: 1. *Forest products refuse.* Any slabs, edgings, sawdust, shavings, chips, bark or other forest products refuse; 2. *Potatoes.* Any potatoes or any part or parts of potatoes; or 3. *Refuse.* Any scrap metal, junk, paper, garbage, septic tank sludge, rubbish, old automobiles or similar refuse..."[4]

• The law also provides a general injunctive remedy for water pollution without regard to violations: "If the department finds that the discharge, emission or deposit of any materials into any waters, air or land of this State constitutes a substantial and immediate danger to the health, safety or general welfare of any person, persons or property the department shall forthwith request the Attorney General to initiate immediate injunction proceedings to prevent such discharge. The injunction proceedings may be instituted without recourse to the issuance of an [administrative] order."[5]

Enforcement mechanisms under the water pollution law include administrative consent orders and civil injunctive remedies,[6] and civil penalties of up to $10,000 per day.[7] Criminal violations are Class E crimes with a fine of not less than $100 nor more than $25,000 per day of violation.[8]

Other Discharge Limitations

• The Attorney General has broad authority to bring actions in court to abate nuisances. This authority is not limited either by the existence of licenses or by provisions of the water pollution control law.[9]

• Statutory nuisances specifically include "causing or suffering any offal, filth or noisome substance to collect or to remain in any place to the prejudice of others;....corrupting or rendering unwholesome or impure the water of a river, stream, pond, or aquifer."[10]

• "A farm or farm operation may not be considered a public or private nuisance if the farm or farm operation alleged to be a nuisance conforms to best management practices, as determined by the Commissioner of Agriculture, Food and Rural Resources..."[11] However, "The commissioner shall investigate all complaints involving a farm or farm operation, including, but not limited to, complaints involving the use of waste products, ground and surface water pollution.....If the commissioner identifies the source or sources of the problem, has reason to believe that the source is a nuisance and finds that the nuisance is caused by the use of *other than best management practices,* the commissioner shall...determine the changes needed in the farm or farm operation to comply with best management practices and prescribe site specific best management practices for that farm operation,"[determine whether the changes are implemented, and make written findings]...If the person responsible for the farm or farm operation does not adopt best management practices, the commissioner shall send a written report to an appropriate agency if a federal or state law has been violated and to the Attorney General. The Attorney General may institute an action to abate a nuisance and the court may order the abatement with costs..."[12]

• A "nuisance caused by the use of other than best practices for manure handling" is also abatable upon suit by the Attorney General, upon referral from the Commissioner of Agriculture, Food, and Rural Resources.[13]

Fish/Fisheries Laws

State laws relating to fish and fisheries do not appear to contain enforceable provisions relating to nonpoint source discharges independent of those identified above.

OPERATIONAL REQUIREMENTS

Forestry Requirements

• The commissioner of forestry is authorized to promulgate rules establishing forest practices for clearcuts and forest harvests adequate to assure regeneration, and setting performance standards for clearcuts including standards to protect water quality and minimize erosion. Management plans are required for clearcuts in excess of 50 acres.[14] Landowners are required to notify the Bureau of Forestry prior to harvesting timber, and to file reports on timber sales.[15] The law prescribes civil forfeitures of $1,000 per violation of the performance standards in the law and regulations.[16] Violation of notice requirements results in a civil forfeiture of $50 for harvests of 50 cords or less and $1000 for larger harvests or for failure to submit other reports.[17] The commissioner of forestry has been directed by the state legislature to recommend a set of statewide forestry standards in 1999. If adopted, such standards may affect future nonpoint source-related enforcement for forest practices.

• The Land Use Regulation Commission (LURC) provides land use regulation for portions of Maine that are unorganized (see discussion below under "Development and Other Earth-Disturbing Activities). LURC regulations include timber harvesting standards; these include provisions for slash disposal, clearcut size/location, retention of buffer strips, and a general requirement to "reasonably avoid sedimentation of surface waters."[18]

• The mandatory shoreland zoning law protects areas within 250 feet of the normal highwater line of any great pond, river or saltwater body, within 250 feet of a coastal wetland or the upland edge of a freshwater wetland, and within 75 feet of the highwater line of a stream. The Board of Environmental Protection adopts minimum guidelines for municipal zoning and land use controls; municipalities must adopt ordinances and have them approved by the commissioner as consistent with and no less stringent than the guidelines. If a municipality does not adopt an approvable ordinance, the board may do so.[19] The statute limits timber harvesting in the protected areas to selective cutting of no more than 40 percent of the trees 4 inches or more in diameter in any ten-year period, prohibits timber harvests within 75 foot areas abutting great pond shoreland zoned for resource protection, and requires reforestation within 2 growing seasons of any harvest beyond the 75 foot buffer.[20]

Agriculture Requirements

Apart from the nuisance-related provisions and water pollution discharge provisions noted above -- where use of best management practices and conservation plans, respectively, constitute exemptions -- other provisions of state law relate to agricultural practices that may result in nonpoint source discharges.

• "When the ground is frozen, a person may not spread manure on agricultural fields within a great pond watershed unless this activity is in accordance with a conservation plan for that land on file with a state soil and water conservation district."[21]

• The Maine Land Use Review Commission rules require all spreading or disposal of manure, in the unorganized areas of the state subject to the commission, to be accomplished in accordance with published guidelines; these rules are enforceable.[22]

• In 1998 the legislature enacted a Nutrient Management Act, which requires farms with more than 50 animal units or that receive 100 or more tons of manure per year to hold and implement a certified nutrient management plan. New farms with more than 300 animal units, or existing farms that expand to more than 300 animal units must hold a livestock operations permit issued by the Maine Department of Agriculture. In addition, beginning December 1, 1999, manure spreading is prohibited between December 1 and March 15 (although the commissioner may issue hardship variances).[23] Failure to develop a nutrient management plan, to implement a nutrient management plan, or to obtain or comply with a permit are offenses punishable by civil forfeiture of up to $1,000 plus $250 per day; winter spreading of manure is punishable by civil forfeiture of up to $1,000 for every day that spreading occurs.[24]

The law also placed a moratorium on new swine feeding operations that confine and feed 500 or more swine, pending a 1998 legislative study on a proposed permit process for large CAFOs. The law also provided for a study by the Maine Department of Agriculture and DEP to evaluate the impact of agriculture on nonpoint source pollution. The study, due January 15, 2001, must evaluate progress in implementing BMPs to exclude livestock from access to streams and lakes for drinking water, evaluation of practices to reduce soil erosion from cropland, and evaluation of BMPs to reduce runoff of nutrients from farmland. The law contemplates, and authorizes the reporting out of legislation to address the findings of the report.[25]

• State law concerning pesticide applications provides for regulation of the places in which pesticides may be used.[26] It provides for certification of commercial applicators and spray contracting firms by the Board of Pesticides Control, and certification of private applicators who intend to use limited or restricted use pesticides; it also provides for establishment of critical areas where pesticide use would "jeopardize endangered species or critical wildlife habitat, present an unreasonable threat to quality of the water supply, be contrary to a master plan for the area where such area is held or managed by an agency of the State or Federal Government, or would otherwise result in unreasonable adverse effects on the public health, welfare or the environment of the area. The designation of a critical area may prohibit pesticide use or may include such limitations on such use as the board deems appropriate..."[27] Civil injunctions, orders, license actions, and criminal prosecutions are available for enforcement.[28] Violations are subject to a civil forfeiture of up to $1500 for a first violation and $4000 for subsequent violations; $500 and $1000 respectively for private applicators.[29]

Development and Other Earth-Disturbing Activities

A number of laws provide enforceable land use mechanisms that may address some nonpoint sources of water pollution. Some of these provide direct authority to regulate nonpoint activities while others cross-reference erosion and sediment control requirements.

• Maine's Site Location of Development Law addresses "development of state or regional significance that may substantially affect the environment."[30] It includes developments in excess of 20 acres, subdivisions for single family homes of 15 or more lots aggregating more than 30 acres, buildings and parking lots and other paved areas that occupy a ground area in excess of 3 acres, or development that generates 100 or more passenger car equivalents at peak hour. Prior approval for construction, operation, sale, or lease is required from department of environmental protection.[31] The proposed development must stormwater and erosion and sediment control standards in laws discussed below.[32] The law exempts certain subdivisions of low density with conservation easements, preservation of certain areas, avoidance of slopes, habitats, and adherence to locally approved erosion control plans.[33] It also exempts development within unorganized areas of the state subject to the jurisdiction of the Maine Land Use Regulation Commission;[34] and exempts from certain requirements developments within designated growth areas under a growth management program.[35]

• Another law provides for land use regulation in the unorganized portions of Maine.[36] The Land Use Regulation Commission (LURC) establishes regulations for protection districts, management districts, and development districts, and reviews structures and subdivisions. A LURC permit is needed to commence construction or operation of a development.[37] Rules require land clearing activities to maintain vegetative buffer zones of 75 feet around any standing body of water <10 acres and 100 feet for any >10 acres, and removal of no more than 40% of the volume of trees 4 inches or more in diameter in any 10 year period in the zone between 100 and 250 feet. Regulations also prescribe standards for drainage ditches and stream crossings, timber harvests, and filling and grading. Within 250 feet of water bodies and wetlands, the maximum size of a filled or graded area on a single parcel is 5,000 square feet, and beyond 250 feet it is 20,000 square feet; these limits also require compliance with the vegetative clearing limits described above. Minimum lot sizes and frontages are prescribed.[38] LURC land use standards for "management districts....may not limit the right, method or manner of cutting or removing timber or crops, the construction and maintenance of hauling roads, the operation of machinery or the erection of buildings and other structures used primarily for agricultural or commercial forest product purposes..."[39]

• Maine's Growth Management Law applies to municipalities not within the jurisdiction of the LURC.[40] Each municipality may adopt a local growth management program; the implementation strategy must be developed in accordance with guidelines including to "Protect, maintain and, when warranted, improve the water quality of each water body...and ensure that the water quality will be protected from long-term and cumulative increases in phosphorous from development in great pond watersheds."[41]

• Another law provides for river corridor commissions to do comprehensive planning and zoning and to adopt rules covering an area "up to 500 feet from the normal high-water mark", and to issue permits subject to reasonable conditions.[42] Under the River Commission law,[43] enforcement by the commission may be by injunction and penalties, as provided in Title 38.[44]

• Maine law authorizes the organization of local watershed districts.[45] Such districts may adopt rules as necessary to carry out the purposes of the district, but have no regulatory powers over land use except by agreement with municipalities.[46]

• Mandatory shoreland zoning provides another enforceable mechanism.[47] It protects areas within 250 feet of the normal highwater line of any great pond, river or saltwater body, within 250 feet of a coastal wetland or the upland edge of a freshwater wetland, and within 75 feet of the highwater line of a stream. The Board of Environmental Protection adopts minimum guidelines for municipal zoning and land use controls; municipalities must adopt ordinances and have them approved by the commissioner as consistent with and no less stringent than the guidelines. If a municipality does not adopt an approvable ordinance, the board may do so. The statute requires setback requirements, limits on timber harvesting, and vegetation buffers between buildings and shoreland.[48] Another section of the law provides further protections for "significant river segements" including minimum setbacks of 125 feet and limitations on roads and gravel pits.[49] Municipalities may zone even more restrictively to protect public health, safety and welfare and to avoid problems associated with floodplain development; zoning ordinances must designate as a resource protection zone all areas within the floodway of the 100 year floodplain along rivers.[50] Local enforcement is by municipal code enforcement officers, with enforcement by the state under the water pollution laws where local zoning is not adopted or enforced.[51] Water utilities may bring civil suits for injunctive relief as well against any violator affecting the water supply.[52]

• The Natural Resource Protection Act prohibits any "dredging, bulldozing, removing, or displacing soil, sand, vegetation or other materials", any "draining or otherwise dewatering", any "filling", or "any construction, repair or alteration of any permanent structure without a permit if the activity is located "in, on or over any protected natural resource or is located adjacent to and operated in such a manner that material or soil may be washed into..a coastal wétland, great pond, river, stream or brook or significant wildlife habitat contained within a freshwater wetland[,or]...freshwater wetlands consisting of or containing [at least 20,000 square feet... or peatlands dominated by shrubs, sedges and sphagnum moss]."[53] Permit standards require that "the activity will not cause unreasonable erosion of soil or sediment...[that it] not unreasonably harm any significant wildlife habitat, freshwater wetland plant habitat, threatened or endangered plant habitat, aquatic habitat, travel corridor, freshwater, estuarine or marine fisheries or other aquatic life....[that it] will not violate any state water quality law...[and] not unreasonably cause or increase the flooding of the alteration area or adjacent properties."[54] The permit program may be delegated by the board of environmental protection to municipalities.[55] The law exempts from permitting requirements various activities including normal farming activities, and forest management provided that other requirements are met.[56] A permit by rule for activities under the Natural Resource Protection Act covers soil disturbances adjacent to wetlands, great ponds, rivers, streams, brooks "if operated in such manner that material or soil may be washed into them." It requires a setback of 25 feet between the normal high water line or upland edge of the protected natural resource and the activity; and erosion into the buffer and the resource "must be prevented" and sediment control measures must be in place before the project begins and must function as intended until the project area is permanently stabilized.[57] Enforcement may be by the municipal government or the department of environmental protection, and both may collect penalties.[58]

Erosion and sediment control requirements are established in several laws identified below. They include some nonpoint source as well as stormwater requirements.

• "A person who conducts, or causes to be conducted, an activity that involves filling, displacing or exposing soil or other earthen materials shall take measures to prevent unreasonable erosion of soil or sediment beyond the project site or into a protected natural resource [viz. "coastal sand dune system, coastal wetlands, significant wildlife habitat, fragile mountain areas, freshwater wetlands, great ponds or rivers, streams or brooks"]"[59] This law applies only within organized areas of the state, and "does not apply to agricultural fields. Forest management activities, including associated road construction or maintenance, conducted in accordance with applicable standards of the Maine Land Use Regulatory Commission, are "deemed" to comply. The law "may not be construed to limit a municipality's authority under home rule to adopt ordinances containing stricter standards than those contained in this section." Erosion control measures must be in place before the activity begins. Measures must remain in place and functional until the site is permanently stabilitized. Adequate and timely temporary and permanent stabilization measures must be taken."

• Maine's stormwater law covers some nonpoint sources as well. "A person may not construct, or cause to be constructed, a project that includes 20,000 square feet or more of impervious area or 5 acres or more of disturbed area in the direct watershed of a body of water most at risk from new development or one acre or more of impervious area or 5 acres or more of disturbed area in any other area without prior approval from the department [of environmental protection]....The department shall adopt rules specifying quantity and quality standards for storm water. Storm water quality standards for projects with 3 acres or less of impervious surface may address phosphorous, nitrates and suspended solids but may not directly address other dissolved or hazardous materials unless infiltration is proposed. Storm water quality standards apply only in the direct watersheds of waterbodies most at risk from development and in sensitive or threatened geographic regions or watersheds defined by the department..." The department is to define both of these categories by rule...based on susceptibility to degradation, sensitivity, cumulative effects.[60] The law applies only within organized areas of the state; a permit required by this law is not required if a permit is required under another similar law, "but the project may be required to meet standards for management of storm water adopted pursuant to this section." Specific exemptions include "forest management activities, including associated road construction or maintenance", disturbing areas "for the purpose of normal farming activities", projects within municipalities where the commissioner has certified the ordinance as meeting or exceeding the state law provisions, industrial facilities that have a federal stormwater permit, construction or expansion of a single-family detached residence, and "projects involving roads, railroads, and associated facilities conducted by or under the supervision of the Department of Transportation or the Maine Turnpike Authority...so long as the projects are constructed pursuant to storm water quality and quantity standards set forth in a memorandum of agreement between the department and the conducting or supervision agency and the project does not require review under [the site location of development program]."

• Another law regulates excavations for borrow, clay, topsoil or silt for areas of 5 or more acres, requiring a notice of intent to comply, and imposing performance standards to protect groundwater, protected natural resources (including surface waters), and buffer strips.[61] Excavations of less than 5 acres have fewer requirements, but sediment may not leave the parcel or enter a protected area, erosion control measures must be in place, and vegetated cover must be established after final grading.[62] This law applies only within organized areas of the state and does not apply to excavations within the jurisdiction of the LURC or to excavations regulated under the Natural Resource Protection Act.

All of these laws are enforceable under the environmental enforcement provisions summarized above under the water pollution control law section of this summary. In addition, those delegated to local land use authorities are enforceable by those authorities.

Endnotes

1. Me. Rev. Stat. Ann. tit. 38, § 413 (West 1989 & Supp. 1997).
2. Me. Rev. Stat. Ann. tit. 38, § 413(2) (West 1989 & Supp. 1997).
3. Me. Rev. Stat. Ann., tit. 38, § 451 (West 1989 & Supp. 1997).
4. Me. Rev. Stat. tit. 38, § 417.
5. Me. Rev. Stat. Ann. tit. 38. § 348.
6. Me. Rev. Stat. Ann. tit. 38, §§ 347-A, 348.
7. Me. Rev. Stat. Ann. tit. 38, § 349.
8. Me. Rev. Stat. Ann. tit. 38, § 349.
9. Me. Rev. Stat. Ann. tit. 17, § 2702 (authority to abate nuisances); tit. 38, § 372 (preserving authority notwithstanding water pollution control laws).
10. Me. Rev. Stat. Ann. tit. 17, § 2802.
11. Me. Rev. Stat. tit. 17, § 2805. The same section also provides that "a method of operation used by a farm or farm operation" may not be considered "a violation of a municipal ordinance if the method of operation constitutes a best management practice as determined by the Department of Agriculture, Food and Rural Resources."
12. Me. Rev. Stat. tit 17, § 2805(5),(6).
13. Me. Rev. Stat. tit. 17, § 2701-B.
14. Me. Rev. Stat. Ann. tit. 12, §§ 8867-8869. These enforceable mechanisms are supplemented by voluntary mechanisms. The Bureau of Forestry "may publish best management practice guidelines for use by landowners and wood harvesters. Landowners and wood harvesters must be notified of these guidelines and assisted in their efforts to implement the guidelines in accordance with the Bureau of Forestry Advisory programs under Title 12, sections 8611 and 8612." Me. Rev. Stat. Ann. tit. 38. § 410-J(2).
15. Me. Rev. Stat. Ann. tit. 12, §§ 8883, 8885; see also 04-058-020 CMR 20.
16. Me. Rev. Stat. Ann. tit. 12, § 9701.
17. Me. Rev. Stat. Ann. tit. 12. § 8887.
18. 04-061 MRC 010.17, A, 5.
19. Me. Rev. Stat. Ann. tit. 38, § 435 et seq.
20. Me. Rev. Stat. Ann. tit. 38, § 439-A.
21. Me. Rev. Stat. Ann. tit. 38, § 417-A.
22. 04-061 MRC 010.17.
23. Me. Rev. Stat. Ann. tit. 7, §§ 4201-4209.

[24] Me. Rev. Stat. Ann. tit. 7, § 4209.
[25] Nutrient Management Act, §§ 9, 10.
[26] Me. Rev. Stat. Ann. tit. 22, § 1471-A et seq.
[27] Me. Rev. Stat. Ann. tit. 22, § 1471-M(4).
[28] Me. Rev. Stat. Ann. tit. 7, §§ 616-A, 612-614; tit. 22, §§ 1471-D, 1471-J. Criminal proceedings are available only after notice and an opportunity for administrative hearing prior to the criminal referral. tit. 7, § 611.
[29] Me. Rev. Stat. Ann. § 7, § 616-A. Intentional or knowing violations are punishable by a fine not to exceed $7500 and/or imprisonment not to exceed 30 days.
[30] Me. Rev. Stat. Ann. tit. 38, § 481 et seq.
[31] Me. Rev. Stat. Ann. tit. 38, § 483-A.
[32] Me. Rev. Stat. Ann. tit. 38, § 484(4-A), referencing §§ 420-D, 420-C.
[33] Me. Rev. Stat. Ann. tit. 38, § 488(5).
[34] Me. Rev. Stat. Ann. tit. 38, § 488(9).
[35] Me. Rev. Stat. Ann. tit. 38, § MRSA 488(14).
[36] Me. Rev. Stat. Ann. tit. 12, § 681 et seq.
[37] Me. Rev. Stat. Ann. tit. 12, § 685-B.
[38] 04-061 MRC 010.17.
[39] Me. Rev. Stat. Ann. tit. 12, § 685-A(5).
[40] Me. Rev. Stat. Ann. tit. 30-A, § 4311 et seq.
[41] Me. Rev. Stat. Ann. tit. 30-A, § 4326(3)(C).
[42] Me. Rev. Stat. Ann. tit. 30-A. § 4467.
[43] Me. Rev. Stat. Ann. tit. 30-A, § 4461 et seq.
[44] Me. Rev. Stat. Ann. tit. 30-A, § 4452 also provides for civil penalties of $100 to $2,500 per day, and abatement. If the economic benefit resulting from the violation exceeds the applicable maximum, the maximum may be increased; the maximum may not exceed twice the economic benefit.
[45] Me. Rev. Stat. Ann. tit. 38, § 2001 et seq.
[46] Me. Rev. Stat. Ann. tit. 38, § 2007(3)(F).
[47] Me. Rev. Stat. Ann. tit. 38, § 435 et seq.
[48] Me. Rev. Stat. Ann. tit. 38. § 439-A.
[49] Me. Rev. Stat. Ann. tit. 38, § 445.
[50] Me. Rev. Stat. Ann. tit. 38, § 440.
[51] Me. Rev. Stat. Ann. tit. 38, § 441, § 443-A(3) "Any municipality which fails to adopt, administer or enforce zoning and land use ordinances as required under this article shall be subject to the enforcement procedures, equitable remedies and civil penalties set forth in sections 347 to 349." In addition, "Any person who orders or conducts any activity in violation of a municipal ordinance adopted under this chapter is penalized in accordance with Title 30-A, section 4452. The Attorney General, the district attorney or municipal officers or their designee may enforce ordinances adopted under this chapter." Me. Rev. Stat. Ann. tit. 38, § 444.
[52] Me. Rev. Stat. Ann. tit. 38, § 444-A.
[53] Me. Rev. Stat. Ann. tit. 38, § 480-A et seq.; § 480-C.
[54] Me. Rev. Stat. Ann. tit. 38, § 480-D.
[55] Me. Rev. Stat. Ann. tit. 38, § 480-F.
[56] Me. Rev. Stat. Ann. tit. 38, § 480-Q.
[57] 06-096 MRC 305.2.
[58] Me. Rev. Stat. Ann. tit. 38, § 480-F(4). Enforcement may also be by Department of Marine Resources officers and all other law enforcement officers. § 480-R.
[59] Me. Rev. Stat. Ann. tit. 38, § 420-C; bracketed language is from cross-reference to § 480-B.
[60] Me. Rev. Stat. Ann. tit. 38, § 420-D.
[61] Me. Rev. Stat. Ann. tit. 38, § 490-A et seq.
[62] 06-096 MRC 378.

MARYLAND

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Maryland's water pollution control law includes some provisions that may be used to take enforcement action against nonpoint source discharges of pollutants; and the state's Department of the Environment may require permits for certain nonpoint source discharges. In addition, soil or sediment pollution is prohibited, except for agricultural activities conducted in accordance with agricultural soil conservation and water quality plans.

• "Except as provided in this subtitle and Subtitle 4 of Title 4 [relating to soil or sediment emissions] of this article and the rules and regulations adopted under those subtitles, a person may not discharge any pollutant into the waters of this State."[1] "Discharge" means: (1) The addition, introduction, leaking, spilling, or emitting of a pollutant into the waters of this State; or (2) The placing of a pollutant in a location where the pollutant is likely to pollute."[2] "Pollutant" means...(2) Any other liquid, gaseous, solid or other substance that will pollute any waters of this State."[3]

• The Maryland Department of the Environment may require nonpoint source dischargers to obtain permits under some circumstances. "A person shall hold a discharge permit issued by the Department before the person may construct, install, modify, extend, alter, or operate any of the following if its operation could cause or increase the discharge of pollutants into the waters of this State:...Any other outlet or establishment."[4] "By rule or regulation, the Department may require a discharge permit for any other activity."[5]

Enforcement of these provisions is by administrative corrective action orders, injunctions, civil penalties not exceeding $10,000 per day (judicially) or $1,000 per day (administratively), or criminal prosecution.[6]

• Except as authorized under the discharge permit provisions described above, or on land managed under an agricultural soil conservation and water quality plan approved by the local soil conservation district, "it is unlawful for any person to add, introduce, leak, spill, or otherwise emit soil or sediment into waters of the State or to place soil or sediment in a condition or location where it is likely to be washed into waters of the State by runoff of precipitation or by any other flowing waters."[7]

Enforcement may be by injunctive relief,[8] or corrective action orders.[9] Civil penalties are available up to $25,000 per day; or criminal penalties of up to $50,000 and/or one year imprisonment.[10] A person engaged in agricultural land management practices without an approved soil conservation and water quality plan is not liable for penalties for a discharge if the person complies with a corrective action order.[11]

Other Discharge Limitations

• The Secretary of the Environment has authority to investigate and bring injunctive actions to abate nuisances, which may include drainage, waste disposal, and other activities affecting public health.[12]

Fish/Fisheries Laws

• "Whenever there occurs in the waters of the State any condition indicative of damage to aquatic resources, including, but not limited to, mortality of fish and other aquatic life, the Department shall investigate the incident, determine the nature and extent of the damage, and establish the cause and source of the occurrence. The Department shall act on these findings and require repair of any damage done and restoration of water resources to a degree necessary to protect the best interest of the people of the State."[13] Any person responsible for the discharge is "personally and/or severally responsible" for abatement and for restoration of the natural resources.[14]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• The Department of Natural Resources "shall administer forest conservation practices on privately owned forest land and manage publicly owned forest lands."[15] The Department *may* promulgate rules and regulations, including minimum forestry practices, and enforce them.[16] These rules may be enforced by district forestry boards.[17] State law also provides for licensing of professional foresters.[18]

• Under the state's Nontidal Wetlands program, "forestry activities required to have an erosion and sediment control plan that are not exempted under subsection (a) of this section shall incorporate nontidal wetlands best management practices..."[19] "The following agricultural and forestry activities are exempt from the approval and mitigation requirements of this section: (1) Agricultural activities undertaken in accordance with public drainage regulations; (2) Agricultural and forestry activities, including the repair and maintenance of farm ponds, drainage ditches, channels, subsurface drains, causeways, bridges, or water control structures, provided that they do not drain, dredge, fill, or convert nontidal wetlands on which agricultural and forestry activities are not presently conducted; (3) Agricultural and forestry activities on areas that have laid fallow as part of a conventional rotational cycle or due to a civil action involving ownership of the property; (4) Agricultural and forestry activities on areas that have been set aside or taken out of production under a formal State or federal program; (5) Forestry activities not requiring an erosion and sediment control plan; (6) Construction or maintenance of forest roads and skid trails in accordance with best management practices..." However,"This subtitle does not apply to agricultural, forestry, or regulated activities located within the Chesapeake Bay critical area" as these activities are separately regulated under that bay protection statute.[20] The regulations include provisions that "... a person conducting a forestry activity shall implement best management practices to protect nontidal wetlands through a sediment and erosion control plan ..."[21] "Best management practices for forestry activities in nontidal wetlands shall be designed to achieve the following goals: (1) Control soil loss and sediment deposition in nontidal wetlands; (2) Minimize water quality degradation caused by sediment..."[22]

• Under the Chesapeake Bay Critical Area Protection Program, "At a minimum, a program sufficient to meet the goals...includes: ...(10) Provisions requiring that all harvesting of timber in the Chesapeake Bay Critical Area be in accordance with plans approved by the district forestry board"[23] (Operation of the Critical Area Program itself is discussed at greater length below under "Development and Other Earth-Disturbing Activities.").

Agriculture Requirements

• Agricultural land managed under a soil conservation and water quality plan approved by the local soil conservation district is not liable for emission of soil or sediment into waters of the State or placement of soil or sediment in a condition or location where it is likely to be washed into waters of the State by runoff of precipitation or by any other flowing waters.[24] A person engaged in agricultural land management practices without an approved soil conservation and water quality plan is not liable for penalties for a discharge if the person complies with a corrective action order.[25]

• A law passed in 1998 requires farmers that use commercial fertilizers to prepare nitrogen and phosphorous management plans by December 31, 2001 and to implement them by December 31, 2002. It requires farmers that use manures and sludges on their fields to have a nitrogen management plan in place and to implement it on the same schedule. Farmers using manure and sludge must also prepare management plans addressing phosphorous by July 1, 2004, and implement them by July 1, 2005. The requirements apply to all agricultural operations with an annual income of at least $2,500, and livestock operations with 8 or more animal units. Farmers who fail to develop a plan may be fined up to $250; those who fail to implement a plan by the required date receive a warning for a first offense and an administrative penalty of up to $100 for each subsequent violation, but not to exceed $2,000. Farmers applying commercial fertilizer inconsistently with nutrient management plans are subject to a penalty of up to $1,000 for a first violation, and up to $2,000 for subsequent violations, but not to exceed a total of $10,000.[26]

• "The General Assembly...finds that agricultural drainage projects, if not properly designed, operated, and maintained, have the potential to contribute nonpoint source pollutants to the waters of the State." The Secretary of Agriculture and the Secretary of Natural Resources "shall jointly promulgate by regulation ... criteria for the design, construction, operation, and maintenance of agricultural drainage projects which will assure, to the maximum extent practicable, the prevention of pollution of the waters of the State." "[B]efore initiating an agricultural drainage project, a public drainage association shall obtain from the Secretary approval of construction, operation, and maintenance plans for the project." "An agricultural drainage project shall be constructed, operated, and maintained in accordance with the approved plans."[27] Either Secretary may issue corrective action orders, enforceable by injunction, and violators are liable for double damages for projects not done in accordance with approved plans.[28]

• Nontidal wetlands requirements are applicable to agriculture. If not exempt from regulation (see forestry above), then an agricultural operation must employ BMPs under a soil conservation district-approved soil conservation and water quality plan to protect nontidal wetlands.[29] "Best management practices for agricultural activities in nontidal wetlands shall be designed to achieve the following goals: (1) Control soil loss and minimize sediment deposition in nontidal wetlands; (2) Minimize water quality degradation..."[30] "This subtitle does not apply to agricultural, forestry, or regulated activities located within the Chesapeake Bay critical area."[31]

• The Secretary of Agriculture "shall [a]dopt rules and regulations governing the storage, sale, distribution, exchange, use, and disposal of any pesticide and its container"[32] Applicators "shall obtain an annual certificate indicating competence in one or more established categories from the Secretary."[33] "When using or recommending pesticides, a person shall: ... Observe all precautions in the handling, use, storage, and disposal of pesticides and their containers so that: (a) Pesticides do not move from the intended site of application, (b) Nontarget areas or organisms, including humans, do not suffer injury, and (c) Unreasonable adverse effects on the environment do not occur or are minimized..."[34] Violations are misdemeanors punishable by fines not exceeding $1,000, or imprisonment not exceeding 60 days, or both.[35] "The Department may issue a civil penalty or suspend, revoke, or deny any license, certificate, or permit" for violations of the law or regulations,[36] or impose a civil penalty of "not more than $2,500 for a first violation and not more than $5,000 for each subsequent violation. The total penalties imposed on a person for violations that result from the same set of facts and circumstances may not exceed $25,000."[37]

• Under the Chesapeake Bay Critical Area Protection Program "At a minimum, a program sufficient to meet the goals ... includes: ... Establishment of buffer areas along shorelines within which agriculture will be permitted only if best management practices are used, provided that structures or any other use of land which is necessary for adjacent agriculture shall also be permitted in any buffer area."[38]

Development and Other Earth-Disturbing Activities

Apart from any programs that may be authorized by general land use regulation such as zoning, state law provides the following authorities.

• Each local jurisdiction is responsible for developing and implementing a program, subject to review and approval by the Chesapeake Bay Critical Area Commission. A program "shall consist of those elements which are necessary or appropriate: (1) to minimize adverse impacts on water quality that result from pollutants that are discharged from structures or conveyances or that have run off from surrounding lands."[39] Under the Chesapeake Bay Critical Area Protection Program "At a minimum, a program sufficient to meet the goals ... includes: ... Provisions to limit the amount of land covered by buildings, roads, parking lots, or other impervious surfaces, and to require or encourage cluster development."[40] Project approval may not be granted unless the project is consistent with and complies with the program.[41] Injunctive relief is available for enforcement.[42]

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• The state nontidal wetlands program provides that the Department of Natural Resources shall "Adopt standards for planning, regulating, restoring, creating, and enhancing nontidal wetlands"[43] and that the Department may "delegate all or part of its authority under this subtitle to any county that enacts a nontidal wetland protection program ... that meets at least the minimum standards adopted by the Department."[44] "[A] person may not conduct a regulated activity without first obtaining a permit from the Department."[45] A permit may not be issued unless the Department finds that the applicant has demonstrated that the regulated activity "will minimize alteration or impairment of the nontidal wetland, including existing topography, vegetation, fish and wildlife resources, and hydrological conditions; [and w]ill not cause or contribute to a degradation of groundwaters or surface waters ..."[46] Enforcement is via permit revocation, stop work orders, civil penalties of up to $10,000 per day, injunction, and misdemeanor fines of up to $10,000 for a first offense, and $25,000 for subsequent offenses.[47]

• "To protect the natural resources of the State, the Secretary of the Environment, in consultation with the Secretary of Natural Resources shall adopt criteria and procedures for the counties and the local soil conservation districts to implement soil erosion control programs. These procedures may provide for departmental review and approval of major grading, sediment, and erosion control plans."[48] "Regardless of planning, zoning, or subdivision controls, a county or municipality may not issue a permit for grading or construction of any building, other than those matters exempted by the provisions of this section, unless the grading or construction conforms with plans approved as provided in this subtitle."[49] "A grading or building permit may not be issued until the developer (1) submits a grading and sediment control plan approved by the appropriate soil conservation district, and (2) certifies that all land clearing, construction, and development will be done under the plan."[50] "A person may not begin or perform any construction unless the person: (I) Obtains an approved sediment control plan; (ii) Implements the measures contained in the approved sediment control plan; (iii) Conducts the construction as specified in the sequence of construction contained in the approved sediment control plan; (iv) Maintains the provisions of the approved sediment control plan; and (v) Implements any sediment control measures reasonably necessary to control sediment runoff."[51] "The provisions of this subtitle do not apply to agricultural land management practices, construction of agricultural structures, or, except in Calvert County, to construction of single-family residences or their accessory buildings that disturb an area of less than one-half acre and occur on lots of two acres or more."[52] Enforcement includes stop work orders, corrective action orders, injunctions, civil penalties of up to $1,000 per violation, not exceeding $20,000 for any action, and misdemeanor fines of up to $5,000 and/or one year imprisonment.[53]

• The state also has an enforceable forest conservation program with respect to land development. "A unit of local government having planning and zoning authority shall develop a local forest conservation program, consistent with the intent, requirements and standards of this subtitle."[54] "Before the approval of the final subdivision plan, or the issuance of the grading or sediment control permit by the State or local authority, the applicant shall have an approved forest conservation plan..."[55] The forest conservation subtitle applies "to any public or private subdivision plan or application for a grading or sediment control permit on areas 40,000 square feet or greater;" it does not apply to construction of highways, forest cutting in areas governed by the Chesapeake Bay Critical Area Protection Law, and agricultural activity that does not result in a change in land use category.[56] Enforcement includes a penalty of 30 cents per square foot of the area found to be in noncompliance,[57] plan revocation,[58] a stop work order by the state or local authority, injunctive relief, and civil penalty of up to $1,000 per day.[59]

Endnotes

1. Md. Code Ann., Envir., section 9-322
2. Md. Code Ann., Envir., § 9-101(b).
3. Md. Code Ann., Envir., § 9-101(g).
4. Md. Code Ann., Envir., § 9-323(a)(3).
5. Md. Code Ann., Envir., § 9-323(b).
6. Md. Code Ann., Envir. §§ 9-334, 9-335, 9-338, 9-339, 9-342, 9-343.
7. Md. Code Ann., Envir. § 4-413(a).
8. Md. Code Ann., Envir. §§ 4-405, 4-415, 4-416.
9. Md. Code Ann., Envir., § 4-412(a), § 4-415.
10. Md. Code Ann., Envir. § 4-417.
11. Md. Code Ann., Envir. § 4-413(b).
12. Md. Code Ann., Envir. §§ 10-101 to 10-105.
13. Md. Code Ann., Envir., § 4-405(c).
14. Md. Code Ann., Envir., § 4-405(c).
15. Md. Code Ann., Nat. Res. § 5-603.
16. Md. Code Ann., Nat. Res. § 5-604.
17. Md. Code Ann., Nat. Res. § 5-606.
18. Md. Code Ann., Business Occupations and Professions § 7-101.
19. Md. Code Ann., Nat. Res., § 8-1205 (Nontidal Wetlands).
20. Md. Code Ann., Nat. Res. § 8-1203(a)(2).
21. COMAR § 26.23.05.02(A) (Nontidal Wetlands: Forestry Activities).
22. COMAR § 26.23.05.02(C)(Nontidal Wetlands: Forestry Activities).
23. Md. Code Ann., Nat. Res., § 8-1808(c).
24. Md. Code Ann., Envir. § 4-413(a).
25. Md. Code Ann., Envir. § 4-413(b).
26. Md. Sen. Bill 178/House Bill 599.
27. Md. Code Ann., Agriculture, § 8-603(b)-(e).
28. Md. Code Ann., Agriculture § 8-603(f)-(h).
29. Md. Code Ann., Nat. Res. § 8-1205.
30. COMAR § 26.23.05.01(D) (Nontidal Wetlands: Agricultural Activities).
31. Md. Code Ann., Nat. Res. § 8-1203(a)(2).
32. Md. Code Ann., Agriculture, § 5-204(1).
33. Md. Code Ann., Agriculture, § 5-207(a).
34. COMAR § 15.05.01.02(B)(3).
35. Md. Code Ann., Agriculture, § 5-211(a).
36. COMAR § 15.05.01.18(A).
37. COMAR § 15.05.01.20(A).
38. Md. Code Ann., Nat., Res., § 8-1808(c)(6).
39. Md. Code Ann., Nat. Res. § 8-1808(b).
40. Md. Code Ann., Nat. Res., § 8-1808(c)(5).
41. Md. Code Ann., Nat. Res. § 8-1811.
42. Md. Code Ann., Nat. Res. § 8-1815.
43. Md. Code Ann., Nat. Res., §§ 8-1203(b)(7).
44. Md. Code Ann., Nat. Res., § 8-1204.

[45] Md. Code Ann., Nat. Res., § 8-1206(b)(1).
[46] Md. Code Ann., Nat. Res., § 8-1207(a)(2),(3).
[47] Md. Code Ann., Nat. Res. § 8-1210.
[48] Md. Code Ann., Envir., § 4-101.
[49] Md. Code Ann., Envir., § 4-102.
[50] Md. Code Ann., Envir., § 4-103(a).
[51] Md. Code Ann., Envir. § 4-105(a)(3).
[52] Md. Code Ann., Envir., § 4-102.
[53] Md. Code Ann., Envir. §§ 4-103, 4-110, 4-113, 4-116.
[54] Md. Code Ann., Nat. Res., § 5-1603(a)(1).
[55] Md. Code Ann., Nat. Res., § 5-1608(b).
[56] Md. Code Ann., Nat. Res., § 5-1602.
[57] Md. Code Ann., Nat. Res., § 5-1608(c).
[58] Md. Code Ann., Nat. Res., § 5-1612(b).
[59] Md. Code Ann., Nat. Res., § 5-1612(c), (d).

MASSACHUSETTS

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Massachusetts prohibits the discharge of a pollutant from any source, not just point sources, without a permit; but agricultural and silvicultural nonpoint source discharges are exempt from the permit requirement by regulation.

• "Any person who, directly or indirectly, throws, drains, runs, discharges or allows the discharge of any pollutant into waters of the commonwealth, except in conformity with a permit...shall be punished by a fine...or by imprisonment...or shall be subject to a civil penalty not to exceed twenty-five thousand dollars per day of such violation."[1] "Pollutant" is defined as "any element or property of sewage, agricultural, industrial or commercial waste, runoff, leachate, heated effluent, or other matter, in whatever form and whether originating at a point or major nonpoint source..."[2] The definition in the regulations lacks the word "major" preceding "nonpoint source."[3]

• Another section of the law prohibits the discharge of "pollutants" without a permit, and provides that "[n]o person shall engage in any other activity that may reasonably be expected to result, directly or indirectly, in discharge of pollutants into waters of the commonwealth" without a permit "unless exempted by regulation of the director."[4]

The regulations exempt from permit requirements "[a]ny introduction of pollutants from non-point source agricultural and silvicultural activities, including runoff from orchards, cultivated crops, pastures, range lands, and forest lands."[5] Massachusetts may be able to directly enforce its surface water quality standards with respect to these activities.[6]

Enforcement mechanisms, in addition to civil penalties, include orders and injunctive relief.[7]

Other Discharge Limitations

• "Whoever places, throws, deposits, discharges, or causes to be placed, thrown, deposited or discharged, any trash, bottles or cans, refuse, rubbish, garbage, debris, scrap, waste or any other material of any kind . . . in or upon coastal or inland waters . . . or within twenty yards of any such water . . . shall be punished by a fine" and may be required to remove the material.[8]

• "No sewage, drainage, refuse or polluting matter, of such kind and amount as either by itself or in connection with other matter will corrupt or impair the quality of the water of any pond or stream used as a source of ice or water supply by a town, public institution or water company for domestic use, or render it injurious to

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health...shall be discharged into any such stream or pond, or upon their banks if any filter basin so used is there situated, or into any feeders of such pond or stream within twenty miles above the point where such supply is taken."[9]

• A similar provision provides for the abatement of situations where "manure, excrement, garbage, sewage or any other matter pollutes or tends to pollute the waters of any stream, pond, spring, underground waters, or watercourse used by [a] city, town, institution or company as a source of water supply."[10] Failure to obey an order to abate the pollution is punishable by a fine, imprisonment, or civil penalty of up to $25,000 per day.[11] Willful defilement of water supplies is defined as a criminal offense.[12]

• Several prohibitions apply to nonpoint source discharges in particular managed public water supply watersheds. One provides that "no person shall take or divert any water of the watershed system of the division [of watershed management], and no person shall corrupt, render impure, waste or improperly use any such water."[13] Within these designated watersheds, the alteration of land or the "generation, storage, disposal, or discharge of pollutants" is prohibited within 200 feet of the bank of a tributary or surface water, or within 400 feet of the bank of a reservoir. The law specifically prohibits in these areas outdoor storage of fertilizers, herbicides, pesticides, road salt, uncovered storage of manure, rendering more than ten percent (or 2500 sq. ft.) of any lot impervious, altering vegetated wetlands, or "any other activity which could degrade the quality of the water in the watersheds."[14] This section does not apply to "activities relating to the normal maintenance or improvement of land in agricultural use...provided, however, that such activities do not impair the quality of the water."[15] Enforcement includes fines.[16]

• The attorney general also has general authority to prevent or remedy damage to the environment, including water pollution, and may enforce any statute, ordinance, bylaw or regulation or secure any common law right or remedy, including the abatement of public nuisances.[17] Local boards of health have power, like the department of environmental protection, to enforce certain state environmental laws dealing with on-lot sewage disposal systems.[18] Boards of health also may abate nuisances that may be injurious to public health. While this may include agricultural nuisances, it may not include odors and noise from normal farming and livestock practices.[19]

• The state's environmental agency may "for the purpose of promoting the public safety, health and welfare, and protecting public and private property, wildlife, fresh water fisheries, and irreplaceable wild, scenic and recreational river resources, adopt...orders regulating, restricting or prohibiting...polluting the scenic and recreational rivers and streams of the commonwealth."[20] The commissioner's jurisdiction under this section extends to the rivers and streams themselves and to such contiguous land not to exceed one hundred yards on either side of the natural bank of such river; and the orders are to be recorded in the property records for the county wherein the lands are located. Enforcement is by injunction, and by fines.[21]

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Fish/Fisheries Laws

• Placing or allowing the runoff into coastal waters of "any oil, poisonous or other injurious substance, including but not limited to, sawdust, shavings, garbage, ashes, acids, sewage, and dyestuffs...or heated effluent, which directly or indirectly materially injure fish, fishspawn or seed therein" is an offense punishable by fine and/or imprisonment.[22]

• A similar provision applies to the discharge of "sewage or any other substance which might be injurious to the public health or might tend to contaminate any shellfish areas or shellfish therein....or injuriously affect the fisheries therein..."[23]

• "A person shall not put, throw, discharge or permit to be discharged or to escape into any inland waters of the commonwealth any waste or other material, in violation of [Massachusetts' wetlands act or clean water act]... which may directly or indirectly injure or kill the fish or fish spawn therein." Any actions that "directly or indirectly" injure or kill or damage fish or fish spawn in the inland waters of the state, except as specifically authorized, result in liability to the state for twice the amount of the damage thereby done.[24] Fines or imprisonment are also provided for.[25]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• Under the Forest Cutting Practices Act the state forestry committee, subject to approval of the commissioner for environmental management, must prepare minimum forest cutting practices and guidelines.[26] Under the Act, landowners must give prior notice of intent to harvest to both the director of the division of forests and parks and to neighboring property owners. The notice must include the proposed cutting plan. The harvest may not begin until the director has provided a final work order, unless the director fails to act within ten days (this exception does not apply in wetland areas).[27] Enforcement is by stop work order and fine of up to $100 per acre.[28] The law does not apply to cutting for the owner's own use, to cutting or sale not exceeding 25,000 board feet or 50 cords, or land clearing activities.[29] The law requires a license to harvest timber or other forest products for hire or profit, and requires licensees to demonstrate familiarity with the state's laws on forestry and timber harvesting; enforcement is by fine and injunction.[30]

• State law prohibits the placement of slash within 25 feet of any continuously flowing stream, any pond, river, or water supply.[31]

• Forestry operations in wetlands are subject to additional regulations and to Best Management Practice requirements.

Agriculture Requirements

• Massachusetts law does not appear to prescribe enforceable practices with respect to agriculture, except with respect to certain agricultural activities occurring in or near wetlands. Use of Best Management Practices in these areas is required by regulations.[32]

• Massachusetts does regulate pesticides, including licensing of dealers, and its law provides that "no person shall distribute, handle, dispose of, discard, or store any pesticide or pesticide container in such a manner as to cause injury to humans, vegetation, crops, livestock, wildlife, beneficial insects, to cause damage to the environment, or to pollute or contaminate any water supply, waterway, groundwater or waterbody."[33] The law also provides general order authority whenever it appear that there is an imminent hazard or a potential threat of unreasonable adverse effect on the environment.[34] Enforcement provisions include fines, injunctions, criminal sanctions, and injunctions.[35]

Development and Other Earth-Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act or that may be authorized by general land use regulation such as zoning, state law does not prescribe detailed operating requirements.

• However, certain construction activities in wetlands, floodplains, and riverbanks are regulated under state law and bear on nonpoint source pollution in these areas.[36] Massachusetts has detailed wetlands protection regulations.

Endnotes

1. Mass. Gen. Laws Ann. ch. 21, § 42.
2. Mass. Gen. Laws Ann. ch. 21, § 26A.
3. Mass. Regs. Code tit. 314, § 4.02.
4. Mass. Gen. Laws Ann. ch. 21, § 43(2).
5. Mass. Regs. Code tit. 314, § 3.05. These regulations do not exempt concentrated anomimal feeding operations, concentrated aquatic animal production facilities, aquaculture projects, or silvicultural point sources.
6. Mass. Regs. Code tit. 314, §4.00. The Commonwealth took this position in its CZARA submittal.
7. Mass. Gen. Laws Ann. ch. 21, §§ 44, 46.
8. Mass. Gen. Laws Ann. ch. 269, § 16.
9. Mass. Gen. Laws Ann. ch. 92, § 167.
10. Mass. Gen. Laws Ann. ch. 111, § 162.
11. Mass. Gen. Laws Ann. ch. 111, § 162.
12. Mass. Gen. Laws Ann. ch. 111, §§ 170, 171.
13. Mass. Gen. Laws Ann., ch. 92, § 109.
14. Mass. Gen. Laws Ann. ch. 92, § 107A.
15. Mass. Gen. Laws Ann. ch. 92, § 107A(n).
16. Mass. Gen. Laws Ann. ch. 92, § 111.
17. Mass. Gen. Laws Ann. ch. 12, § 11D. See also ch. 91, §§ 12, 12A (abatement of nuisances).
18. Mass. Gen. Laws Ann. ch. 21A, § 13.
19. Mass. Gen. Laws Ann. ch. 111, § 125A.
20. Mass. Gen. Laws Ann. ch. 21, § 17B.
21. Id.
22. Mass. Gen. Laws Ann. ch. 130, § 23.
23. Mass. Gen. Laws Ann. ch. 130, § 25.

[24] Mass. Gen. Laws Ann. ch. 132, § 42.
[25] Mass. Gen. Laws Ann. ch. 131, § 90.
[26] Mass. Gen. Laws Ann. ch. 132, § 41.
[27] Mass. Gen. Laws Ann. ch. 132, § 42.
[28] Mass. Gen. Laws Ann. ch. 132, § 43.
[29] Mass. Gen. Laws Ann. ch. 132, § 44.
[30] Mass. Gen. Laws Ann. ch. 132, § 46.
[31] Mass. Gen. Laws Ann. ch. 48, § 16.
[32] Mass. Code Regs. tit. 310, ch. 10.
[33] Mass. Gen. Laws Ann. ch. 132B, § 6.
[34] Mass. Gen. Laws Ann. ch. 132B, § 12.
[35] Mass. Gen. Laws Ann. ch. 132B, § 14.
[36] Mass. Gen. Laws Ann. ch. 131, §§ 40, 40A.

MICHIGAN

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Michigan's water pollution control laws include provisions that may be used to take enforcement action against nonpoint source discharges that cause environmental harm. They also provide general authority for the state to adopt rules and issue orders with respect to polluting substances. Virtually all of Michigan's laws relating to the environment are codified as the "Natural Resources and Environmental Protection Act," administered by the state's departments of natural resources and environmental quality.[1] Chapter and article headings in the Act *are not part of the act and are not to be used to construe the scope of the act.*[2] This has particular relevance to the interpretation of nonpoint source enforceable mechanisms, as the following enforceable provisions are found in a part of the Act captioned "Article II, Chapter 1-Point Source Pollution Control."[3]

• The broadest prohibition apparently applies to nonpoint sources as well as point sources. "A person shall not directly or indirectly discharge into the waters of the state a substance that is or may become injurious to any of the following: (a) To the public health, safety or welfare. (b) To domestic, commercial, industrial, agricultural, recreational, or other uses that are being made or may be made of such waters. (c) To the value or utility of riparian lands. (d) To livestock, wild animals, birds, fish, aquatic life, or plants or to the growth, propagation, or the growth and propagation thereof be prevented or injuriously affected; or whereby the value of fish and game is or may be destroyed or impaired."[4]

• In addition, the Department of Environmental Quality "may promulgate rules and issue orders restricting the polluting content of any waste material or polluting substance discharged or sought to be discharged into any...waters of the state. The department shall take all appropriate steps to prevent any pollution the department considers to be unreasonable and against public interest in view of the existing conditions in any...waters of the state."[5] This broad provision also apparently covers nonpoint as well as point source categories.

A related requirement provides for issuance of waste discharge permits. However, the regulations apply the permit requirement most clearly to point source dischargers.[6] Definitions in the state regulations nevertheless create the possibility that nonpoint source dischargers could also fall within the permit requirement.[7]

The state agency may enforce the laws and regulations noted above, and may bring or cause to be brought civil actions or criminal prosecutions in court.[8] It may revoke a permit, issue an order of abatement, or refer a case to the attorney general.[9]

Sanctions include civil fines of not less than $2,500 nor more than $25,000/day, and criminal penalties and terms of imprisonment for knowing violations.[10]

Other Discharge Limitations

• The Michigan Environmental Protection Act (MEPA) allows the Attorney General or "any person" to bring an action in court "for declaratory and equitable relief against any person for the protection of the air, water, and other natural resources and the public trust in these resources from pollution, impairment, or destruction."[11] Natural resource damage actions may also be brought by the state.

• Nuisance law provides additional remedies that may be used to address some instances of nonpoint source pollution. Michigan law provides that causing pollution ("directly or indirectly discharg[ing] into the waters of the state" any substance that is or may become injurious to public health, safety, or welfare, or to human uses of waters or to aquatic life or wildlife or to riparian land) is "prima facie evidence of a public nuisance and in addition to the remedies provided for in this part may be abated according to law in an action brought by the attorney general in a court of competent jurisdiction."[12]

However, a farm may not be found to be a nuisance if it "conforms to generally accepted agricultural and management practices according to policy determined by the Michigan commission of agriculture." The law provides that these "[g]enerally accepted agricultural and management practices shall be reviewed annually by the Michigan commission of agriculture and revised as considered necessary."[13]

• An anti-litter law has some potential applicability to nonpoint source water pollution as well. It provides that "[a] person shall not knowingly, without the consent of the public authority having supervision of public property or the owner of private property, dump, deposit, place, throw, or leave, or cause or permit the dumping, placing, throwing, or leaving of, litter on public or private property or water other than property designated and set aside for such purposes."[14] Litter is defined as "all rubbish, refuse, waste material, garbage, offal, paper, glass, cans, bottles, trash, debris, or other foreign substances." "Public or private property or water includes....a body of water or watercourse, or the shore or beach of the body of water or watercourse, including the ice above the water..."[15] Offenses are punishable by civil fines of up to $800 or $2,500 depending upon the volume of the discarded litter, and costs of removing the material and "the costs of damages to any land, water, wildlife, vegetation, or other natural resource or to any facility damaged by the violation."[16]

Fish/Fisheries Laws

• "A person shall not put into any stream, pond, or lake any sand, coal, cinders, ashes, log slabs, decayed wood, bark, sawdust, or filth."[17] Violation of this provision is a misdemeanor punishable by a fine of not more than $100, and/or imprisonment for up to 90 days, and damages.[18]

• The Michigan DNR also uses its general enforcement authorities to "protect and conserve the natural resources" and "guard against the pollution of lakes and streams and enforce all laws provided for that purpose."[19] To that end, it can use its authority to impose sanctions for fish kills, based on the unlawful taking of fish by "means" other than rods and lines.[20]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• Michigan has a law that applies to forest improvement districts. These are governmental subdivisions containing at least 4 working forests, and are established by 10 or more forest owners with 50,000 acres in the aggregate filing a petition with the DNR.[21] Districts have power to develop comprehensive forest management plans; and the DNR participates in the plan if state land encompassed by the district's gross boundary is greater than 5% of the total forest area.[22] But the state does not provide financial or other support for the district. "For the public benefit, the [district's] board shall mandate the continuous growing, improvement, and harvesting of forest tree species so as to protect and maintain the forest soil, air, water resources, wildlife, and aquatic habitat within a district. The board of a district shall establish minimum standards for the conduct of forest practices on forest land within a district. These standards shall do all of the following: (a) Provide for the improvement and harvesting of forest tree species in a manner that will increase the productivity of the forest land, reduce soil and debris entering streams, and protect wildlife and fish habitat....."[23] "A member shall notify the district of compliance with the forest practice rules by submitting a forest management plan on forms prescribed and provided by the board."[24] The district board must issue a notice of violation if a forest practice rule was violated. The notice must order that further violations cease and may order the member to make "reasonable efforts to repair the damage or correct the unsatisfactory condition."[25] If the member fails to comply, the board may take action and then file a lien to recover the costs of the action.[26] This is essentially a cooperative, member-enforced approach, under which timber sales are inspected by foresters employed by the district. But state enforcement actions for forestry nonpoint source water pollution are basically limited to those identified in the "Discharge Prohibitions" portion of this summary.

• Michigan also has a tax incentive program for commercial forests.[27] It requires forest management plans to be prepared by a registered forester or natural resources professional, and requires compliance with such plan to receive the favorable tax benefits. This program is considered an enforceable mechanism because violation of the plan does not simply lead to loss of tax benefits, as in many other states, but is also a misdemeanor (or felony, depending upon the value of removed forest products).[28]

• Michigan's law relating to sand dune protection and management has some relevance to forest cover.[29] The Department of Environmental Quality notifies local governments that have critical dune areas, and local governments adopt zoning ordinances with approval by the department, or the department regulates directly under a model zoning plan.[30] Permitting is carried on by the local government or the department.[31] The local zoning ordinance must cover at least lands within 250 feet of critical dune area if essential to the dune area; direct departmental regulation is limited to the 250 feet (unless the local government authorizes an extension).[32] The ordinance must assure that removal of trees corresponds to instructions or plans of the local soil conservation district.[33] In addition, zoning ordinances may not allow silvicultural practices "that are likely to increase erosion, decrease stability, or are more extensive than required to implement a use for which a permit is requested."[34]

• Michigan's Inland Lakes and Streams law (discussed below under "Development and Other Earth-Disturbing Activities") has some bearing on such forestry activities as construction of stream crossings.

Agriculture

• The Department of Agriculture is required to investigate "all complaints involving a farm or farm operation, including, but not limited to, complaints involving the use of manure and other nutrients, agricultural waste products,...surface- or groundwater pollution..." If the department finds that the operation is using generally accepted agricultural and management practices, then it notifies the farm and the complainant of its finding. If the department finds that "the source or potential sources of the problem [is] caused by the use of other than generally accepted agricultural and management practices," the department must "advise" the farm operation to resolve or abate the problem and to conform to such practices.[35] As noted above, conformance to such practices is necessary if a farming operation is to enjoy the protection from actions to abate a nuisance. There is also a memorandum of understanding between the Department of Agriculture and the Department of Environmental Quality that provides that if there is a discharge to surface water, the DEQ will address the complaint and can take enforcement action if needed under the Natural Resources and Environmental Protection Act (as described above under "Discharge Limitations").

• The soil conservation district law[36] empowers districts to act as governmental subdivisions, but does not give them broad powers (apart from making rules consistent with their other responsibilities). [37] However, conservation districts may act as the enforcing agencies for a county under agreement under the soil erosion and sedimentation control program.[38] Some agricultural practices -- but not "plowing, tilling, or harvesting" of crops[39] -- fall within the scope of Michigan's Soil Erosion and Sedimentation Control program, discussed below under Built Environment. If a person engaged in agricultural practices enters into an agreement with the appropriate soil conservation district to pursue agricultural practices consistent with the rules, then such person is not subject to site plans, approvals, or permit requirements under the law, but only to the enforcement provisions.[40]

• Michigan law provides for pesticide registration, groundwater protection fees and state management plans to protect groundwater. The law also provides for dealer licensing and applicator certifications including training requirements.[41] The law provides for action by the government where there is confirmed contamination of groundwater, including requiring the person whose "action or negligence" was "potentially responsible" to develop and submit an activity plan for approval and to implement it.[42] Also the state may issue an order if an applicator is using a pesticide in an unsafe or inadequate manner or a manner inconsistent with its labeling.[43] Enforcement is via registration and certificate actions, orders, administrative fines of up to $1,000, civil fines of up to $5,000, injunctions, and misdemeanor prosecutions for knowing violations.[44]

Development and Other Earth-Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act or that may be authorized by general land use regulation such as zoning, state law provides the following authorities relevant to nonpoint source discharges.

• The Soil Erosion and Sediment Control Act[45] provides for some enforceable mechanisms directed at erosion from a variety of activities. The Department of Agriculture must, with assistance of soil conservation districts, prepare and submit to DEQ for its approval a "unified statewide soil erosion and sedimentation control program" identifying land uses and controls, including agricultural practices (other than plowing, tilling, and harvesting).[46] DEQ provides information on effects of sediment on water quality, location of degraded or at risk waters, and water quality standards to be included in the program to protect designated uses. DEQ then adopts rules for the program.[47] Counties administer the rules, but cities, villages or charter townships may, by ordinance, provide for their own corresponding controls.[48] State, local, or county *agencies* may also apply to DEQ for designation as an authorized public agency by submitting the erosion and sedimentation control procedures used for all land uses normally undertaken by the agency; if approved, authority is delegated. This means that such agencies may self-regulate and may not need permits (e.g. DOT, county road commissions, etc.).[49] "A person shall not maintain or undertake a land use or earth change governed by this part or the rules or governed by an applicable local ordinance, except in accordance with this part and the rules or with the applicable local ordinance and pursuant to a permit approved by the appropriate county or local enforcing agency."[50] An owner of land on which an earth change has been made that may result in or contribute to soil erosion or sedimentation of waters must implement and maintain control measures that will "effectively reduce" such erosion or sedimentation. [51] Subdividers must, with filing of the subdivision plat, attach a statement of compliance, and certificate of permitting in accordance with this law or the applicable local ordinance.[52] And no building permit may be issued for construction involving disturbance of an acre or more, or within 500 feet of a lake or stream, until there is proof of compliance.[53] The Soil Erosion and Sediment Control Act does not apply to logging, mining, nor to plowing, tilling, or harvesting of crops.[54] Enforcement includes administrative notices and orders, injunctions, misdemeanor prosecutions, civil fines of up to $500, and cost-recovery if the agency needs to enter on the land and construct and maintain the necessary measures.[55]

• Other laws dealing with riparian and littoral lands also have some potential bearing on nonpoint source water pollution and controls. DEQ has jurisdiction over "alterations of natural or present watercourses of all rivers and streams in the state to assure that the channels and the portions of the floocplains that are the floodways are not inhabitated and are kept free and clear of interference or obstruction that will cause any undue restriction of the capacity of the floodway."[56] "A person shall not occupy or permit the occupation of land for residential, commercial, or industrial purposes or fill or grade or permit the filling or grading for a purpose other than agricultural, of land in a floodplain, stream bed, or channel of a stream...or undertake or engage in an activity on or with respect to land that is determined by the department to interfere harmfully with the discharge or stage characteristics of a stream" without a permit.[57] DEQ makes rules and issues orders for the prevention of harmful interference with the discharge and stage characteristics of streams.[58] Enforcement may include prosecution for misdemeanor with a civil fine of up to $500, or up to $2,500 for more serious violations.[59]

• Michigan law also provides protection for inland lakes and streams.[60] The law requires a permit for dredge or fill, for structures therein, or for connecting a ditch or other channel with a lake or stream.[61] The permit is issued if the department finds that the structure or project "will not adversely affect the public trust or riparian rights....the department shall consider the possible effects of the proposed action upon the inland lake or stream and upon waters from which or into which its waters flow and the uses of all such waters, including uses for recreation, fish and wildlife, aesthetics, local government, agriculture, commerce, and industry. The department shall not grant a permit if the proposed project or structure will unlawfully impair or destroy any of the waters or other natural resources of the state...A permit shall specify that a project completed in accordance with this part shall not cause unlawful pollution as defined by part 31."[62] Enforcement is by civil action for compliance and civil fine of up to $5,000 per day, or a misdemeanor prosecution with a fine of up to $10,000 per day for more significant violations.[63]

• Other laws protect shorelands and sand dune areas,[64] as well as littoral and riparian wetlands and certain isolated wetlands.[65] These laws provide some basis for local nonpoint source controls, but a number exempt agricultural uses. Designated state natural rivers also are entitled to protection, including local zoning and subdivision controls over activities on adjacent lands, or DEQ controls absent such local action.[66]

Endnotes

1. Mich. Comp. Laws Ann. § 324.101 et seq. (NREPA).
2. Mich. Comp. Laws Ann. § 324.103.
3. Mich. Comp. Laws Ann. § 324.3101 et seq. Compare "Article II, Chapter 2- Nonpoint Source Pollution Control," § 324.8301 et seq. The statutory compilers have also reserved Part 81 for a future "General Nonpoint Source Pollution Control" program.
4. Mich. Comp. Laws Ann. § 324.3109(1).
5. Mich. Comp. Laws Ann. § 324.3106.
6. Mich. Comp. Laws Ann. § 324.3112; Mich. Rules 323.2106(1) (point source dischargers required to obtain permit).
7. Mich. Rules 323.2102(n) (defining "discharge" to include "indirect" discharges into any "waters of the state or upon the ground"); see Rules 323.2106(2),(3) (not specifically referencing "point sources").
8. Mich. Comp. Laws Ann. §§ 324.1601, 324.3115.
9. Mich. Comp. Laws Ann. § 324.3112(2).
10. Mich. Comp. Law Ann. § 324.3115.
11. Mich. Comp. Laws Ann. § 324.1701-.1705.
12. Mich. Comp. Laws Ann. § 324.3109(4).
13. Mich. Comp. Laws Ann. § 286.473.
14. Mich. Comp. Laws Ann. § 324.8902.

[15] Mich. Comp. Laws Ann. § 324.8901.
[16] Mich. Comp. Laws Ann. §§ 324.8905a, 324.8905b.
[17] Mich. Comp. Laws Ann. § 324.47903.
[18] Mich. Comp. Laws Ann. § 324.47904.
[19] Mich. Comp. Laws Ann. §§ 324.503, 324.1601.
[20] Mich. Comp. Laws Ann. § 324.48703.
[21] Mich. Comp. Laws Ann. §§ 324.50108, 324.50124.
[22] Mich. Comp. Laws Ann. § 324.50135.
[23] Mich. Comp. Laws Ann. § 324.50140.
[24] Mich. Comp. Laws Ann. § 324.50141.
[25] Mich. Comp. Laws Ann. § 324.50142.
[26] Mich. Comp. Laws Ann. § 314.50143.
[27] Mich. Comp. Laws Ann. § 324.51101 et seq.
[28] Mich. Comp. Laws Ann. § 324.51120.
[29] Mich. Comp. Laws Ann. § 324.35301 et seq
[30] Mich. Comp. Laws Ann. § 324.35303.
[31] Mich. Comp. Laws Ann. § 324.35304.
[32] Mich. Comp. Laws Ann. § 324.35312.
[33] Mich. Comp. Laws Ann. § 324.35313.
[34] Mich. Comp. Laws Ann. § 324.35316.
[35] Mich. Comp. Laws Ann. § 286.473a.
[36] Mich. Comp. Laws Ann. § 324.9301 et seq.
[37] Mich. Comp. Laws Ann. § 324.9308(j).
[38] Mich. Comp. Laws Ann. § 324.9308(l).
[39] Mich. Comp. Laws Ann. § 324.9101(1).
[40] Mich. Comp. Laws Ann. § 324.9109.
[41] Mich. Comp. Laws Ann. §§ 324.8301-324.8315.
[42] Mich. Comp. Laws Ann. § 324.8323.
[43] Mich. Comp. Laws Ann. § 324.8327.
[44] Mich. Comp. Laws Ann. §§ 324.8309-.8312; 3243.8329-.8333. Also see Parts 85, 87, 111, 115, 117, and 201 of the Act.
[45] Mich. Comp. Laws Ann. § 324.9101 et seq.
[46] Mich. Comp. Laws Ann. § 324.9103.
[47] Mich. Comp. Laws Ann. § 324.9104.
[48] Mich. Comp. Laws Ann. §§ 324.9105, .9106.
[49] Mich. Comp. Laws Ann. § 324.9110.
[50] Mich. Comp. Laws Ann. § 324.9112.
[51] Mich. Comp. Laws Ann. § 324.9116.
[52] Mich. Comp. Laws Ann. §324.9111.
[53] Mich. Rule 323.1711.
[54] Mich. Comp. Laws Ann. § 324.9115.
[55] Mich. Comp. Law Ann. §§ 324.9107 - 324.9121. Enforcement mechanisms are also available under Part 31 of the NREPA (described above under Discharge Limitations) and under Permit-By-Rule provisions § 323.2190.
[56] Mich. Comp. Laws Ann. § 324.3104.
[57] Mich. Comp. Laws Ann. § 324.3108.
[58] Mich. Comp. Laws Ann. § 324.3107.
[59] Mich. Comp. Laws Ann. §§ 324.3115.
[60] Mich. Comp. Laws Ann. § 324.30101 et seq.
[61] Mich. Comp. Laws Ann. § 324.30102.
[62] Mich. Comp. Laws Ann. § 324.30106.
[63] Mich. Comp. Laws Ann. §§ 324.30112

[64] Mich. Comp. Laws Ann. §§ 324.32301 et seq., 324.35301 et seq.
[65] Mich. Comp. Laws Ann. § 324.30301 et seq.
[66] Mich. Comp. Laws Ann. § 324.30501 et seq.

MINNESOTA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Minnesota's water pollution control law includes some provisions that may be used to take enforcement action against nonpoint source discharges.

• Minnesota has a general statutory provision obligating every person to "notify" the state of the discharge of "any substance or material" that "may cause pollution of the waters" and the discharger to take all reasonable actions to "minimize or abate" the pollution caused.[1] However, the most explicit discharge limitation on nonpoint sources is found in the state rules, stating, "No sewage, industrial waste or other wastes shall be discharged from either a point or *nonpoint source* into the waters of the state in such quantity or in such a manner alone or in combination with other substances as to cause pollution..."[2] Enforcement includes criminal prosecution, civil penalties, injunction, action to compel performance, and any "other appropriate action."[3]

Other Discharge Limitations

• A separate authority addresses the pollution of public water supplies. "No sewage or other matter that will impair the healthfulness of water shall be deposited where it will fall or drain into any pond or stream used as a source of water supply for domestic use." The state Commissioner of Health has broad authority to issue to any person orders and direction that it deems "proper and expedient" to desist from causing pollution.[4]

• The state law generally authorizes county boards of commissioners to adopt ordinances that "provide for the cleaning and removal of obstructions from waters in the county and to prevent obstruction or pollution."[5]

• General nuisance law in Minnesota identifies nuisance as, "Anything which is injurious to health, or indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property..."[6] The state regulations apply nuisance directly to nonpoint sources by specifying that "No sewage, industrial waste or other wastes shall be discharged from either point or nonpoint sources into any waters of the state so as to cause any nuisance conditions, such as the presence of significant amounts of floating solids, scum,...excessive suspended solids, material discoloration...undesirable slimes or fungus growths, aquatic habitat degradation, excessive growth of aquatic plants or other harmful effects."[7] Agriculture operations are not considered a nuisance, except where the operations are negligent or contrary to acceptable agricultural practices, cause direct injury or threat of injury to health/safety of any person, cause water pollution, are large animal feedlots; or result in criminal prosecution.[8] The maximum fine for causing nuisance is $700, and prosecution or civil action may result.[9]

• Minnesota's groundwater protection law requires the pollution control agency to develop best management practices; and the commissioner of agriculture must develop best management practices for agricultural chemicals and practices.[10] The respective regulatory agency may adopt water source protection requirements "if the implementation of best management practices has proven to be ineffective."[11] Violators of a water source protection requirement are subject to the penalties prescribed under the pollution control act, except for agricultural chemical violations, which are subject to the penalties prescribed for agrichemical spills and violations.[12]

Fish/Fisheries Laws

• The state has a general prohibition against disposing of "substances" in state waters that "injure or are detrimental to the propagation of wild animals or taint the flesh of wild animals,"[13] which are specifically defined to include fish.[14] Each day of propagation is a separate offense.[15] Another provision prohibits "taking" fish with a range of specific substances, including "explosives, drugs, poisons, lime,... or other similar substances" or substances that "kill, stun or affect the nervous system of fish."[16] Pesticides are excluded from this list of substances.[17] Punishment for violation of these provisions are fines ranging from $100 to $3000 and incarceration for between 90 days and one year. [18] The Commission of Natural Resources is charged with deciding whether to take action against a violator.[19]

OPERATIONAL REQUIREMENTS

Forestry Requirements

Minnesota has few provisions regulating private forestry operations with respect to nonpoint source water pollution and none that appear to be enforceable. Its Sustainable Forest Resources Act of 1995 provides for voluntary guidelines.[20]

• The Department of Natural Resources commissioner retains some discretion to protect state lands and related water bodies. A statutory provision prevents the commissioner from selling for private forest management state forests that "border on or are adjacent to meandered lakes or public waters and water courses," and if the commissioner harvests these state lands, the commissioner must "reserve the timber and impose other conditions deem(ed) necessary to protect watersheds, wildlife habitat, shorelines and scenic features." [21] Clear cutting is prohibited where "soil, slope or other watershed conditions are fragile" and where it occurs within certain distances within a "wild, scenic and recreation river."[22]

Agriculture Requirements

• Local governments are "encouraged" to adopt a soil loss ordinance, which states that "a person may not cause, conduct, contract for or authorize an activity that causes excessive soil loss," as "evidenced by sedimentation on adjoining land or in a body of water." *However, agricultural uses are exempted* from the soil loss ordinance as long as the farmer is using "best practicable conservation practices." The soil loss also applies to pastures used for grazing or cattle paths. *Where a locality has chosen to adopt it,* the soil loss ordinance is enforced by a complaint submitted to the local government from, an adversely affected landowner, an official of local government, or a soil and water district board member.[23] Following filing of the complaint, the landowner must participate in mediation and failure to comply with the mediated settlement may result in a civil penalty of up to $500.[24] Other statutory provisions provide that local ordinance violations can result in criminal prosecution and a maximum fine of up to $700.[25]

• State permits or agency certificates of compliance are required for construction, location and operation of animal feedlots, or manure storage facilities that create a "potential pollution hazard" and where animal manure used for domestic fertilizer is stored for longer than one year.[26] Feedlots with more than 1000 animal units must obtain a discharge permit from the pollution control agency. Proposed regulations slated for consideration in 1999 would require permits for all facilities with greater than 50 animal units by the year 2004. A 1998 law also requires commercial manure applicators to be licensed by March 2000.[27]

• The state has a relatively broad prohibition addressing harm from pesticide use, handling and application. "A person may not use, store, handle, distribute or dispose of a pesticide...that endangers humans, damages agricultural products, food, livestock, fish or wildlife or that will cause *unreasonable effects on the environment.*"[28] Pesticide applicators require licensing.[29] Application of chemigation requires a permit from the commissioner.[30] Where there are violations, the commissioner is authorized, but not required, to "take action necessary to prevent" groundwater contamination resulting from leaching, backsiphoning or backflowing of pesticides through the soil or water wells or from the direct flow of pesticides to the groundwater. Agrichemical practices that adversely affect groundwater are described above under "Other Limitations." In addition, Minnesota law provides for corrective action and enforcement actions with respect to agrichemical spills.[31]

• Minnesota also regulates fertilizer activities, prohibiting the storage, handling, distribution, or disposal of fertilizer, rinsate, or application equipment in such a manner that will endanger humans, fish, or wildlife, that will cause unreasonable adverse effects on the environment or that will cause contamination of public or other waters of the state.[32] It also licenses applicators.[33]

• Minnesota has a broad prohibition against draining materials into a ditch, providing that it is a misdemeanor to "drain any noisome materials into any ditch,"[34] The drainage authority is also required to consider various environmental impacts resulting from a proposed drainage project including the "effect on water quality.[35]

Development and Other Earth-Disturbing Activities

Designation of a "critical area" and a statutory provision requiring a sediment control plan and a permit for "development activity" disturbing over one acre of land are enforceable restrictions on development activities that may cause nonpoint source pollution.

• Prior to engaging in a "development activity" that will disturb over one acre of land, a person must seek and obtain a permit from the local government contingent upon implementation and completion of a sedimentation control plan and time schedule that prevents excess soil loss.[36] A "development activity" means "a physical disturbance of the land that may result in sedimentation of adjacent lands or waters, associated with activities that include clearing, grading, excavating, transporting and filling lands," but excludes "road construction."[37] Failure to obtain a permit or to make satisfactory progress to complete the plan is subject to a civil penalty.[38]

• A critical area is "an area significantly affected by, or having effect upon, an existing or proposed major government development which is intended to serve substantial numbers of persons beyond the vicinity in which the development is located and which tends to generate substantial development or urbanization," or "an area containing or having significant impact upon historical, natural, scientific, or cultural resources or statewide importance"[39] Once such an area is established, then the statute prohibits issuance of development permits by local or state agency.[40] However, certain exceptions exist that result in issuance of a development permit: If no critical site plans and regulations have been adopted by the local government (as required under the Rules), if a local ordinance was in effect immediately prior to the designation of the critical area that would have granted a development permit, and there is an emergency or need to protect public health and safety, then the local government may grant a development permit.[41] If the Minnesota Environmental Quality Board determines that the administration of the local plans and regulations "is inadequate to protect the state or regional interests," then the Board may compel enforcement of the plans and regulations.[42]

• To protect the state shoreline, the DNR Commissioner shall adopt model standards and criteria for the "subdivision, use and development of shoreland" and adapt the model ordinance for use in a county that has an inadequate shoreland conservation ordinance or none at all.[43] Violations of the shoreland conservation ordinance or model standards are considered misdemeanors and are enforced through the actions by the county commissioners or by mandamus proceedings instituted by any taxpayer to compel specific performance by an official.[44] Fines of $700 can be assessed.[45] As part of a locally-enforced, ordinance-based shoreland management system, "on-site sewage treatment systems must be set back from ordinary high water level by distances ranging from 50 to 150 feet." (Certain designated areas within the wild, scenic and recreation rivers program have required set backs of 50 feet.")[46] There is criminal prosecution for violation of these ordinances and a maximum fine of $700.[47]

• A floodplain management ordinance, which is required to be adopted, administered and enforced by local governments, prohibits placement of a structure, fill, deposit or other floodplain use that is "unreasonably hazardous to the public."[48] Placement of any of the aforementioned is considered a public nuisance and can be enjoined or abated through civil action or prosecuted criminally as a violation of a local ordinance. Each violation is subject to prosecution as a misdemeanor, and the maximum fine is $700.[49]

Endnotes

[1] Minn. Stat. 115.061.
[2] Minn. Rules 7050.0210(13).
[3] Minn. Stat. 115.071.
[4] Minn. Stat. 144.35.
[5] Minn. Stat. 145A.05(5).
[6] Minn. Stat. 561.01.
[7] Minn. Rules 7050.0210
[8] Minn. Stat. 561.19
[9] Minn. Stat. 561.01, 609.025, 609.033.
[10] Minn. Stat. 103H.151.
[11] Minn. Stat. 103H.275.
[12] Id.; see Minn. Stat. ch. 18D (up to $7500 per violation).
[13] Minn. Stat. 97C.065.
[14] Minn. Stat. 97A.015(55).
[15] Minn. Stat. 97C.065.
[16] Minn. Stat. 97C.325.
[17] Minn. Stat. 97C.065.
[18] Minn. Stat. 97A.301.
[19] Minn. Stat. 97A.205, 97C.065.
[20] Minn. Stat. Ch. 89A.
[21] Minn. Stat. 92.45.
[22] Minn. Rules 6105.0150.
[23] Minn. Stat. 103F.405, 103F.415, 103F.421.
[24] Minn. Stat. 103F.455.
[25] Minn. Stat. 488A.01, 488A.10, 488A.27.
[26] Minn. Rules 7020.0400.
[27] See State of Minnesota, Feedlots: Summary of 1998 Legislation.
[28] Minn. Stat. 18B.07.Subd.2.
[29] Minn. Stat. 18B.33, 18B.34.
[30] Minn. Stat. 18B.08, 18B.10.
[31] Minn. Stat. Ch. 18D.
[32] Minn. Stat. 18C.201.
[33] Minn. Stat. 18C.425.
[34] Minn. Stat. 160.27.
[35] Minn. Stat. 103E.015.
[36] Minn. Stat. 103F.441.
[37] Minn. Stat. 103F.401.
[38] Minn. Stat. 103F.441.
[39] Minn. Stat. 116G.05.
[40] Minn. Stat. 116G.11.
[41] Minn. Stat. 116G.12.
[42] Minn. Stat. 116G.09. Minn. Rules 4410.9600.
[43] Minn. Stat. 103F.211, 103F.215.
[44] Minn. Stat. 394.37.
[45] Minn. Stat. 609.034.
[46] Minn. Rules 6105.0650, 6120.3400.
[47] Minn. Stat. 488A.01, 488A.10, 488A.27, 609.034.
[48] Minn. Stat. 103F.121(1), (5).
[49] Minn. Stat. 103F.145, 488A.01, 488A.10, 488A.27, 609.033, 609.034.

MISSISSIPPI

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Mississippi's water pollution control law prohibits causing pollution or discharging wastes into waters so as to violate water quality standards. The law appears to provide a basis for enforcement against nonpoint source discharges.

- "It shall be unlawful for any person (I) to cause pollution of any waters of the state or to place or cause to be placed any wastes in a location where they are likely to cause pollution in any waters of the state; (II) to discharge any wastes into any waters of the state which reduce the quality of such waters below the water quality standards established therefor by the commission.....Any such action is hereby declared to be a public nuisance."[1]

The law defines "wastes" as "sewage, industrial wastes, oil field wastes, and all other liquid, gaseous, solid, radioactive, or other substances which may pollute or tend to pollute any waters of the state."[2] Pollution is defined as contamination or alteration of waters "unless in compliance with a valid permit."[3] But Mississippi's regulations provide that no permit may be required for nonpoint agriculture and silviculture pollution.[4] Violations are enforceable by administrative orders, civil penalties of up to $25,000 per day, injunction, or misdemeanor prosecution.[5]

Other Discharge Limitations

Mississippi's laws do not appear to contain other discharge limitations addressing nonpoint sources, apart from the use of nuisance remedies which would be supported by the referenced provision above defining water pollution as a nuisance.

Fish/Fisheries Laws

Mississippi's laws do not appear to contain fisheries provisions that appear to address nonpoint source water pollution, but do provide that any person who violates water pollution laws or regulations and thereby causes the death of fish or wildlife must pay the state the amount necessary to restock.[6]

OPERATIONAL REQUIREMENTS

Forestry Requirements

- The Forest Harvesting Law declares a state policy for sound forestry, to encourage better management of forest lands...and "to prevent soil erosion and consequent silting of stream channels and reservoirs; to protect watersheds and reservoirs and to insure at all times an adequate supply of water of the forest quality..."[7]

But the enforceable regulatory standards require simply that certain numbers of trees be left on each acre for growing stock and/or seed trees.[8] The law does not apply to land clearing for crop production or pasture, building sites or roads, nor to noncommercial cutting by owners for their own use.[9] The law is enforceable by injunction or by misdemeanor prosecution with a fine of $25-$50 per working unit of 40 acres or less.[10]

Agriculture Requirements

• State wastewater permit regulations cover some sizes and types animal feeding operations not required to receive NPDES permits, and may contribute to control of nonpoint source water pollution from such establishments. In addition, such operations must be at least 1000 feet from the nearest dwelling or commercial establishment not owned by the applicant, and at least 300 feet from the property line.[11] Land application of animal waste must be at least 50 feet from the property line and 300 feet from the nearest dwelling not owned by the applicant.[12] Enforcement is under the water pollution control law.

• The water pollution control law also prohibits the following activities unless they have a permit "as may be required for the disposal of all wastes which are or may be discharged thereby into the waters of the state...[:] the construction, installation or operation of any industrial, commercial or other establishment, *including irrigation projects* or any extension or modification thereof or addition thereto, the operation of which would cause an increase in the discharge of wastes into the waters of the state or would otherwise alter the physical, chemical or biological properties of any waters of the state in any manner not already lawfully authorized..."[13] Unlike the agricultural and silvicultural nonpoint exemption from permitting identified above, the inclusion of irrigation projects gives authority for permitting.

• State law requires registration of pesticides and certification and licensing of applicators.[14] If the Commission on Environmental Quality finds groundwater contamination by a chemical not within its jurisdiction, it must notify the Department of Agriculture and Commerce which must proceed under the pesticide law.[15] Enforcement includes license and certification actions, injunctions, and criminal prosecutions.[16] Non-registration and registration violations with respect to pesticides, or to "handle, transport, store, display, distribute, or dispose of any pesticide or container in such manner as to endanger man and his environment," is a criminal offense punishable as a misdemeanor with a fine of $500.[17]

• Drainage districts, swampland districts, and conservation districts do not have express powers for enforceable regulation except that districts may adopt "necessary regulations, programs, and procedures" for prevention of erosion, floodwater, and sediment damage, "subject to approval of the chancery court or chancellor and on proper notice to the interested parties."[18] However this portion of the law further provides that none of these powers shall be exercised except for the purpose of participating in federally authorized programs for "soil and water conservation and utilization."[19]

Development and Other Earth-Disturbing Activities

No operating requirements are set forth, apart from any that may be contained in urban stormwater programs under the Clean Water Act or that may be authorized by general land use regulation such as zoning.

State law provides typical authorities to municipalities and counties to regulate building location and development, but "no permits shall be required with reference to land used for agricultural purposes including forestry activities...outside the corporate limits of municipalities."[20] Penalties for violation of a zoning ordinance are fines not to exceed $100 per day.[21]

Endnotes

1. Miss. Code Ann. § 49-17-29(2)(a).
2. Miss. Code Ann. § 49-17-5(1)(b).
3. Miss. Code Ann. § 49-17-5(1)(a).
4. Miss. Wastewater Regulations, chap. 1, tit. II, sec. B.5.
5. Miss. Code Ann. §§ 49-17-31, 49-17-43.
6. Miss. Code Ann. § 49-17-43(c).
7. Miss. Code Ann. § 49-19-53.
8. Miss. Code Ann. §§ 49-19-55, -57, -59, -61, -63.
9. Miss. Code Ann. § 49-19-67.
10. Miss. Code Ann. §§ 49-19-71, 49-19-75.
11. Miss Wastewater Regs. chap. 1, tit.II, sec. C.3, C.4.
12. Miss. Wastewater Regs., chap. 1, tit. I, sec. C.2
13. Miss. Code Ann. § 49-17-29(2)(b)(iii).
14. Miss. Code Ann. § 69-23-1 et seq.
15. Miss. Code Ann. § 49-17-26.
16. Miss. Code Ann. §§ 69-23-115, -117, -129.
17. Miss. Code Ann. §§ 69-23-5(2), 69-23-19.
18. Miss. Code Ann. § 51-33-3.
19. Miss. Code Ann. § 51-33-9.
20. Miss. Code Ann. § 17-1-3.
21. Miss. Code Ann. § 17-1-27.

MISSOURI

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Missouri's water pollution law contains discharge prohibitions that may be enforced against nonpoint source discharges that cause pollution or result in violations of water quality standards.

• "It is unlawful for any person (1) To cause pollution of any waters of the state or to place or cause or permit to be placed any water contaminant in a location where it is reasonably certain to cause pollution of any waters of the state; or (2) To discharge any water contaminants into any waters of the state which reduce the quality of such waters below the water quality standards established by the commission if not subject to effluent regulations...."[1] Pollution is defined as "such contamination or other alteration of the physical, chemical or biological properties of any waters of the state...or such discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state as will or is reasonably certain to create a nuisance or render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, industrial, agricultural, recreational, or other legitimate beneficial uses, or to wild animals, birds, fish or other aquatic life."[2] Discharge is defined as "the causing or permitting of one or more water contaminants to enter the waters of the state."[3]

Enforcement is through administrative penalties up to $10,000 per day, civil penalties up to $10,000 per day, and criminal prosecution.[4]

Other Discharge Limitations

•Under Missouri's Solid Waste Management Act, it is unlawful to "(d)ump or deposit...any solid wastes...into streams, springs, and all bodies of surface or ground water, whether natural or artificial, within the boundaries of the state...."[5] The law lists a number of exceptions to the prohibition, including: solid waste processing facilities or solid waste disposal areas that have the required permit; farming operations or manufacturing operations that use solid wastes in a manner that will not create a public nuisance; and disposal by an individual of solid wastes resulting from his own residential activities on property he owns or occupies, in a manner that does not create a public nuisance.[6] Enforcement of this provision is through administrative fines of up to $1,000 per day, civil penalties not to exceed $1,000 per day, and injunctions.[7] Civil monetary penalties are not available if an administrative penalty has been assessed in the case.

•Missouri statutes also establish public safety offenses and miscellaneous criminal offenses that potentially address some activities resulting in nonpoint source pollution. For example: "Whoever willfully or maliciously poisons, defiles or in any way corrupts the water of a well, spring, brook or reservoir used for domestic or municipal purposes, or whoever willfully or maliciously diverts, dams up and holds back from its natural course and flow any spring, brook or other water supply for domestic or municipal purposes...shall be adjudged guilty of a misdemeanor...." [8] The statute further provides that in a civil suit, the offender is liable to injured party for three times the actual damages sustained.[9]

•In addition, it is a criminal offense to "purposely introduce into any cave, cave system, sinkhole or subsurface waters of the state any substance or structure that will or could violate any provision of the Missouri clean water law...or any water quality standard or effluent limitation promulgated pursuant thereto."[10] This provision does not apply to underground mining operations or to situations where "natural subsurface drainage systems including, without limitation, caves, cave systems, sinkholes, fissures and related openings are used for purposes of stormwater drainage, artificial recharge of aquifers, and irrigation return flow, and where modifications of natural drainage systems are made for purposes of improving natural drainage relationships."[11] Enforcement is through criminal (class A misdemeanor) prosecution.[12]

•Nuisance law may also apply. Missouri's water pollution law states generally that "pollution of the waters of this states...creates a public nuisance...."[13]

Fish/Fisheries Laws

•Under Missouri's fish and game law, it is unlawful "for any person to cause any deleterious substance to be placed, run or drained into any of the waters of this state in quantities sufficient to injure, stupefy or kill fish which may inhabit the same at or below the point where any substance was thrown, run or drained into such waters...."[14] This prohibition does not apply to those engaged in industry who discharge water "under such precautionary measures as have been specifically approved" by the state conservation commission.[15] Enforcement is through criminal (Class A misdemeanor) prosecution.[16]

OPERATIONAL REQUIREMENTS

Forestry Requirements

•Missouri's forestry laws do not appear to provide enforceable operating requirements related to nonpoint source pollution. However, the law includes a tax incentive program which defines "forest croplands" as lands devoted exclusively to growing wood and timber and provides that all persons "interested in any way in the forest croplands or the cutting of crops therefrom...shall comply with and follow such forest management rules and regulations as required" by the state conservation commission.[17] State regulations establishing requirements for forest croplands provide that private landowners must ensure that forest land is managed so as to protect the watershed and prevent damage to tree growth, must not build any structures on the land, and must not use the land for animal grazing.[18] The sanction for failing to comply with the state rules is cancellation of "forest cropland" status and consequent loss of tax benefits that accrue with such status.[19]

Agriculture Requirements

• Under the Missouri Pesticide Use Act, "(n)o person shall discard, transport, or store any pesticide or pesticide containers in such a manner as to...pollute any waterway."[20] Enforcement of the law is through administrative "stop sale, use or removal" orders to enjoin future use and through criminal (misdemeanor) prosecution.[21]

• Missouri regulates the disposal of dead animals; these requirements became generally applicable in 1992, but were extended to poultry and turkeys in 1995. The law allows disposal of dead animals at state licensed rendering facilities, in properly designed animal composters, in approved sanitary landfills, by incineration in a designed incinerator facility, or by on-site burial (but subject to specific loading rates for areas with and without major groundwater pollution potential, and subject to setback distances from wells, surface waters, and neighboring properties). Permits are required for transport of dead animals, and for operation of substations for the collection of dead animals. Enforcement includes civil penalties, and misdemeanor sanctions.[22]

• Missouri has CAFO provisions that are similar to federal requirements, but which establish various subclassifications for regulatory purposes.

Development and Other Land-Disturbing Activities

Other than urban and industrial stormwater programs, and general planning and zoning authority (which exists only in urban and urbanizing areas) , there appear to be no specific enforceable nonpoint source requirements relating to land-disturbing activities.

Endnotes

1. Mo. Rev. Stat. 644.051, 644.016.
2. MRS 644.016(9).
3. MRS 644.016(2).
4. MRS 644.079, 644.076.
5. MRS 260.210.
6. MRS 260.210.
7. MRS 260.249.
8. MRS 577.150 .
9. MRS 577.150.
10. MRS 578.215.
11. MRS 578.215, 578.220.
12. MRS 578.225.
13. MRS 644.011.
14. MRS 252.210.
15. MRS 252.210.
16. MRS 252.230, 252.210.
17. MRS 254.020, 254.130.
18. Missouri Code Regs., Tit. 3, 10-2.202.
19. MRS 254.200.
20. MRS 281.085.

[21] MRS 281.090, 281.105.
[22] MRS 269.010-.220.

MONTANA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Montana's water pollution control law includes some provisions that may be used to take enforcement action against nonpoint source discharges. A general provision prohibits discharges or placement of wastes that cause pollution, including pollution from nonpoint sources. The law also establishes a nondegradation policy that applies to certain nonpoint sources, though it does not apply to agricultural discharges covered under a ground water management plan.

• The water quality code makes it unlawful to "cause pollution ... of any state waters or to place or cause to be placed any wastes where they will cause pollution of any state waters."[1] "Pollution" is defined broadly, and clearly includes pollution from nonpoint sources.[2] However, exempt from the prohibition is "any placement of materials that is authorized by a permit issued by any state or federal agency ... if the agency's permitting authority includes provisions for review of the placement of materials to ensure that it will not cause pollution of state waters."[3]

• The code also makes it unlawful to "cause degradation of state waters without authorization," and establishes a detailed nondegradation policy for state waters.[4] Under the non-degradation policy, degradation of high-quality waters may not be authorized without an extensive cost-benefit analysis and consideration of non-degrading options.[5] However, several potentially polluting activities are exempted from the nondegradation policy and classified as "nonsignificant." These include: nonpoint sources existing on or before April 29, 1993; new nonpoint sources that follow "reasonable land, soil, and water conservation practices"; use of agricultural chemicals under an approved agricultural ground water management plan; land application of manure and sewage sludge; nonpoint source activities that cause short-term changes in water quality and result from streambed preservation activities or permitted water uses; and dam maintenance and repair that causes short-term changes in water quality.[6]

The Department of Environmental Quality has general inspection and penalty authority for violations of the water quality code, including the discharge prohibition.[7] For alleged violations, the DEQ may serve a notice letter or an administrative notice and order, and may require public hearing of the charges.[8] After finding a violation, a hearing board may issue an order for prevention, abatement, or control of pollution, and administrative penalties of up to $10,000 per violation per day.[9] The DEQ also may issue specific compliance orders, cleanup orders for any material that is "accidentally or purposely dumped, spilled, or otherwise deposited in or near state waters and that may pollute state waters," or emergency orders; it also may bring civil actions for appropriate relief, including temporary and permanent injunctions.[10] Judicial remedies include civil penalties of up to $25,000 per day and, for willful or negligent violations of the discharge prohibition, criminal fines of up to $25,000 per day, imprisonment of up to one year, or both.[11] Criminal penalties may be doubled for repeat violations.[12]

Other Discharge Limitations

• The civil code defines nuisance as "anything which is injurious to health, indecent or offensive to the senses...or which unlawfully obstructs the free passage or use, in the customary manner, of any navigable lake, river, bay, stream, canal or basin...."[13]

• Similarly, the criminal code defines public nuisance as a "condition which defines safety or health, is offensive to the senses, or obstructs the free use of property so as to interfere with the comfortable enjoyment of life or property by an entire community or neighborhood or by any considerable number of persons," or which "renders dangerous for passage ... waters used by the public."[14]

Both the civil and criminal nuisance provisions contain "coming to the nuisance" exemptions for agricultural or farming operations that are operating normally and have been in operation "longer than the complaining resident has been in possession or commercial establishment has been in operation."[15] Moreover, there is a "right to farm" law that intends "to protect agricultural activities from governmental zoning and nuisance ordinances," by pre-empting local governments from passing any "ordinance or resolution that prohibits any existing agricultural activities or forces the termination of any existing agricultural activities outside the boundaries of an incorporated city or town."[16]

Within these limitations, "any person whose property is injuriously affected or whose personal enjoyment is lessened by the nuisance" may bring a civil action for damages, as well as for an injunction or abatement.[17] Public nuisances may be enforced against by indictment or information as well as civil actions or abatement.[18] Public nuisances under the criminal code are subject to fines not to exceed $500, imprisonment of up to six months, or both.[19] Abatement may be sought in an equity action for public nuisance filed in the name of the state by the county attorney or any resident of the state, and may include forfeiture of fixtures, closing and/or temporary seizure of the premises.[20]

Fish/Fisheries Laws

• The fish and wildlife code does not provide an enforceable authority for nonpoint source pollution. It does make the use of explosives or "any corrosive or narcotic poison or other deleterious substance...for the purpose of catching, stunning, or killing fish" a misdemeanor,[21] and requires restitution for illegal killing of wildlife, including fish, where killing is done "knowingly or purposely."[22] The general penalties for violation of the code include fines of $50-$1,000 and/or imprisonment of up to 6 months.[23] The restitution requirement is $10 per game fish illegally taken.[24]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• The forestry code requires creation of "streamside management zones" for forest streams.[25] A streamside management zone must "encompass[] a strip at least 50 feet wide on each side of a stream, lake, or other body of water, measured from the ordinary high-water mark, and extends beyond the high-water mark to include wetlands and areas that provide additional protection in zones with steep slopes or erosive soils."[26] Within these zones, there are specific prohibitions on certain forest activities, including: broadcast burning; off-road vehicle operation; clearcutting; road construction unless necessary for stream crossing; handling, storage, application or disposal of hazardous or toxic substances in a manner that pollutes water bodies or that may damage humans, land, animals, or plants; side-casting of road material into water bodies; or deposit of slash in water bodies.[27]

There are detailed regulations delineating the stream management zones and defining prohibited practices and site-specific alternative practices.[28] The department of natural resources and conservation has inspection authority on federal, state and private land to ensure compliance with the rules for streamside management zones.[29] The department may issue civil penalties of up to $1,000 per day, as well as rehabilitation orders.[30]

• The forestry code also contains a section titled "protection of forest resources,"[31] which "encourages" the use of best management practices and includes a requirement that notice be given prior to commencement of any forestry practices.[32] Upon receiving such notice, the department of natural resources and conservation must decide whether to require an onsite consultation with the operator, based on whether "the proposed timber sale is in a high-priority location for watershed resources" or whether "a consultation could contribute to improved watershed management."[33] However, this procedure is not in itself enforceable; the code expressly states that consultation "is intended only for the purpose of providing information to owners and operators and does not confer upon the department or any other agency of state or local government authority to compel an owner or operator to undertake or refrain from undertaking specific management practices that are not otherwise regulated by law or rule."[34]

Agriculture Requirements

• The soil conservation code allows for creation of soil conservation districts to conduct research, implement projects and provide technical assistance and education on soil conservation.[35] These districts are authorized to formulate and propose soil and water conservation regulations, which are subject to approval by referendum.[36] Once approved, the regulations may prescribe specific agricultural practices for soil and water conservation within the district.[37] Affected parties may petition for a variance where "there are great practical difficulties or unnecessary hardship in the way of ... carrying out ... the strict letter of the land use regulations."[38] The district's decision whether to issue a variance is reviewable in court.[39]

Soil conservation districts have authority to enter and inspect premises to determine compliance with their regulations.[40] They may petition the state district court for an order enforcing the regulations where nonobservance "tends to increase erosion on [defendant's] lands ...and is interfering with the prevention or control of erosion on other lands."[41] The court may order specific performance of required practices, or permit the district to perform the work and recover its costs from the landowner.[42]

• The Natural Streambed and Land Preservation Act requires that any "project," defined as the physical alteration of a stream resulting in change in the state of the stream, be approved by the local soil conservation district or board of county commissioners before commencing work.[43] Approval decisions are made by the district board based on recommendations made by an onsite inspection team, and are subject to judicial review.[44] The decision is based on multiple factors, including: the effects on soil erosion and sedimentation; upstream or downstream flooding and erosion effects; streamflow, turbidity, and water quality effects; and effect on fish and aquatic habitat.[45] Projects engaged in without approval or outside the scope of the approval are declared a public nuisance and subject to abatement proceedings; they are also subject to civil penalties of up to $500 per day and/or a misdemeanor fine of up to $500.[46] However, "customary and historic maintenance and repair of existing irrigation facilities that do not significantly alter or modify the stream" are excluded from the definition of "project," and thus from the approval requirement.[47]

• The Agricultural Chemical Ground Water Protection Act covers both pesticides and fertilizers, and requires the department of agriculture and the department of environmental quality to cooperate to administer ground water standards for agricultural chemicals.[48] It requires them to develop numerical standards and interim standards for agricultural chemicals, primarily based on EPA's promulgated and nonpromulgated standards under the Clean Drinking Water Act.[49] Both departments are authorized to "implement appropriate actions ... to mitigate any existing impacts of an agricultural chemical found in ground water."[50] These include development of a general ground water management plan[51] and site-specific management plans, which must be complied with by all persons in the covered geographic area.[52] The plans are adopted by rulemaking or with emergency authority.[53] Site-specific management plans may include restrictions on chemical use in certain areas; best management practices; certification, training and licensing requirements; setback areas near water wells; and alternative practices.[54]

It is unlawful to violate any provision of a site-specific ground water management plan, any order issued pursuant to the Act, or any provision of the Act.[55] Both the department of agriculture and the DEQ have monitoring authority.[56] The department of agriculture is the lead department for determining compliance with groundwater management plans, and is granted inspection authority under the Act.[57] The DEQ is the lead department for determining health risks, and may enforce the Act using its enforcement authority under the water quality code.[58] The department of agriculture may issue compliance orders, assess administrative civil penalties of up to $1,000 per violation, and file civil actions seeking a temporary or permanent injunction.[59] Violators are also subject to judicial penalties of up to $10,000 per violation and, for intentional violations, criminal penalties of up to $25,000 and/or imprisonment of up to one year, which can be doubled for repeat offenses.[60]

• Montana's general pesticide law makes it illegal "to discard any pesticide or pesticide container in a manner that causes injury to humans, domestic animals, or wildlife or that pollutes any waterway in a way harmful to any wildlife in the waterway or to the environment."[61] The department of agriculture has general entry, investigation and enforcement authority for pesticide violations, including violations of the handling, use and application standards.[62]

Violation of the pesticide law or rules is a misdemeanor, punishable by a fine of $100-$1,500; the department also may issue compliance orders, including cleanup requirements, and/or seek injunctive relief in court.[63] "Major violations," which include misuse that is inconsistent with labelling and results in "proven exposure" or "proven harm" to humans, agricultural commodities, livestock, or the environment, are subject to civil penalties of up to $25,000 per violation; and, if committed willfully, subject to a $50,000 fine and imprisonment of up to 10 years.[64]

Development and Other Earth-Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act or that may be authorized by general land use regulation such as zoning, state law provides the following authorities.

• The water quality code allows, but does not require, the creation of local water quality districts "to protect, preserve, and improve the quality of surface water and ground water."[65] County commissions and/or city councils may establish such districts, whose directors may then develop a local water quality program that is implemented through local ordinances, including administrative and civil enforcement and penalties.[66] Specific focuses of the programs include onsite waste water disposal, storm water runoff, and engine lubricants.[67] The districts also have authority to assess fees for water use, although irrigation and livestock uses are exempt from these fees.[68] Upon approval of the programs, state enforcement authority may be delegated to the district level.[69]

• The legislature also has enacted a law protecting lakeshores, and declared that "local governments should play the primary public roles in establishing policies to conserve and protect lakes."[70] Under that law, "a person who proposes to do any work that will alter or diminish the course, current, or cross-sectional area of a lake or its lakeshore must first secure a permit for the work from the local governing body."[71] Local jurisdictions are required to adopt regulations, including criteria for issuing and denying permits for work in lake areas; factors for consideration include water quality, fish and wildlife habitat, navigation and recreation, public nuisance, and visual and aesthetic values.[72] Regulations and decisions of these governing bodies are judicially enforced and judicially reviewable.[73] Violation of orders or regulations is a misdemeanor, subject to up to 30 days in jail and/or a $500 fine; violators may also be required to restore the lake to its original state before the unauthorized work was commenced.[74]

• As discussed above, the Natural Streambed and Land Preservation Act requires that any "project," defined as the physical alteration of a stream resulting in change in the state of the stream, be approved by the local soil conservation district or board of county commissioners before commencing work.[75]

Endnotes

1. Mont. Code Ann. § 75-5-605(a).
2. Mont. Code Ann. § 75-5-103.
3. Mont. Code Ann. § 75-5-605(a).
4. Mont. Code Ann. §§ 75-5-605(d), 75-5-303.
5. Mont. Code Ann. § 75-5-303.
6. Mont. Code Ann. §§ 75-5-317(2)(a), (b), (c), (h), (q), (r). The detailed nondegradation regulations are found at Mont. Admin. R. § 16.20.701.
7. Mont. Code Ann. § 75-5-611.
8. Mont. Code Ann. § 75-5-611; the enforcement regulations are found at Mont. Admin. R. § 16.20.102.
9. Mont. Code Ann. § 75-5-611.
10. Mont. Code Ann. §§ 75-5-612, -601, -621, -614.
11. Mont. Code Ann. §§ 75-5-631, -632.
12. Mont. Code Ann. § 75-5-632.
13. Mont. Code Ann. § 27-30-101(1).
14. Mont. Code Ann. § 45-8-111.
15. Mont. Code Ann. § 27-30-101(3); Mont. Code Ann. § 45-8-111(4).
16. Mont. Code Ann. §§ 76-2-901, -903.
17. Mont. Code Ann. §§ 27-30-103, -301, -302.
18. Mont. Code Ann. §§ 27-30-202, -204.
19. Mont. Code Ann. §§ 45-8-111(6).
20. Mont. Code Ann. §§ 45-8-112.
21. Mont. Code Ann. § 87-3-206.
22. Mont. Code Ann. § 87-1-112.
23. Mont. Code Ann. § 87-1-102(1).
24. Mont. Code Ann. § 87-1-111(1)(g).
25. Mont. Code Ann. § 77-5-301 et seq.
26. Mont. Code Ann. § 77-5-301(8).
27. Mont. Code Ann. § 77-5-303.
28. Mont. Admin. R. § 36.11.301 et seq.
29. Mont. Code Ann. § 77-5-304.
30. Mont. Code Ann. § 77-5-305(2), (3).
31. See Mont. Code Ann. § 76-13-101 et seq.
32. Mont. Code Ann. § 76-13-131.
33. Mont. Code Ann. § 76-13-132.
34. Mont. Code Ann. § 76-13-133.
35. Mont. Code Ann. § 76-15-101.
36. Mont. Code Ann. § 76-15-701.
37. Mont. Code Ann. § 76-15-706.
38. Mont. Code Ann. § 76-15-723.
39. Mont. Code Ann. § 76-15-726.
40. Mont. Code Ann. § 76-15-708.
41. Mont. Code Ann. § 76-15-709.
42. Mont. Code Ann. § 76-15-709.
43. Mont. Code Ann. § 75-7-101 et seq.
44. Mont. Code Ann. §§ 75-7-112, -114.
45. Mont. Code Ann. § 75-7-112.
46. Mont. Code Ann. §§ 75-7-122, -123.
47. Mont. Code Ann. § 75-7-103(5)(b).
48. Mont. Code Ann. § 80-15-101 et seq.; detailed regulations are at Mont. Admin. R. § 4.11.101 et seq.
49. Mont. Code Ann. § 80-15-201. "The board may determine ... that an interim numerical standard different from either a promulgated or nonpromulgated federal standard is justified." Mont. Code Ann. §

80-15-201(1). However, standards may not be more stringent than federal standards unless they are adopted through a full notice-and-comment procedure. Mont. Code Ann. § 80-15-110.

50. Mont. Code Ann. § 80-15-203.
51. Mont. Code Ann. § 80-15-211.
52. Mont. Code Ann. § 80-15-212.
53. Mont. Code Ann. § 80-15-217.
54. Mont. Code Ann. § 80-15-214.
55. Mont. Code Ann. § 80-15-402.
56. Mont. Code Ann. § 80-15-202.
57. Mont. Code Ann. §§ 80-15-203(2)(b), 80-15-401.
58. Mont. Code Ann. §§ 80-15-203(2)(a), 80-15-401.
59. Mont. Code Ann. §§ 80-15-403, -412, -404.
60. Mont. Code Ann. §§ 80-15-413, -414.
61. Mont. Code Ann. § 80-8-305(1).
62. Mont. Code Ann. § 80-8-304.
63. Mont. Code Ann. §§ 80-8-306, -305.
64. Mont. Code Ann. § 80-8-306(5).
65. Mont. Code Ann. § 7-13-4501 et seq.; Mont. Code Ann. § 75-5-311.
66. Mont. Code Ann. § 75-5-311(5).
67. Mont. Code Ann. § 75-5-311(4).
68. Mont. Code Ann. § 7-13-4523.
69. Mont. Admin. R. § 16.20.501 et seq.
70. Mont. Code Ann. § 75-7-201 et seq.
71. Mont. Code Ann. § 75-7-204.
72. Mont. Code Ann. §§ 75-7-207, -208.
73. Mont. Code Ann. § 75-7-215.
74. Mont. Code Ann. §§ 75-7-216, -205.
75. Mont. Code Ann. § 75-7-101 et seq.

NEBRASKA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Nebraska's water pollution law includes provisions that may be used to take action against nonpoint source discharges that pollute state waters or result in water quality violations.

• Under Nebraska's Environmental Protection Act, it is unlawful to "cause pollution of any...waters...of the state or to place or cause to be placed any wastes in a location where they are likely to cause pollution" of any waters of the state.[1] Waste is defined as "sewage, industrial waste, and all other liquid, gaseous, solid, radioactive, or other substances which may pollute or tend to pollute any air, land or waters of the state."[2]

• It is unlawful to violate any water quality standards, any permit or license condition, any order, or any rule or regulation adopted under the state Environmental Protection Act.[3]

• The law also declares it unlawful and a public nuisance to "discharge or emit any wastes into any...waters...of the state which reduce the quality of such...waters" below water quality standards.[4] (This section further provides that a livestock operation is not a nuisance if it is in compliance with applicable regulations and zoning regulations, and if the nuisance action is brought by a private person whose ownership or possession of land allegedly affected by the nuisance was subsequent to (a) the issuance of an appropriate permit for the livestock operation or (b) when operation of the feedlot began and an inspection by the department revealed that no permit was required.[5])

Enforcement of these water pollution control provisions is through corrective action orders, injunctions, civil penalties up to $10,000 per day, and criminal (felony and misdemeanor) prosecution. The state may recover damages for restocking the waters with fish or replenishing wildlife.[6]

Other Discharge Limitations

• In addition to the above nuisance provision, Nebraska law provides that the "corrupting or rendering unwholesome or impure of any watercourse, stream, or water, or unlawfully diverting any such watercourse from its natural course or state to the injury or prejudice of others," shall be deemed nuisances.[7] Maintenance of a nuisance is a class III misdemeanor, and courts "shall order every such nuisance to be abated or removed."[8]

• Under Nebraska's Groundwater Management and Protection Act, each natural resources district is required to prepare a groundwater management plan, which must include information on groundwater supplies, crop water needs, groundwater quality concerns, etc. The groundwater management plan must be approved by the director of water resources.[9] If a district determines from the groundwater management plan that a "management area" should be established to protect groundwater supplies, it shall by order designate the management area and adopt one or more of the controls authorized by the law, which include best management practices.[10]

Each state agency and political subdivision is directed to report promptly to the department of environmental quality any information which indicates that groundwater contamination is occurring.[11] After being informed that contamination is occurring, the department must study the problem. Upon determining that contamination is coming from a point source, the director "shall expeditiously use the procedures authorized ... to stabilize or reduce the level and prevent the increase or spread of such contamination."[12]

If the director of environmental quality determines from a study that one or more sources of contamination are not point sources, and if a management area has been designated covering that affected area, the director shall consider whether to require the natural resources district to adopt an "action plan." If there is no management area covering the contaminated area, the director shall hold hearings and determine whether to designate a management area and prepare an action plan.[13] If the director determines an action plan is necessary, the district shall prepare an action plan designed to stabilize or reduce the level and prevent the increase or spread of groundwater contamination, and shall include any of the controls authorized by law, including best management practices.[14] If the district fails to adopt an action plan in a specific time, the power to specify the controls authorized by law is vested in the director of environmental quality, along with enforcement authority.[15]

Enforcement of the Groundwater Management and Protection Act by natural resources districts is primarily through cease and desist orders, which may be enforced judicially. Any violation of a cease and desist order issued by a district is a Class IV misdemeanor.[16]

Fish/Fisheries Laws

• Nebraska's game and parks code contains fisheries provisions that may relate to nonpoint source pollution. The code provides that it is unlawful to "dump or drain any refuse from any factory, slaughterhouse, gas plant, garage, repair shop, or other place whatsoever or any refuse, junk, dross, litter, trash, lumber, or leavings into or near any of the waters of this state or into any bayou, drain, ditch, or sewer which discharges such refuse or an part thereof into any of the waters of this state. It shall be unlawful to place, leave, or permit to escape any such refuse in such manner that it or any part of it is through the action of the elements or otherwise carried into any of the waters of this state."[17] Refuse is defined to include "oils, tars, creosote, blood, offal, decayed matter, and all other substances which are injurious to aquatic life."[18]

• It is also unlawful to "place the carcass of any dead animal, fish, or fowl in or near" waters of the state or to "leave such carcass where the whole or any part thereof may be washed or carried into" waters of the state.[19]

• Finally, it is unlawful to "place, run, or drain any matter harmful to fish into any of the waters of this state that have been stocked by the [Game and Parks] commission."[20]

Enforcement of these provisions is through criminal (Class II or IV misdemeanor) prosecution.

OPERATIONAL REQUIREMENTS

Forestry Requirements

The state's Erosion and Sediment Control Act, described in the following section, may be applicable to forestry activities to control soil loss.[21]

Agriculture Requirements

• Each natural resources district in the state is required under the Erosion and Sediment Control Act to adopt a program for implementing the state erosion and sediment control program. The district program must include (1) soil-loss limits for the various types of soils, which are to be adopted and promulgated as rules and regulations and which must be at least as stringent as those adopted by the state director of natural resources; (2) recommended erosion or sediment control practices; and (3) programs, procedures, and methods to implement the program.[22]

The Act also delegates authority to municipalities and counties to adopt rules governing erosion and sediment control that are in substantial conformance with the state erosion and sediment control program.[23] In such cases, the municipality or county may assume jurisdiction to enforce applicable soil-loss limits.

Any person who has a farm unit conservation plan approved by the district and is implementing it in strict compliance, or any person whose normal agricultural, horticultural, and silvicultural practices are in conformance with the applicable soil-loss limit is deemed to be in compliance with the Erosion and Sediment Control Act. Except for cases where erosion occurs on the site of any nonagricultural land-disturbing activity, a landowner will not be required to conform his practices to the applicable soil-loss limit or will not be required to implement the soil and water conservation practices in the plan unless and until there is made available to the landowner at least 90 percent cost-sharing assistance.[24]

Where there are violations of a district's soil-loss limits, the district may reach an agreement with the owner for eliminating excessive erosion, which agreement is enforceable in district court. The district may also, following a hearing, issue administrative orders. In the case of agriculture, silviculture or horticulture activities, the administrative order is to direct the owner to conform to the applicable soil-loss limit. For "non-agriculture" activities, the administrative order may authorize the owner to either conform to the soil-loss limits or prevent the sediment caused by excessive erosion from leaving the land.[25] The order may specify alternative soil and water conservation practices or erosion or sediment control practices that may be used.[26] The district court issues an order directing the owner to comply with the district's administrative order, and any person who fails to comply with the court order is deemed in contempt of court and punished accordingly.[27]

• While the Department of Environmental Quality is responsible for adopting standards for pesticides in surface and groundwater, the Department of Agriculture is charged with developing and implementing a state management plan for the prevention, evaluation, and mitigation of occurrences of pesticides or pesticide breakdown products in ground water and surface water. The Department of Agriculture is authorized to promulgate regulations specifying methods to be used in the application of pesticides, including time, place, manner, methods, materials, amounts, and concentrations, and may restrict or prohibit the use of pesticides in designated areas. The regulations "shall encompass all reasonable factors which the department deems necessary to prevent damage or injury by drift or misapplication" to plants, wildlife, fish and other aquatic life, surface and groundwater and humans.[28]

Nebraska law further provides that it is unlawful to use a pesticide contrary to the labeling or to a rule of the department limiting its use. It is also unlawful to "dispose of, discard or store a pesticide...in a manner that the person knows or should know is...likely to cause injury to humans, the environment, vegetation, crops, livestock, wildlife or pollinating insects...(or) likely to pollute a water supply or waterway....[29]

Enforcement of the Pesticide Act is through administrative cease and desist orders, license revocation, administrative fines of up to $5,000, injunctions, civil fines of not more than $15,000, and criminal (misdemeanor) prosecution.[30]

• A permit is required for anyone who applies chemicals to land or crops through the use of chemigation. An application for a permit is approved if the irrigation distribution system complies with the statutory requirements and the applicator has been certified.[31] Enforcement is through criminal (misdemeanor) prosecution, civil penalties of up to $1,000, and injunctions.[32]

• "In order to conserve groundwater supplies and to prevent the inefficient or improper runoff of such ground water, each person who uses ground water irrigation in the state shall take action to control or prevent the runoff of water used in such irrigation."[33] Each district is directed to adopt regulations prescribing: standards for what constitutes the improper runoff of groundwater used in irrigation; procedures to prevent, control, and abate such runoff; remedial measures to prevent, control or abate runoff; and enforcement procedures.[34] Enforcement is through cease and desist orders issued by the district.[35]

Development and Other Earth-Disturbing Activities

• The Erosion and Sediment Control Act discussed above applies to non-agricultural, land-disturbing activities, though the Act excludes residential, commercial and industrial construction involving less than two acres.[36]

Endnotes

1. Nebraska Revised Statutes 81-1506(a).
2. NRS 81-1502(14).
3. NRS 81-1508.02.
4. NRS81-1506(b).
5. NRS 81-1506(b).
6. NRS 81-1508(1), 81-1508.01(1), 81-1508.02.
7. NRS 28-1321.
8. NRS 28-1321(4), (5).
9. NRS 46-656.12.
10. NRS 46-656.20, 46-656.25.
11. NRS 46-656.35.
12. NRS 46-656.36-.37.
13. NRS 46-656.38 -- 46-656.62.
14. NRS 46-656.40 -- 46-656.42.
15. NRS 46-656.45.
16. NRS 46-656.08, 656.10
17. NRS 37-555.
18. NRS 37-555.
19. NRS 37-556.
20. NRS 37-558.
21. *See* NRS 4603(7).
22. NRS 2-4605.
23. NRS 2-4606.
24. NRS 2-4610(1),(2).
25. NRS 2-4608(2).
26. NRS 2-4608(3).
27. NRS 2-4613.
28. NRS 2-2626.
29. NRS 2-2645.
30. NRS 2-2626(6)-(8), 2-2647, 2-2648.
31. NRS 46-117.
32. NRS 46-1127, 46-1139, 46-1143.
33. NRS 46-656.11(1).
34. NRS 46-656.11(2).
35. NRS 46-656.11(3).
36. NRS 2-4603(7).

NEVADA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Nevada's water pollution control law includes some provisions that may be used to take enforcement action against some nonpoint source discharges that pollute the waters of the state.

• Nevada's water pollution control act ("Act") allows the state environmental commission ("commission") to prescribe controls for those "diffuse sources" (equivalent to nonpoint sources)[1] existing on January 1, 1979 that are "significantly causing or adding to water pollution in violation of a water quality standard."[2]

• The commission also may prescribe controls for new diffuse sources to prevent degradation of high quality waters,[3] except with respect to "normal agricultural rotation, improvement or farming practices."[4] The Act further provides that new or increased diffuse sources must provide measures that are designed to prevent, eliminate or reduce water pollution from the source and are reasonably consistent with the economic capability of the project or development.[5]

The Act directs the commission to delegate administration of the diffuse sources program to counties and cities that request it and have sufficient resources.[6] For violations involving diffuse sources, an administrative order prescribing corrective actions can be issued or a civil action can be brought with the court ordering injunctive relief or posting of a bond or other security, but no civil or criminal penalty is authorized.[7]

• Special regulations exist to protect the Lake Tahoe watershed. The Act makes it illegal to discharge waste within 100 feet of the lake or a stream or other water supply in the Lake Tahoe watershed.[8]

Other Discharge Limitations

• The county and city boards of health are authorized to define and abate nuisances.[9]

• Nevada law creates a cause of action for damages against any person who maintains, dumps, turns or flows "anything of a liquid nature poisonous or injurious to...livestock, into an open ditch...pond, reservoir or any other place," unless the livestock are fenced out of the affected water body.[10]

Fish/Fisheries Laws

• Any person who places in or allows to fall into waters of the state "any substance deleterious to fish or wildlife" is guilty of a misdemeanor for the first offense and gross misdemeanor for a subsequent offense.[11] Misdemeanor convictions that are punishable by fines ($50 to $500) and/or imprisonment (six months or less).[12] Conviction of the unlawful killing of a mammal, bird or fish results in additional civil penalties.[13] A court may also revoke or suspend wildlife-related licenses,[14] and licenses may be suspended administratively after conviction, based on a point system reflecting the severity of the offense.[15]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• The Nevada forestry statute requires a permit from the state forester firewarden for logging or cutting operations, which may be denied if the operation will cause significant soil erosion and siltation.[16] The forestry statute also requires a certificate before the conversion of timberland "to any use other than the growing of timber,"[17] which the firewarden may deny for, among other reasons, failure to give satisfactory proof that adequate provision will be made "to stabilize, revegetate or rehabilitate disturbed soils in order to minimize erosion, flooding or other damage to the watershed."[18] According to rules promulgated under the Act, all logging permits and timberland conversion certificates must require the use of best management practices to prevent, eliminate or reduce water pollution from diffuse sources.[19] A violation of permit conditions or forest practice rules can result in administrative suspension or revocation of any logging permit;[20] and lack of compliance with timberland conversion certificate may also result in administrative suspension or revocation.[21] Violation of these provisions is a misdemeanor punishable with a fine (up to $1000) and/or imprisonment (six months or less).[22]

• The Nevada forestry statute provides for variances for certain otherwise prohibited forestry activities. Nevada law prohibits "felling of trees, skidding, rigging or construction of roads...within 200 feet of a waterbody"[23] without a variance, which may be granted if, among other standards, the goal of maintaining water quality standards will not be compromised.[24] It is illegal to engage in tractor logging on slopes of 30 percent or more without a variance, and, in deciding whether to grant and/or what conditions to the variance, the firewarden must consider displacement and erosion of soils and siltation of streams.[25] The enforcement provisions and sanctions are noted above.

• The forestry statute also requires tractor skid trails, landings, logging truck roads and firebreaks to be located, constructed, used and left so as to not "appreciably diminish the quality of the water"[26] and includes standards that require that the waterbreak and culvert system on all tractor skid trails, landings, logging truck roads and firebreaks be designed so as to prevent degradation of water quality.[27]

Agriculture Requirements

• A "diffuse source" as described above includes "agricultural activity" and "return flows from irrigation."[28] The enforceable mechanisms are also described above.

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• A conservation district may petition the state conservation commission to formulate land use regulations that may include provisions that prevent soil erosion and sedimentation.[29] Variances from these provisions may be available from a board of adjustment set up by the commission.[30] The commission may request a court to enforce the land use regulations[31] or authorize a land occupier to recover damages from another occupier for a violation.[32] A court may order a defendant to bring the land into compliance or allow the commission to perform the work and recover the costs.[33]

• Nevada law prohibits grazing in areas into which water is diverted for municipal, drinking or domestic purposes in the state, with some exceptions including prospectors or other persons with ten head of livestock passing over or being temporarily upon such lands, livestock running at large upon the range and persons herding on their own lands.[34] Violation of this provision is a misdemeanor, and each day constitutes a separate violation.[35]

• Nevada regulates pesticides and certifies pesticide applicators.[36]

Development and Other Earth-Disturbing Activities

• State law empowers local governments to regulate land improvements and location of structures and to take into account the potential impairment of natural resources.[37] Also zoning regulations must be designed to preserve the quality of water resources.[38] Nevada law broadly provides for the state land use planning agency to assist local governments in planning for "areas of critical environmental concern"[39] and requires preparation of regional land use plans that include goals relating to conservation and protection of water and other natural resources.[40]

• Also see "diffuse sources." Nevada regulations provide for permits to construct or grade, which "must require that practices be used to prevent, eliminate or reduce water pollution from any diffuse source during the activity.[41]

Endnotes

[1] NRS 445A.335.
[2] NRS 445A.570(1)(a).
[3] NRS 445A.570(1)(b).
[4] NRS 445A.565(1).
[5] NRS 445A.565(2)(b).
[6] NRS 445A.570(2).
[7] NRS 445A.680, 445A.695.
[8] NRS 445A.170-190.
[9] NRS 439.360, 439.470, 269.205, 266.335.
[10] NRS 575.040.
[11] NRS 503.430.
[12] NRS 501.385.
[13] NRS 501.3855(2).
[14] NRS 501.387.
[15] NRS 501.1814-.1818.
[16] NRS 528.042, 528.044(1)(b)(4).
[17] NRS 528.082-.090.

[18] NRS 528.084(2)(d).
[19] NAC 445A.340.
[20] NRS 528.047.
[21] NRS 528.088.
[22] NRS 528.090, 193.150.
[23] NRS 528.053(1).
[24] NRS 528.053(2).
[25] NRS 528.048(2), (3)
[26] NRS 528.055.
[27] NRS 528.0551.
[28] NAC 445A.309.
[29] NRS 548.410.
[30] NRS 548.505(7).
[31] NRS 548.445.
[32] NRS 548.440(2).
[33] NRS 548.450(3).
[34] NRS 568.330.
[35] NRS 568.330(3) & (4).
[36] NRS 586.010 et seq.
[37] NRS 278.020.
[38] NRS 278.250(2).
[39] NRS 321.640-770.
[40] NRS 278.0274(2).
[41] NAC 445A.339.

NEW HAMPSHIRE

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

New Hampshire's water pollution control law has several provisions that may be used to take enforcement action against nonpoint source water pollution. Two of these provisions prohibit disposal of "wastes" or discharges of "pollution" that result in violation of water quality classifications. A third prohibits the discharge of "wastes" to any waters of the state without a written permit. And a fourth, more narrowly defined prohibition, identifies some specific substances that may not be placed into the state's waters or onto the banks of such waters. None of these provisions is expressly limited to point sources.

- "After adoption of a given classification for a stream, lake, pond, tidal water, or section of such water, the department [of environmental services] shall enforce such classification by appropriate action in the courts of the state, and it shall be unlawful for any person or persons to dispose of any sewage, industrial, or other wastes, either alone or in conjunction with any other person or persons, in such a manner as will lower the quality of the waters of the stream, lake, pond, tidal water, or section of such water below the minimum requirements of the adopted classification...."[1] "

- "If, after adoption of a classification of any stream, lake, pond, or tidal water, or section of such water...it is found that there is a source or sources of pollution which lower the quality of the waters in question below the minimum requirements of the classification so established, the person or persons responsible for the discharging of such pollution shall be required to abate such pollution within a time to be fixed by the department...."[2]

- "It shall be unlawful for any person or persons to discharge or dispose of any sewage or waste to the surface water or groundwater of the state without first obtaining a written permit from the department of environmental services. Applications for permits shall be made upon forms prescribed by the department..."[3]

For purposes of these prohibitions, "Waste" means "industrial waste and other wastes;" while "other wastes" means "garbage, municipal refuse, decayed wood, sawdust, shavings, bark, lime, ashes, offal, oil, tar, chemicals and other substances other than sewage or industrial wastes, and any other substance harmful to human, animal, fish or aquatic life."[4]

Enforcement of these prohibitions is by the department of environmental services, which may establish the period for abatement, issue a cease and desist order, or seek injunctive relief in court.[5] "On application of the department of environmental services, the superior court or any justice of such court...may enjoin any act in violation of any lawful order of the department of environmental services."[6] "The department shall issue a written cease and desist order against any discharge or act in violation of this subdivision...or lawful regulation of the department...or any condition of any

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permit lawfully issued by the department, and any such discharge or act may be enjoined by the superior court upon application of the attorney general..."[7] "The written cease and desist order...shall be recorded by the department in the registry of deeds for the county in which the property is situated and, upon recordation, said order shall run with the land..."[8] Enforcement against timber operations in violation of this chapter is conducted by the director of the division of forests and lands, department of resources and economic development.[9] Violators are subject to civil penalties of up to $10,000 per day; or administrative penalties of not more than $2,000 per offense. Willful or negligent violations, or knowing failure to obey a lawful order subjects the violator to a fine of up to $25,000 per day and/or imprisonment for up to 6 months.[10]

• A separate, and more narrow water pollution provision may be applicable to a limited set of nonpoint problems. "It shall be unlawful for any person to put or place, or cause to be put or placed into a surface water of the state or on the ice over such waters, or on the banks of such waters, any bottles, glass, crockery, cans, scrap metal, junk, paper, garbage, tires, old automobiles or parts thereof, tree, or similar litter."[11] Enforcement is by abatement order, abatement and cost recovery, injunction, and fine.[12]

In interpreting and applying its laws to nonpoint source water pollution, New Hampshire may rely in part upon its law declaring a public trust in the waters of the state, creating obligations for all of its land management and regulatory agencies: "[T]he water of New Hampshire whether located above or below ground constitutes a limited and, therefore, precious and invaluable public resource which should be protected, conserved and managed in the interest of future generations. The state as trustee of this resource for the public benefit declares that it has the authority and responsibility to provide careful stewardship over all the waters lying within its boundaries. The maximum public benefit shall be sought, including the assurance of health and safety, the enhancement of ecological and aesthetic values, and the overall economic, recreational and social well-being of the people of the state. *All levels of government within the state, all departments, agencies, boards and commissions, and all other entities, public or private, having authority over the use, disposition or diversion of water resources, or over the use of the land overlying or adjacent to, the water resources of the state, shall comply with this policy and with the state's comprehensive plan and program for water resources management and protection.*"[13] Under the water pollution law, state law provides that the department of environmental services shall be governed solely by criteria related to a more narrowly defined purpose: "to protect water supplies, to prevent pollution in the surface and groundwaters of the state and to prevent nuisances and potential health hazards."[14]

Other Discharge Limitations

Public health and nuisance-type provisions also provide enforceable mechanisms applicable to some forms of nonpoint source pollution.

• "The health officers of towns may make regulations for the prevention and removal of nuisances, and such other regulations relating to the public health as in their judgement the health and safety of the people require, which shall take effect [upon approval by the selectmen, and publication]."[15] The department of health and human services has the same power, with enforcement by the department or by local boards of health.[16] These may extend to some forms of nonpoint source water pollution.

Agricultural operations are not abatable as a public or private nuisance "if such agricultural operation has been in operation for one year of more and if it was not a nuisance at the time it began operation." However, this provision does not apply "when any aspect of the agricultural operation is determined to be injurious to public health or safety under [the health officer provisions noted above]."[17] Also, the exemption does not apply "if a nuisance results from the negligent or improper operation of an agricultural operation. Agricultural operations shall not be found to be negligent or improper when they conform to federal, state and local laws, rules and regulations."[18] This appears to say that unless agricultural operations are in violation of a law, they cannot be abated as a nuisance apart from the public health risk provisions cited above.

• "No privy, toilet, sink, drain, cesspool, septic tank, or the discharges from such facilities, and no pen or sty for swine, shall be erected or continued in such place or condition as, in the judgment of the health officers, to be a nuisance or injurious to the public health. The health officer may make, in the manner provided in RSA 147:1, such regulations as necessary to ensure the safety and adequacy of subsurface sanitary disposal systems within the municipality..."[19]

• Whoever places "any animal or other substance liable to become putrid or offensive, or injurious to the public health, or deposits garbage or refuse on premises not designated as public dumping facilities...shall be guilty of a violation."[20]

• "If a person shall place, leave, or cause to be placed or left, in or near a lake, pond, reservoir or stream tributary thereto, from which the domestic water supply of a city, town or village is taken, in whole or in part, any substance or fluid that may cause such water to become impure or unfit for such purposes he shall be guilty of a misdemeanor if a natural person, or guilty of a felony if any other person."[21] "The health officer of the town or the water commissioners having charge of the water supply, or the proprietors of the water supply, may remove such substance or fluid; and they may recover the expense of removal from the person who placed the same, or caused it to be placed."[22] It is also a criminal offense to knowingly and willfully poison, defile, or pollute a water supply "in such a manner as to affect the purity of the water or ice so supplied at the point where the water or ice is taken for such domestic use" or to put "the carcass of any dead animal or other offensive material into said waters or upon the ice."[23]

Fish/Fisheries Laws

• "Whoever unlawfully discharges contaminants into the inland or coastal waters of the state shall be liable to the state for any damage to the fish, other aquatic life and wildlife or their habitat in said waters caused by such contamination."[24]

OPERATIONAL REQUIREMENTS

Forestry Requirements

The Director of the Division of Forests and Lands, within the Department of Resources and Economic Development, enforces provisions on timber harvesting on private and public lands; the Director also makes rules on "the cutting of timber near

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certain waters and public highways."[25] These provisions create some enforceable obligations related to nonpoint source water pollution.

• The timber harvesting law requires filing of a notice of intent to cut.[26] The law requires cross-compliance with the state's wetlands permitting program including implementation of best management practices; and it requires compliance with the state's alteration of terrain program. Licensing of professional foresters also provides some basis for enforcement.[27]

• The law prohibits the felling in any 12 month period of more than 50 percent of the basal area of trees within 150 feet of any great pond, standing body of water 10 acres or more, or any fourth- or high-order stream, or within 50 feet of any perennial stream.[28] However, the director may grant a variance from these geographical harvest prohibitions; and the prohibitions do not apply to timber cutting for land conversion purposes, rather than for timber, if all relevant local permits have been secured.[29]

• The law also prohibits disposal of slash and mill residue in any perennial stream or standing body of water, within 25 feet of any fourth order stream, or within 50 feet of any great pond or standing body of water 10 acres or more in area.[30]

A cease and desist order is to be issued by the department against any timber operation in violation of the law; violations may also be enjoined by superior court.[31] In addition, the department must "[i]ssue cease and desist orders to temporarily suspend logging or other operations in forest areas when the director determines that such actions have resulted in, or are likely to result in, pollution of surface water or groundwater." The cease and desist order remains in effect while the director notifies the department of environmental services, which will conduct its own investigation and determine what, if any, orders to issue.[32] Administrative fines may be also assessed for any offense, not to exceed $2,000 per offense.[33] The limits on harvesting adjacent to bodies of water are enforceable as misdemeanors by the local municipality, with notice to the director of forests and lands, who may act to assure uniform statewide enforcement.[34] Violations of these harvest limits or of the prohibitions on disposal of slash and mill residue are misdemeanors (each 200 linear feet or fraction thereof on the affected water body is a separate offense).[35]

• Apart from the forest practices law, the Alteration of Terrain program (described in detail under "Development and Other Earth-Disturbing Activities") also provides some basis for enforcement. Timber harvesting operations are entitled to a permit under this program provided they have filed the notice of intent to cut. The regulations require loggers to obtain the site specific permit by signing a statement on the notice of intent to cut that expresses familiarity with legal obligations and "hereby agree to abide by appropriate Best Management Practices to include all state laws pertaining to logging operations."[36] "Appropriate Best Management Practices" means "those contained in the manual 'Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire' prepared by the New Hampshire department of resources and economic development."[37]

• Persons who have filed the necessary notice of intent to cut wood and have given written notice to the department of environmental services and the department of resources and economic development also satisfy the requirements for "minimum impact activities" under the state's wetland fill and dredge permit program.[38] Under this program, however, logging operations must locate all skid trails, truck roads, and log landings far enough from streams and ponds so that waterborne particles will settle out before reaching the streams or ponds. Skid trails and roads, culverts, bridges, crossings, etc must be installed in accordance with Best Management Practices, and crossings must be removed when logging is complete; permanent crossings must handle the 25-year flood.[39] Erosion and siltation measures must be installed and maintained.[40] Wetland enforcement measures are described below under "Development and Other Earth-Disturbing Activities."

• Comprehensive shoreland protection is partly applicable to forestry activities;[41] it requires maintenance of a natural woodland buffer within 150 feet (limiting harvest to not more than 50 percent of basal area and 50 percent of saplings within a 20 year period).[42] However, forest management not associated with shoreland development or land conversion is exempt from these provisions if conducted in compliance with the forest practices provisions described above limiting the cut adjacent to waters to 50 percent of basal area in any year.[43]

Agriculture Requirements

• The commissioner of agriculture, markets, and food is to consult with other agencies and publish best management practices "so as to permit the maximum use of nutrient and soil conditioning values, while achieving the least possible adverse impact upon the environment or human, animal and plant health."[44] These are voluntary/advisory in the first instance, and must rely on other authorities for enforceability. The commissioner is to investigate complaints of improper handling and application of manure, compost, or chemical fertilizer, and if the commissioner "has reason to believe such handling is a nuisance caused by failure to use best management practices," must notify the responsible person of the changes needed to conform to BMPs and require a plan for compliance if the changes are not made within 10 days of the notification. If the person fails to implement the recommended changes, the commissioner must notify local health officers and the department of environmental services *"who shall take such action as their authority permits."*[45]

• The commissioner also has rulemaking power over storage, use, and application of fertilizers.[46] Mislabeling and registration violations are misdemeanors (if committed by a natural person) or felonies (if by other, such as corporation); civil forfeitures are not to exceed $5,000 per violation per day, and administrative fines are not to exceed $1,000 per violation. These provisions offer limited utility for nonpoint source pollution unless the commissioner has adopted rules proscribing certain uses and applications aimed at water bodies.

• The pesticide control board may make rules for the times, places, and conditions of use of pesticides in different areas of the state if "such pesticides may be injurious to persons, animals, or crops" other than the target pests, and may require that pesticides be used only under permit of the board.[47] Regulations prohibit application of pesticide by commercial applicator or homeowner within 25 feet of surface waters; special permits are required under special conditions such as aerial applications, public water supply watersheds, etc.[48] Enforcement sanctions and penalties are like those for fertilizer registration violations.[49]

The Alteration of Terrain erosion control program (described below under "Development and Other Earth-Disturbing Activities") does *not* apply to "normal agricultural practices." Likewise, the Comprehensive Shoreland law exempts all agricultural activities and operations "provided such activities and operations are in conformance with the most recent best management practices determined by...[USDA's Natural Resources Conservation Service, USDA's Cooperative Extension Service] and the [state's] department of agriculture, markets, and food."[50]

Development and Other Earth-Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act or that may be authorized by general land use regulation such as zoning, state law provides the following authorities.

- The Alteration of Terrain program provides some enforceable mechanisms. "Any person proposing to dredge, excavate, place fill, mine, transport forest products or undertake construction in or on the border of the surface waters of the state, and any person proposing to significantly alter the characteristics of the terrain, in such a manner as to impede the natural runoff or create an unnatural runoff, shall be directly responsible to submit to the department [of environmental services] detailed plans concerning such proposal and any additional relevant information requested by the department, at least 30 days prior to undertaking an such activity. The operations shall not be undertaken unless and until the applicant receives a permit from the department. The department shall have full authority to establish the terms and conditions under which any permit may be exercised, giving due consideration to the circumstances involved and the purposes of this chapter, and to adopt such rules as are reasonably related to the efficient administration of this section, and the purposes of this chapter..."[51]

The regulations require a permit if "dredging, excavation, filling, mining, transporting of forest products, earth moving or other significant alteration of the characteristics of the terrain" will occur "in or on the border of the surface waters of the state"; and if "construction, earth moving or other significant alteration of the characteristics of the terrain" when the contiguous disturbed area is 50,000 or more square feet if within the protected shoreline as defined by RSA 483-B, or 100,000 or more square feet in any other area.[52] "Significantly alter..." is defined as activity that "changes or disturbs the terrain so as to impede the natural runoff or create an unnatural runoff that has the potential to adversely affect water quality in the state's surface waters."[53] Regulations provide that permit applications (except for general permit applications) must be reviewed for "(a) Water quality protection measures proposed to be used during the construction phase of the proposed activity for the prevention of soil erosion; (b) Permanent water quality protection measures to be constructed as part of the project...; and (c) Impacts due to changes in runoff hydrology...[calculated for 2-year and 10-year storms]."[54] Regulations establish detailed design and performance criteria for various kinds of stormwater and erosion control features.[55] Enforcement provisions and sanctions are the same as those provided for violation of the state's water pollution control laws.

• The Comprehensive Shoreland Protection Act, administered by Dept. of Env. Services, provides a variety of enforceable mechanisms.[56] It provides for "establishment of standards for the subdivision, use, and development of the shorelands of the state's public waters. The development standards provided in this chapter shall be the minimum standards necessary to protect the public waters of the state of New Hampshire. These standards will serve to.....prevent and control water pollution..."[57] Protected shoreland includes all land within 250 feet of public waters. The law requires persons engaged in excavation, land disturbance, subdivision, and onlot septic system installation, within the protected shoreland to obtain required permits under other programs...but allows department to grant, deny, or attach reasonable conditions "to protect the public waters or the public health, safety or welfare."[58] The law prohibits the establishment or expansion of "salt storage yards, automobile junk yards, and solid or hazardous waste facilities"; requires a setback of 50 feet for primary structures; prohibits use of fertilizer within 25 feet; requires a natural woodland buffer within 150 feet (limiting removal for land conversion purposes to not more than 50 percent of basal area and 50 percent of saplings within a 20 year period); specifies minimum setbacks for septic systems; and requires all new structures within protected shorelands to meet terrain alteration rules (and requires permits for disturbances exceeding 50,000 square feet); and sets minimum lot size and frontage standards.[59] The law does not apply within any municipality that has adopted an ordinance that is at least as stringent as the state law and that has been certified as such.[60] The comprehensive shoreland law is enforced by the commissioner of environmental services.[61] Enforcement tools include cease and desist orders, injunctive relief, civil penalties of up to $20,000, and administrative fines of up to $5,000.[62] Municipalities may also enforce.[63] A knowing violation is misdemeanor (if natural person), or felony (if other person).[64]

• The River Management and Protection Program is managed by the department of environmental services. "The state shall....regulate the quantity and quality of instream flow along certain protected rivers or segments of rivers to conserve and protect outstanding characteristics including recreational, fisheries, wildlife, environmental...[etc.]"[65] Designations are "natural rivers", "rural rivers", "rural-community rivers," and "community rivers."[66] Protections of all 4 types of designated rivers include 250-foot setbacks of land application of solid waste (but not including "manure, lime and wood ash used for fertilizer, and sludge and septage")[67] Channel alterations are not allowed on natural rivers, but the commissioner may approve temporary alterations in connection with repair or maintenance of bridges, roads, or riprap. Also, channel alterations are not allowed on the latter 3 types of rivers that alter the flow characteristics of the river or adversely affect the resources for which the river is designated, but the commissioner may approve alterations necessary for construction, repair or maintenance of a project including public water supply intake facilities.

• The Lakes Management and Protection program administered by the department of environmental services develops "management criteria" for the state's lakes to "provide the basis for state agency decisions regarding lakes management and protection."[68] Criteria are to "ensure that (a) Water quality shall not be degraded from existing water quality standards...(b) Potential sources of pollution, whether point or non-point sources on the land or deriving from activity on the lake, shall be managed in such a way as to minimize their adverse impact on water quality. No significant adverse impact or cumulative adverse impact on water quality shall be permitted." The program results in the development of plans, while the implementation is by cooperation of state agencies. Thus, any enforcement is based on use of other statutory and regulatory authorities.

• The wetlands program requires permitting, and use of erosion and siltation control measures.[69] The department of environmental services has emergency order authority to direct the cessation of activities posing "immediate risk" to wetlands; and compliance order authority.[70] A wetland violation is a misdemeanor (if natural person) or felony (if other person).[71]

Endnotes

1. N.H. Rev. Stat. Ann. § 485-A:12.I.
2. N.H. Rev. Stat. Ann. § 485-A:12.II.
3. N.H. Rev. Stat. Ann. § 485-A:13.I.(a).
4. N.H. Rev. Stat. Ann. §§ 485-A:2.XVI, 485-A:2.VIII.
5. N.H. Rev. Stat. Ann. §§ 485-A:12.I, 485-A:12.II.
6. N.H. Rev. Stat. Ann. § 485-A:13.II.
7. N.H. Rev. Stat. Ann. § RSA 485-A:22.III.
8. N.H. Rev. Stat. Ann. § 485-A:22.IV.
9. N.H. Rev. Stat. Ann. § 485-A:22-a.
10. N.H. Rev. Stat. Ann. 485-A:22.
11. N.H. Rev. Stat. Ann. § 485-A:15.I.
12. N.H. Rev. Stat. Ann. §§ 485-A:15; 485-A:13.II.
13. N.H. Rev. Stat. Ann. § 481:1.
14. N.H. Rev. Stat. Ann. § 485-A:1.
15. N.H. Rev. Stat. Ann. § 147:1.
16. N.H. Rev. Stat. Ann. § 147:2.
17. N.H. Rev. Stat. Ann. § 432:33.
18. N.H. Rev. Stat. Ann. § 432:34.
19. N.H. Rev. Stat. Ann. § 147:10.
20. N.H. Rev. Stat. Ann. § 147:13.
21. N.H. Rev. Stat. Ann. § 485.17.
22. N.H. Rev. Stat. Ann. § 485.18.
23. N.H. Rev. Stat. Ann. § 485.19.
24. N.H. Rev. Stat. Ann. § 211:71.
25. N.H. Rev. Stat. Ann. § 227-G:3,4.
26. N.H. Rev. Stat. Ann. § 227-J. The notices is required by RSA 97:10 for real estate tax purposes, and the notice is used for cross-compliance with environmental and other programs.
27. N.H. Rev. Stat. Ann. § 227-J:4.
28. N.H. Rev. Stat. Ann. § 227-J:9.
29. N.H. Rev. Stat. Ann. § 227-J:9.
30. N.H. Rev. Stat. Ann. § 227-J:10.
31. N.H. Rev. Stat. Ann. § 227-J:II(c).
32. N.H. Rev. Stat. Ann. § 227-J:II(d).
33. N.H. Rev. Stat. Ann. § 227-J:14.
34. N.H. Rev. Stat. Ann. § 227-J:9.
35. N.H. Rev. Stat. Ann. §§ 227-J:9, 227-J:10.
36. N.H. Code Admin. R. Env-Ws-415.04.
37. N.H. Code Admin. R. Env-Ws-415.02(b).
38. N.H. Rev. Stat. Ann. § 482-A; see § 482-A:3.V.
39. N.H. Code Admin. R. Ann. Env-Wt 304.05 (1997).
40. N.H. Code Admin. R. Ann. Env-Wt 304.06 (1997).
41. N.H. Rev. Stat. Ann. § 483-B.

[42] N.H. Rev. Stat. Ann. § 483-B:9.
[43] N.H. Rev. Stat. Ann. § 227-J:9.
[44] N.H. Rev. Stat. Ann. § 431:34.
[45] N.H. Rev. Stat. Ann. § 431:35.
[46] N.H. Rev. Stat. Ann. §§ 431:13; 431:32.
[47] N.H. Rev. Stat. Ann. § 430:31.
[48] N.H. Code Admin. R. Ann. Pes 1001.
[49] N.H. Rev. Stat. Ann. § 430:45.
[50] N.H. Rev. Stat. Ann. § 483-B:3.III.
[51] N.H. Rev. Stat. Ann. § 485-A:17.
[52] N.H. Code Admin. R. Ann. Env-Ws 415.03.
[53] N.H. Code Admin. R. Ann. Env-Ws 415-02(y).
[54] N.H. Code Admin. R. Env-Ws 415.07.
[55] N.H. Code Admin. R. Env-Ws 415.11.
[56] N.H. Rev. Stat. Ann. § 483-B.
[57] N.H. Rev. Stat. Ann. § 483-B:2.
[58] N.H. Rev. Stat. Ann. § 483-B:6.
[59] N.H. Rev. Stat. Ann. § 483-B:9.
[60] N.H. Rev. Stat. Ann. § 483-B:19.
[61] N.H. Rev. Stat. Ann. § 483-B:5.
[62] N.H. Rev. Stat. Ann. § 483-B:18.
[63] N.H. Rev. Stat. Ann. § 483-B:8.
[64] N.H. Rev. Stat. Ann. § 483-B:18.III.
[65] N.H. Rev. Stat. Ann. § 483:1.
[66] N.H. Rev. Stat. Ann. § 483:7-a.
[67] N.H. Rev. Stat. Ann. §§ 483:9, 9-a, 9-aa, 9-b.
[68] N.H. Rev. Stat. Ann. § 483-A:5.
[69] N.H. Rev. Stat. Ann. § 482-A; N.H. Code Admin. R. Env-Wt 304.06.
[70] N.H. Rev. Stat. Ann. § 482-A:6.
[71] N.H. Rev. Stat. Ann. § 482-A:23.

NEW JERSEY

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

New Jersey's water pollution control law includes several provisions that may be used to take enforcement action against certain nonpoint source discharges.

• New Jersey law prohibits the discharge of any pollutant except as authorized by statute or under permit. "Pollutant" means "any dredged spoil, solid waste, incinerator residue, sewage, garbage, refuse, oil, grease, sewage sludge, munitions, chemical wastes, biological materials, radioactive substance, thermal waste, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal or agricultural waste or other residue discharged into the waters of the state."[1] Enforcement provisions include compliance orders, injunctive relief, and civil penalties of not more than $50,000 for each violation;[2] and criminal sanctions if there is a knowing or reckless violation which causes a significant adverse environmental effect.[3]

• The law further provides that no person shall put or place into, drain into, or place where it can run, flow, wash or be emptied into, or where it can find its way into, any of the fresh or tidal waters of the state, any petroleum products, debris, hazardous, deleterious, destructive, or poisonous substances of any kind. The penalty for violation is $6,000 for each offense. Exemptions from this provision, however, include chemicals used on agricultural, horticultural or forestry crops, or in connection with livestock...in a manner approved by the department of environmental protection.[4]

It is worth noting that the state's Water Quality Planning Act also authorizes the state to designate areawide waste treatment management planning areas.[5] The areawide plan is to include establishment of a regulatory program which would, among other things, provide control or treatment of all point and nonpoint sources of pollution, including in-place or accumulated pollution sources, to the extent practicable.[6] The plan should also include a process 1) to identify agriculturally and silviculturally related nonpoint sources of pollution, including runoff from manure disposal areas and from land used for livestock and crop production; and 2) to set forth procedures and methods including land use requirements, to control to the extent feasible such sources. The plan should also include a process 1) to identify construction activity related sources of pollution; and 2) to set forth procedures and methods, including land use requirements, to control to the extent feasible such sources. The areawide plan is not itself enforceable, but is intended to identify appropriate enforceable mechanisms where needed.

Other Discharge Limitations

• Special provisions prohibit the discharge of "sewage or other polluting matter" directly or indirectly into certain waters of the Passaic river and tributaries; enforcement is by injunction and fine of up to $100 per day.[7]

• Local boards of health have power to pass ordinances and make rules and regulations with regard to the public health in order "to protect the public water supply and prevent the pollution of any stream of water or well...."[8]

• Common law nuisance remedies may also be available. However, there is an irrebuttable presumption created by statute that no agricultural operation, activity or structure which is conducted or located within a municipally approved farmland preservation program *and* which conforms to agricultural management practices approved by the state agricultural development committee *and* does not pose a direct threat to public health and safety shall constitute a public or private nuisance.[9]

Fish/Fisheries Laws

• See the prohibition on draining of "deleterious substances" above. It is not necessary, to sustain a violation, for the state to show that the substances have caused the death of fish, birds, or mammals.[10]

OPERATIONAL REQUIREMENTS

Forestry Requirements

State laws relating to forestry do not appear to contain independently enforceable requirements relating to nonpoint source discharges.

Agriculture Requirements

State laws relating to agriculture do not appear to contain independently enforceable requirements relating to nonpoint source discharges.

• State law does include authority to regulate or condition uses of pesticides.[11]

Development and Other Earth Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act or that may be authorized by general land use regulation such as zoning, state law provides the following authorities.

• Under the Soil Erosion and Sediment Control Act, the state Soil Conservation Committee in the Department of Agriculture must develop standards for the control of soil erosion and sedimentation.[12] Any person proposing to engage in any project must receive certification by the local soil conservation district of a plan for soil erosion and sediment control. A "project" means any disturbance of more than 5000 sq. feet for the surface area of land for 1) construction that would require a construction permit; 2) the demolition of one or more structures; 3) construction of a parking lot; 4) construction of a public facility; 5) for the operation of any mining; 6) for the clearing or grading of any land for other than agricultural or horticultural purposes. [13] No one shall be issued a certificate unless there is compliance with a certified plan for permanent measures to control soil erosion and sedimentation.[14] Municipalities may enforce a conforming ordinance; otherwise enforcement is by the soil /conservation district; enforcement is by stop-construction order, civil action, and civil penalty of $25 to $3000.[15]

• The state's Freshwater Wetlands Act requires a freshwater wetlands permit for anyone engaging in a "regulated activity".[16] A "regulated activity" is "1) the removal, excavation, disturbance or dredging of soil, sand, gravel, or aggregate material of any kind; 2) the drainage or disturbance of the water level or water table; 3) the dumping, discharging, or filling with any materials; 4) the driving of pilings; 5) the placing of obstructions; 6) the destruction of plant life which would alter the character of a freshwater wetland, including the cutting of trees."[17] The law exempts from the permit requirements, unless required by federal EPA rules, "normal farming, silviculture and ranching activities" and "normal harvesting of forest products in accordance with a forest management plan approved by the state forester."[18] [The forest management plan statute authorizes the dept to develop a forest management plan for the state parks and forests and to provide technical assistance to promote BMPs for forest operators on the harvesting of forest products. It has no enforceable requirements, however].[19] Enforcement of the Freshwater Wetlands Act is by order, civil action, civil penalty, or criminal action. The civil penalty is authorized up to $10,000.[20]

• The Coastal Area Facility Review Act requires a permit from the department of environmental protection for all new development proposed on a beach or dune, as defined in the statute. "Development" means "the construction, relocation, or enlargement of any building or structure and all site preparation therefor, the grading, excavation or filling on beaches or dunes, and shall include residential development, commercial development, industrial development, and public development."[21] It is enforceable by orders, civil actions, and penalties up to $25,000 per violation.[22]

• The Waterfront Development Law regulates those developments not covered and not superseded by the Coastal Area Facility Review Act.[23] The department of environmental protection may, by appropriate action in any court, prevent the encroachment or trespass upon the water front of any navigable waters and compel the removal of any such encroachment or trespass, and restrain, prevent and remove any construction, erection or accretion injurious to the flow of any such waters, which may be detrimental to the proper navigation thereof and the maintenance and improvement of commerce thereon. Approval is required for such construction. It is enforceable by orders, civil actions, and penalties up to $1000 per violation.

Endnotes

1. N.J. Stat. Ann. § 58:10A-3(n).
2. N.J. Stat. Ann. § 58:10A-10.
3. N.J. Stat. Ann. § 58:10A-10(f).
4. N.J. Stat. Ann. § 23:5-28.
5. N.J. Stat. Ann. § 58:11A-4.
6. N.J. Stat. Ann. § 58:11A-5.
7. N.J. Stat. Ann. §§ 58:14-7, 58:14-8.
8. N.J. Stat. Ann. § 26:3-31(1).
9. N.J. Stat. Ann. § 4:1C-26.
10. N.J. Stat. Ann. § 23:5-28.
11. N.J. Stat. Ann. § 13:1F-4.
12. N.J. Stat. Ann. § 4:24-42.

[13] N.J. Stat. Ann. § 4:24-43; see § 4:24-41(g).
[14] N.J. Stat. Ann. § 4:24-49.
[15] N.J. Stat. Ann. §§ 4:24-47, 4:24-48, 4:24-53.
[16] N.J. Stat. Ann. § 13:9B-9.
[17] N.J. Stat. Ann. § 13:9B-3.
[18] N.J. Stat. Ann. § 13:9B-4.
[19] N.J. Stat. Ann. § 13:1L-13.
[20] N.J. Stat. Ann. § 13:9B-21.
[21] N.J. Stat. Ann. § 13:9-5.
[22] N.J. Stat. Ann. § 13:19-18.
[23] N.J. Stat. Ann. § 12:5-2.

NEW MEXICO

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

New Mexico's Water Quality Act does not contain an enforceable prohibition directly applicable to nonpoint source discharges, but the Act does authorize the Water Quality Control Commission broadly to "promulgate and publish regulations to prevent or abate water pollution in the state" and to require permits.[1] Thus, the availability of any enforceable authority depends entirely on the promulgation of specific regulatory requirements. The general permitting and enforcement scheme operates as follows.

• "Water pollution" is defined as "introducing or permitting the introduction into water, either directly or indirectly, of one or more water contaminants in such quantity and of such duration as may with reasonable probability injure human health, animal or plant life or property, or to unreasonably interfere with the public welfare or the use of property."[2] The Act directs the commission to "adopt water quality standards for surface and ground waters of the state,"[3] and gives it discretion to adopt regulations requiring "a permit for the discharge of any water contaminant."[4] However, the Act allows "reasonable degradation of water quality resulting from beneficial use [provided] such degradation shall not result in impairment of water quality to the extent that water quality standards are exceeded."[5] The same section also exempts activities regulated under the state oil and gas act, and limits the Act's application to activities regulated under the state's groundwater, hazardous waste, or solid waste acts, "except to abate water pollution or control the disposal or use of septage or sludge."[6] Moreover, the Commission is barred from placing a permit requirement on "the use of water in irrigated agriculture, except in the case of employment of a specific practice in connection with such irrigation that documentation or actual case history has shown to be hazardous to public health or the environment."[7]

The Commission is required to assign responsibility for administering its regulations to "constituent agencies," such as the department of environment, state engineer, department of game and fish, and department of agriculture, among others.[8] The constituent agencies are empowered to issue administrative compliance orders (including penalties) or commence civil actions.[9] The Act provides for administrative orders with penalties up to $15,000 per day for violations of permit and certification requirements, and $10,000 per day for other violations of the Act and its regulations or water quality standards.[10] For failure to take corrective actions required in a compliance order, the penalty may be up to $25,000 per day. Further, a permit may be terminated or modified upon violation of its conditions.[11]

There are also judicial civil penalties paralleling the $15,000 and $10,000 administrative penalties (though not the $25,000 penalty for noncompliance with an order).[12] The Act also sets out criminal penalties for knowing violations. Knowingly violating a permit or discharging when a permit is required is a fourth degree penalty, with stricter penalties for subsequent violations (third degree felony), causing substantial adverse environmental impact (third degree felony), or a substantial danger of death or serious bodily injury (second degree felony).[13]

Other Discharge Limitations

The Water Quality Act includes a savings provision, which preserves "rights of action or remedies in equity under the common law or statutory law, criminal or civil."[14] Accordingly, "no provision of the Water Quality Act or any act done by virtue thereof estops the state or any political subdivision or person as owner of water rights or otherwise, in the exercise of their rights in equity or under the common law or statutory law, to suppress nuisances or to abate pollution."[15] Several statutory provisions on nuisance law could also be applied to nonpoint source water pollution.

- A public nuisance is defined as an unlawful act that either is "injurious to public health, safety, morals or welfare" or "interferes with the exercise and enjoyment of public rights, including the right to use public property."[16] Committing a public nuisance is a misdemeanor.

- The state code also makes "polluting water for which the act is not otherwise prescribed by law" a misdemeanor.[17] It defines "polluting water" as "knowingly and unlawfully introducing any object or substance into any body of public water causing it to be offensive or dangerous for human or animal consumption or use" and declares the act to be a public nuisance.[18]

- Municipalities are authorized to "appoint a board of health" or "perform any act or adopt any regulation necessary or expedient for the promotion of health and the suppression of disease."[19] They also may regulate plumbing and sewage disposal,[20] "direct the location, regulate and prohibit any offensive and unwholesome business or establishment" within one mile of their boundaries,[21] and "define a nuisance, abate a nuisance and impose penalties upon a person who creates or allows a nuisance to exist."[22]

"Any public officer or private citizen" may bring a civil action to abate a public nuisance.[23] Plaintiffs may seek an injunction against a public nuisance, with court costs and attorneys fees, but a recent case held that the court is not empowered to award damages.[24] Criminal prosecution is the prerogative of the state, through the usual channels. The punishment for a petty misdemeanor is a fine of up to $500 or a jail term of up to 6 months or both; the punishment for a misdemeanor is $1000 or a year or both.[25]

The Right to Farm Act[26] exempts from public or private nuisance claims any "agricultural operation or agricultural facility if the operation was not a nuisance at the time the operation began and [if it] has been in existence for more than one year," provided that the operation or facility is not "operated negligently, improperly or illegally such that the operation or facility is a nuisance." Cities with agricultural operations or facilities within their limits at the time the Right to Farm Act was passed cannot apply nuisance ordinances against these farms.

Fish/Fisheries Laws

• No provisions relate explicitly to fish kills or habitat destruction due to nonpoint pollution. The state game commission is empowered to "prohibit the killing or taking of any ... game fish of any kind or sex."[27] It is a misdemeanor to "hunt, take, capture, kill or attempt to take, capture or kill, at any time or in any manner, any ...game fish in the state" except as permitted by the state game commission or otherwise by law."[28] Further, every "poisonous or stupefying substance ... used ... in taking or killing game or fish in violation of this chapter" is declared to be a public nuisance.[29] The game and fish code is enforced by "the director of the department of game and fish, each conservation officer, each sheriff in his respective county and each member of the New Mexico State Police."[30] "Any person violating any of the provisions of [the code] or any regulations adopted by the state game commission which relate to the time, extent, means, or manner that game animals, birds or fish may be hunted, taken, captured, killed, possessed, sold, purchased or shipped is guilty of a misdemeanor."[31] The penalty for most violations is a fine of at least $50 but not more than $500, or up to six months in jail, or both.[32] The department of fish and game also can collect civil damages for unlawful destruction of "any game quadruped, bird, or fish."[33]

OPERATIONAL REQUIREMENTS

Forestry Requirements

New Mexico forestry laws do not appear to contain enforceable provisions relating to nonpoint source discharges. However, New Mexico counties may enact enforceable ordinances addressing harvest practices.[34]

Agriculture Requirements

• New Mexico law has provisions for creation of local soil and water conservation districts,[35] and conservancy districts.[36] Neither seems to have regulatory authority.

• In contrast, once created, local wind erosion districts can respond to landowner complaints of property damage due to "effects of wind erosion on lands of an adjoining freeholder."[37] The districts can serve notice on a land owner that preventive measures need to be taken to minimize or avoid damage to neighbors from wind erosion, and can specify a reasonable time for the land owner to implement those measures.[38] If the owner does not implement the measures, the district must have the work performed at county expense.[39] The district must then levy a special assessment against the land to recoup the costs of performing the work.[40]

Development and Other Earth-Disturbing Activities

No relevant operating requirements are set forth, apart from those that may be contained in urban stormwater programs under the Clean Water Act or those authorized under the general zoning and construction authorities of municipalities and counties.

Endnotes

[1] N.M. Stat. Ann. § 74-6-4(D).
[2] N.M. Stat. Ann. § 74-6-2(B). The Act defines "water contaminant" to mean "any substance that could alter if discharged or spilled the physical, chemical, biological or radiological qualities of water." N.M. Stat. Ann. § 74-6-2(A).
[3] N.M. Stat. Ann. § 74-6-4(C).
[4] N.M. Stat. Ann. § 74-6-5(A).
[5] N.M. Stat. Ann. § 74-6-12.
[6] N.M. Stat. Ann. § 74-6-12.
[7] N.M. Stat. Ann. § 74-6-4(K).
[8] N.M. Stat. Ann. §§ 74-6-4(E), (J).
[9] N.M. Stat. Ann. § 74-6-10.
[10] N.M. Stat. Ann. § 74-6-10.
[11] N.M. Stat. Ann. § 74-6-5(L).
[12] N.M. Stat. Ann. § 74-6-10.1.
[13] N.M. Stat. Ann. § 74-6-10.2.
[14] N.M. Stat. Ann. § 74-6-13.
[15] N.M. Stat. Ann. § 74-6-13.
[16] N.M. Stat. Ann. § 30-8-1.
[17] N.M. Stat. Ann. § 30-8-2.
[18] N.M. Stat. Ann. § 30-8-2.
[19] N.M. Stat. Ann. § 3-43-1.
[20] N.M. Stat. Ann. § 3-18-22.
[21] N.M. Stat. Ann. § 3-18-13.
[22] N.M. Stat. Ann. § 3-18-17.
[23] N.M. Stat. Ann. § 30-8-8.
[24] Schwartzman Inc. v. Atchison, T. & S.F. Ry., 857 F. Supp. 838 (D.N.M. 1994).
[25] N.M. Stat. Ann. § 31-19-1.
[26] N.M. Stat. Ann. §§ 47-9-1 to -7.
[27] N.M. Stat. Ann. § 17-2-1.
[28] N.M. Stat. Ann. § 17-2-7. "Take" and "taking" are defined to mean "harass, hunt, capture, or kill any wildlife or attempt to do so." N.M. Stat. Ann. § 17-2-38(L).
[29] N.M. Stat. Ann. § 17-2-20. Conservation officers may summarily seize and destroy poisonous or stupefying substances used illegally to take or kill fish or game. Id.
[30] N.M. Stat. Ann. § 17-2-19.
[31] N.M. Stat. Ann. § 17-2-10.
[32] N.M. Stat. Ann. § 17-2-10(B).
[33] N.M. Stat. Ann. § 17-2-26.
[34] For example, Rio Arriba County adopted a permitting process for timber harvests incorporating the voluntary New Mexico forest practices guidelines as mandatory conditions. *See* Forest Trust, November 1998.
[35] N.M. Stat. Ann. §§ 73-20-25 to -49.
[36] N.M. Stat. Ann. §§ 73-14-1 et seq.
[37] N.M. Stat. Ann. § 73-22-5(A).
[38] N.M. Stat. Ann. § 73-22-5(A).
[39] N.M. Stat. Ann. § 73-22-5(B).
[40] N.M. Stat. Ann. § 73-22-5(C).

NEW YORK

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

New York's Environmental Conservation Law provides some enforceable authority applicable to nonpoint source discharges. Support for applying the law broadly to include nonpoint source enforcement may be provided by a declared statutory policy to maintain reasonable standards of purity of the waters of the state "and to that end require the use of all known available and reasonable methods to prevent and control the pollution of the waters of the state."[1]

• "It shall be unlawful for any person, directly or indirectly, to throw, drain, run or otherwise discharge into such waters organic or inorganic matter that shall cause or contribute to a condition in contravention of the standards adopted by the department pursuant to section 17-0301 [which establishes classification of waters and water quality standards.]"[2] Enforcement is by administrative order, injunction, civil penalty of up to $25,000 per day, or for willful violations by criminal prosecution.[3]

• "Sewage, industrial waste or other wastes, or any substance injurious to edible fish and shellfish, or the culture or propagation thereof, or which shall in any manner affect the flavor, color, odor or sanitary condition of such fish or shellfish so as to injuriously affect the sale thereof, or which shall cause any injury to the public and private shell fisheries of this state shall not be placed or allowed to run into the waters of the state in the marine district nor into any waters of Long Island, tributary to the marine district."... "Garbage, cinders, ashes, oils, sludge or refuse of any kind shall not be thrown, dumped or permitted to run into the waters of the marine district."[4] Enforcement is under the same provisions.

Other Discharge Limitations

• The Department of Health "may make rules and regulations for the protection from contamination of any or all public supplies of potable waters and water supplies...and the commissioner of environmental protection of the city of New York and the board of water supply of the city of New York may make such rules and regulations subject to the approval of the department..."[5] Enforcement is via notice of violation, enforcement by local board of health; injunction; summary abatement; and civil penalties of up to $200 for noncompliance.[6] Violations are punishable as misdemeanors punishable by fines of up to $200 and up to 1 year imprisonment.[7]

• "The commissioner [of health] shall have all necessary powers to make investigations and examinations into nuisances, or questions affecting the security of life and health in any locality."[8] The governor may request investigation by commissioner of health, and upon approval of report, the governor may declare the matters public nuisances and may order them to be changed, abated or removed; such orders are judicially enforceable.[9] In addition, "Every local board of health shall order the suppression and removal of all nuisances and conditions detrimental to life and

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health found to exist within the health district;"[10] and local health officers have power to "investigate and abate public nuisances which may affect health."[11] Such orders are judicially enforceable. Also, the Environmental Conservation Law expressly preserves state, local and private rights and remedies to "suppress nuisances or to abate any pollution now or hereafter existing".[12]

• "A person, who throws or deposits gas tar..or offal, refuse, or any other noxious offensive, or poisonous substance into any public waters, or into any sewer or stream running or entering into such public waters, is guilty of a misdemeanor."[13]

• "A person, who deposits, leaves or keeps, on or near a route of public travel...on the water, any noisome or unwholesome substance...is guilty of a misdemeanor," which is punishable by a fine of not less than $100 and/or imprisonment for 3-6 months.[14]

There is only a limited exception from nuisance liability for certain agricultural activities. "Notwithstanding any other provision of law, the agricultural activities conducted on a farm...shall not be considered a *private* nuisance, provided such agricultural activities were commenced prior to the surrounding activities, have not increased substantially in magnitude or intensity and have not been determined to be the cause of conditions dangerous to life or health as determined by the [state health] commissioner, the local health officer or local board of health...."[15]

Fish/Fisheries Laws

In addition to the provision of the water pollution title of the Environmental Conservation Law summarized above, relating to discharges of substances "injurious to edible fish and shellfish, or the culture or propagation thereof," New York law provides several other enforceable authorities potentially applicable to nonpoint discharges affecting or potentially affecting fish.

• "No person shall, at any time of the year, pursue, take, wound or *kill in any manner*, number or quantity, any fish protected by law,...shellfish,...crustacea protected by law, or protected insects, except as permitted by the Fish and Wildlife Law."[16] Moreover, "No fish, other than migratory food fish of the sea in the marine and coastal district, shall be taken except by angling."[17]

• "No dyestuffs, coal tar, refuse from a gas house, cheese factory, creamery, condensary or canning factory, sawdust, shavings, tan bark, lime, acid, oil *or other deleterious or poisonous substance* shall be thrown or allowed to run into any waters, either private or public, in quantities injurious to fish life, protected wildlife or waterfowl inhabiting those waters or injurious to the propagation of fish, protected wildlife or waterfowl therein."[18]

• New York law prohibits the placement of "sewage or other matter injurious to fish" and the erection or maintenance of any "privy, pigsty, inclosure for poultry, barn or barnyard" from which drainage or refuse can "find its way into water used by any state fish hatchery."[19]

• "No earth, soil, refuse, or solid substances...shall be disposed of in any stream or tributary thereto which is inhabited by trout" or placed on the banks "in such a manner that such solid substance can enter the stream at any stage of water level."[20]

These provisions are punishable as petty criminal violations, including imprisonment for up to 15 days and/or fine of not more than $250, plus penalties per fish, shellfish, or other aquatic creature taken.[21] Fines are slightly higher for violations of the second and third provisions noted above.[22]

OPERATIONAL REQUIREMENTS

Forestry Requirements

State forest-related laws do not appear to contain enforceable provisions related to nonpoint source discharges from forestry activities.

Agriculture Requirements

• "Every owner or occupier of agricultural land as defined [a landholding exceeding 25 acres and used for raising agricultural or forestry products; and smaller holdings with "concentrated agricultural operations" such as feedlots and poultry operations]...shall apply to the appropriate soil and water conservation district for a soil and water conservation plan for the land under his ownership or control."[23] While the obligation of the district to prepare a plan is enforceable, there is no penalty for failing to apply for or implement the required plan.

• New York also provides for registration of pesticides, certification of applicators, and other general requirements relating to pesticide use, although none that specifically address nonpoint source discharges.[24]

Development and Other Earth Disturbing Activities

Apart from requirements that may be contained in urban stormwater programs under the Clean Water Act or that may be authorized by general land use regulations, New York's nonpoint source regulatory mechanisms of this type are largely local or pursuant to state programs designed to protect particular kinds of water resources.

• The State Environmental Quality Review Act requires state and local agencies to prepare environmental impact statements, consider alternatives, and mitigate harm. SEQRA can affect control of nonpoint sources with respect to state and local government projects, major development decisions, etc.[25]

• Under the state's Wild, Scenic and Recreational Rivers law,[26] "[t]he commissioner or agency shall make and enforce regulations necessary for the management, protection, and enhancement of and control of land use and development in the wild, scenic and recreational river areas..." This authority can address nonpoint source-related activities in these areas. In wild river areas, structures and development are prohibited. In scenic river areas, mining, excavation, and public roads are prohibited, as is large-scale development (but the rules allow development on lots of 4 acres or greater). In scenic river areas, moreover, "the continuation of present agricultural practices, the propagation of crops, forest management pursuant to forest management standards duly promulgated by regulations, limited dispersed or cluster residential developments and stream improvement structures for fishery management purposes shall be permitted." In recreational river areas, the lands may be developed for the full range of agricultural uses, forest management pursuant to forest management standards duly promulgated by regulations, stream improvement structures for fishery management purposes, and may include small communities as well as dispersed or cluster residential developments and public recreational areas, as well as roads and railroads.[27] Enforcement remedies include civil penalties of $100 to $1000 per day and injunctive relief. [28]

• The Shoreowners' Protection Act[29] regulates "activities or development" which means "any land use, construction or placement by any person of a structure, or any action which materially alters the condition of land, including grading and excavating or other disturbance of soil. The term shall include the division of land into lots, parcels or sites."[30] This law too may provide usable authority in dealing with nonpoint source discharges and potential discharges. Enforcement is under the general enforcement provisions of the Environmental Conservation Law.[31]

• The Freshwater Wetlands Act[32] also provides some regulatory authority that may affect some forms of nonpoint source water pollution. Local governments may administer the law if they adopt their own ordinance; local governments may transfer these functions to the county, or the Department of Environmental Conservation may assume enforcement and implementation. DEC may designate by rule special wetlands of unique value to be subject to DEC administration. Unmapped wetlands of less than 12.4 acres in size are reserved to jurisdiction of local governments.[33] Permits are required for any form of drainage, dredging, excavation, dumping, filling of any soil, stones, sand, gravel, mud, rubbish, or fill of any kind, either directly or indirectly; erecting any structures or obstructions; "any form of pollution, including but not limited to, installing a septic tank, running a sewer outfall, discharging sewage treatment effluent or other liquid wastes into or so as to drain into a freshwater wetland; and any other activity which substantially impairs any of the several functions served by freshwater wetlands or the benefits derived therefrom..."[34] These activities are regulated within 100 feet from the boundary of any wetland; a local government or the DEC may regulate a greater distance "where necessary to protect and preserve the wetland."[35] The law provides for DEC determining what uses of mapped and classified wetlands are "compatible" and directs the commissioner to "prepare minimum land use regulations to permit only such compatible uses." Local governments must adopt consistent regulations unless "overriding economic and social considerations vital to" the local jurisdiction require a variance.[36] Freshwater wetlands permits are not required for grazing and watering livestock, or for making reasonable use of water resources, harvesting natural products of wetlands, selectively cutting timber, draining land or wetlands for growing agricultural products; public health activities and orders.[37] The law is enforceable by civil penalty of up to $3,000, order, or injunction.[38] (Also potentially relevant in some instances is a law regulating placement of fill in navigable waters).[39]

• The Tidal Wetlands Act[40] requires the commissioner to adopt "land-use regulations governing the use of" inventoried tidal wetlands. "No permits may be

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granted by any local body, nor shall any construction or activity take place at variance with these regulations."[41] The law requires state permits for draining, dredging, dumping, filling etc. as with freshwater wetlands, but lacks the "any form of pollution..." clause found in the freshwater wetlands act. It also requires a permit for "any other activity within or immediately adjacent to inventoried wetlands which may substantially impair or alter the natural condition of the tidal wetland area."[42] The law is enforceable by civil penalties of up to $10,000 per day, orders, or misdemeanor prosecutions.[43]

• The Long Island Pine Barrens maritime reserve act[44] requires a management plan to guide land use to protect the pine barrens and underlying aquifer. It is administered by participating towns, per approval by the governor. Towns and local jurisdictions must review all development applications, and must implement the law consistently with the management plan. The commission responsible for implementing the act reviews development activities in critical resource areas and reviews developments of regional significance as identified in the plan.

Endnotes

1. N.Y. Envtl. Conserv. Law § 17-0101.
2. N.Y. Envtl. Conserv. Law § 17-0501.
3. N.Y. Envtl. Conserv. Law §§ 71-1707, 71-1711, 71-1725, 71-1929; 71-1931; 71-1715; 17-0301(6); 17-0905.
4. N.Y. Envtl. Conserv. Law § 17-0503.
5. N.Y. Pub. Health Law § 1100.
6. N.Y. Pub. Health Law § 1102.
7. N.Y. Pub. Health Law § 1103.
8. N.Y. Pub. Health Law § 1300(1).
9. N.Y. Pub. Health Law § 1301.
10. N.Y. Pub. Health Law § 1303(3).
11. N.Y. Pub. Health Law § 1304.
12. N.Y. Envtl. Conserv. Law § 17-1101.
13. N.Y. Pub. Health Law § 1300-b; N.Y. Envtl. Conserv. Law § 71-3503 (same).
14. N.Y. Pub. Health Law § 1300-a.
15. N.Y. Pub. Health Law § 1300-c.
16. N.Y. Envtl. Conserv. Law § 11-0107(1).
17. N.Y. Envtl. Conserv. Law § 11-1301(1)(a).
18. N.Y. Envtl. Conserv. Law § 11-0503(1).
19. N.Y. Envtl. Conserv. Law § 11-0503(2).
20. N.Y. Envtl. Conserv. Law § 11-0503(4).
21. N.Y. Envtl. Conserv. Law § 71-0919(1)(b), referencing § 71-0923, § 71-0925.
22. N.Y. Envtl. Conserv. Law § 71-0925 (fine for discharge of dyestuffs, etc. is $500-$1,000 plus $10 per fish killed; fine for pollution of hatchery waters is $500 plus $10 per fish killed).
23. N.Y. Soil and Water Conserv. Dist. Law § 9(7-a). Definitions at § 3.
24. N.Y. Envtl. Conserv. Law §§ 33-0701 to 1301.
25. N.Y. Envtl. Conserv. Law §§ 8-0101 to 8-0117.
26. N.Y. Envtl. Conserv. Law §§ 15-2701 to 2723.
27. N.Y. Envtl. Conserv. Law § 15-2709.
28. N.Y. Envtl. Conserv. Law § 15-2723.
29. N.Y. Envtl. Conserv. Law, Art. 34.
30. N.Y. Envtl. Conserv. Law § 34-0103(1).
31. N.Y. Envtl. Conserv. Law, Art. 71.
32. N.Y. Envtl. Conserv. Law § 24-0101 et seq.

[33] N.Y. Envtl. Conserv. Law §§ 24-0501, 24-0503, 24-0505, 24-0507.
[34] N.Y. Envtl. Conserv. Law § 24-0701.
[35] N.Y. Envtl. Conserv. Law § 24-0701.
[36] N.Y. Envtl. Conserv. Law § 24-0903.
[37] N.Y. Envtl. Conserv. Law § 24-0701.
[38] N.Y. Envtl. Conserv. Law §§ 71-2303, 71-2305.
[39] N.Y. Envtl. Conserv. Law § 15-0505.
[40] N.Y. Envtl. Conserv. Law § 25-0101 et seq.
[41] N.Y. Envtl. Conserv. Law § 25-0302.
[42] N.Y. Envtl. Conserv. Law § 25-0401.
[43] N.Y. Envtl. Conserv. Law §§ 71-2503, 71-2507.
[44] N.Y. Envtl. Conserv. Law §§ 57-0101 to 0137.

NORTH CAROLINA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

The North Carolina water pollution law establishes several discharge prohibitions that are potentially enforceable against nonpoint sources. A general provision prohibits the discharge of waste in violation of water quality standards; the state may issue special orders to abate water pollution; and there are specific prohibitions against unpermitted discharges to the Atlantic Ocean and other defined areas.

• Absent a permit or special order, no person shall "cause or permit any waste, directly or indirectly, to be discharged to or in any manner intermixed with the waters of the State in violation of the water quality standards applicable to the assigned classifications."[1] "Discharge of waste" is defined broadly to include "discharge, spillage, leakage, pumping, placement, emptying, or dumping into waters of the State"[2]; "waste" is defined to include sewage, industrial waste, toxic waste, and "other waste."[3] "Other waste" is defined as "sawdust, shavings, lime, refuse, offal, oil, tar chemicals, dissolved and suspended solids, sediment, and all other substances ... which may be discharged into or placed in such proximity to the water that drainage therefrom may reach the water."[4]

• Even more broadly, the Environmental Management Commission may issue special orders "to any person whom it finds responsible for causing or contributing to any pollution of the waters of the State within the area for which standards have been established."[5] The law defines "water pollution" as "the man-made or man-induced alteration of the chemical, physical, biological, or radiological integrity of the waters of the State, including, but not specifically limited to, alterations resulting from the concentration or increase of natural pollutants caused by man-related activities."[6]

• There are also specific prohibitions against the discharge of wastes or thermal discharges to waters of the Atlantic Ocean within state jurisdiction;[7] discharge of pollutants to "defined managed areas," such as fisheries, without a permit;[8] and stormwater discharges that result in water pollution.[9]

Violations of the water pollution law may be assessed civil penalties of up to $10,000 per violation per day, misdemeanor criminal fines of up to $15,000 per violation per day, or felony criminal fines of up to $250,000 per violation per day; they also are subject to injunctive relief.[10]

Other Discharge Limitations

North Carolina nuisance law may be applicable to some forms of nonpoint source pollution. There does not appear to be a statutory definition of "nuisance" that expressly includes water pollution, but common-law definitions should cover some forms of nonpoint discharge.

• State and local health officials are authorized to bring civil actions for abatement of public health nuisances,[11] as are county officials.[12] Private suits for "injuries remediable by the old writ of nuisance" are allowed under the common law and civil procedure code, and may seek damages, removal of the nuisance, or both.[13]

A recent statutory enactment makes it more difficult to bring either private or public nuisance suits against agricultural or forestry operations where the operation has been in existence for more than one year.[14] However, that provision in turn contains an exception, stating that it "shall not affect or defeat the right of any person, firm, or corporation to recover damages for any injuries or damages sustained by him on account of any pollution of, or change in condition of, the waters of any stream."[15]

Fish/Fisheries Laws

• The Environmental Management Commission is authorized "to direct the investigation of any killing of fish and wildlife which, in the opinion of the Commission, is of sufficient magnitude to justify investigation and is known or believed to have resulted from the pollution of the waters or air."[16] The Commission is required to develop and to follow fish kill response protocols for coordinating investigation of and response to "significant fish kill events."[17] Where investigation determines that a person has, with or without a permit, "negligently, or carelessly or unlawfully, or willfully and unlawfully, caused pollution of the water or air...in such quantity, concentration or manner, that fish or wildlife are killed as the result thereof, the Commission may recover, in the name of the State, damages from such person" according to an established schedule of damages.[18]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• The Sedimentation Pollution Control Act requires the Department of Environment, Health and Natural Resources to adopt "Forest Practice Guidelines Related to Water Quality," which are best management practices for forest activity.[19] The Forest Practice Guidelines are found in the North Carolina Administrative Code[20] as well as in a Forestry Practices Manual issued by the Division of Forest Resources. Forest activities conducted in accordance with these Guidelines are exempt from the other provisions of the Act,[21] which regulates certain kinds of "land-disturbing activity" that causes erosion and sedimentation.[22]

Agriculture Requirements

North Carolina has extensive provisions regulating agricultural activity that could cause nonpoint source pollution. These fall into three main categories: soil conservation measures aimed at preventing soil erosion and sedimentation; regulations on siting and operation of animal feeding operations; and pesticide-related laws. Agricultural activities also may be affected by the Watershed Supply Water Protection Act, which is discussed below in the "Development" section.

• Soil and Water Conservation Districts are authorized to prepare comprehensive plans for soil conservation, including best management practices, and "to bring such plans and information to the attention of occupiers of lands within the district."[23] Districts also may condition any grants or other assistance on landowners covenanting to adopt such practices on their lands.[24] Further, "the supervisors of any district shall have authority to formulate regulations governing the use of lands within the district in the interest of conserving the soil and soil resources and preventing and controlling soil erosion"; in such cases, regulations must be proposed by the district and approved by a two-thirds vote of district residents in a referendum.[25] When land-use regulations are in place, district supervisors are authorized to enter and inspect lands to determine whether the regulations are being observed,[26] and to file civil actions for injunctive relief, to take remedial measures, and to seek compensation for any costs incurred.[27]

• For animal feeding operations, the Animal Waste Management Systems Act "intends to establish a permitting program for animal waste management systems that will protect water quality and promote innovative systems and practices while minimizing the regulatory burden."[28] It applies to feeding operations of more than 250 swine, 100 confined cattle, 75 horses, 1000 sheep, or 30,000 confined poultry with a liquid waste management system.[29] These operations must maintain an "animal waste management system" which is defined as a "combination of structures and nonstructural practices serving a feedlot that provide for the collection, treatment, storage, or land application of animal waste,"[30] and which must be designed "so that the animal operation served by the animal waste management system does not cause pollution in the waters of the State except as may result because of rainfall from a storm event more severe than the 25-year, 24-hour storm."[31]

Operators are required to obtain a permit before constructing or operating an animal waste management system, and permit applications must include animal waste management plans with "best management practices for riparian buffers or equivalent controls, particularly along perennial streams."[32] The operations are required to undergo an annual inspection and review, and to give immediate notification of direct discharges of animal waste or other immediate threats to the environment.[33] However, "except as required by federal law or regulations, the [Environmental Management] Commission may not adopt effluent standards or limitations applicable to animal or poultry feeding operations," though it may assess fines of up to $10,000 against conveyances "constructed for the purpose of willfully discharging pollutants to the waters of the State."[34]

• Similarly, the Swine Farm Siting Act applies to operations raising more than 250 swine on a single site.[35] It requires that swine houses or lagoons holding animal waste "shall be located at least 1,500 feet from any occupied residence; at least 2,500 feet from any school, hospital, or church; and at least 500 feet from any property boundary"; it also requires that "the outer perimeter of the land area onto which waste is applied from a lagoon that is a component of a swine farm shall be at least 50 feet from any boundary of property on which an occupied residence is located and from any perennial stream or river, other than an irrigation ditch or canal."[36] However, swine houses or lagoons can be sited closer to residences, schools, hospitals, churches or property boundaries (though apparently *not* to rivers and streams) than the stated limits "if written permission is given by the owner of the property and recorded with the Register of Deeds."[37] "Any person owning property directly affected by the siting requirements" may bring a civil action against the swine farmer; "persons directly affected" are defined to include those owning "property that abuts a perennial stream or river, or on which a perennial stream or river is located."[38] Plaintiffs may seek injunctive relief, damages and, in appropriate cases, court costs, attorney and expert witness fees.[39]

• The North Carolina Pesticide Law[40] provides that "no person shall handle, transport, store, display or distribute pesticides in such a manner as to endanger man and his environment or to endanger food, feed, or any other products that may be transported, stored, displayed, or distributed with pesticides" and that "no person shall dispose of, discard, or store any pesticides or pesticide containers in such a manner as may cause injury to humans, vegetation, crops, livestock, wildlife, or to pollute any water supply or waterway."[41] It also establishes pesticide registration requirements and prohibits distribution or sale of unregistered or mislabelled pesticides.[42]

The Pesticide Board is authorized to adopt regulations for carrying out the Pesticide Law, including regulations governing handling, transport, storage, display, distribution, and disposal of pesticides.[43] The Board issues licenses for pesticide dealers and applicators,[44] and may require reports and conduct inspections, investigations and administrative hearings.[45] Violations of the Act or regulations are subject to misdemeanor criminal penalties and/or civil penalties of up to $2,000 per violation.[46] The Board may seek civil injunctive relief in court, and has emergency authority for license suspensions and seizures in cases of imminent hazard caused by any pesticide, whether registered or unregistered.[47]

• The Watershed Supply Water Protection Act, discussed in detail below, requires local governments to develop water supply watershed protection programs that govern development in key areas and that could affect agricultural activities. However, the Act expressly states that "the reduction of agricultural nonpoint source discharges shall be accomplished *primarily* through the Agriculture Cost Share Program for Nonpoint Source Pollution Control,"[48] a separate program that encourages voluntary implementation of best management practices.[49] In addition, the Act provides that any local watershed protection ordinances governing agricultural and silvicultural activities "shall be no more restrictive than those adopted by the [Environmental Management] Commission."[50]

Development and Other Earth-Disturbing Activities

• The Sedimentation Pollution Control Act[51] applies to certain kinds of "land-disturbing activity" that causes erosion and sedimentation. "Land-disturbing activity" is defined as "any use of the land by any person in residential, industrial, educational, institutional or commercial development, highway and road construction and maintenance that results in a change in the natural cover or topography and that may cause or contribute to sedimentation."[52] It excludes agricultural activities, forestry activities conducted in accordance with best management practices, mining, or emergency activities.[53] For land-disturbing activity, the Act establishes mandatory standards including: (1) no activity is permitted in proximity to a lake or natural watercourse unless there is a buffer zone "along the margin of the watercourse of sufficient width to confine visible siltation within the twenty-five percent of the buffer zone nearest the land-disturbing activity"; (2) graded slopes and fills shall not be steeper "than the angle which can be retained by vegetative cover or other adequate erosion-control devices or structures"; and (3) tracts where more than an acre of land is uncovered must include, "such sedimentation and erosion control devices and practices as are sufficient to retain the sediment generated by the land-disturbing activity within the boundaries of the tract" during construction, and permanent ground cover following completion of construction."[54]

Under the Act, the Sedimentation Control Commission is authorized to "develop, promulgate, publicize and administer a comprehensive State erosion and sedimentation control program," including rules and regulations. The rules are to "contain conservation standards for various types of soils and land uses, which standards shall include criteria and alternative techniques and methods for the control of erosion and sediment resulting from land-disturbing activities."[55] The Commission is also required to develop a model local erosion control ordinance and to review and approve proposed programs submitted by local governments and State agencies and erosion control plans submitted by project proponents.[56] The Act sets out a procedure for approval of proposed erosion control plans; in addition to decisions on the merits, plans may be disapproved based on a finding of previous violations of the Act or failure to pay a previous penalty.[57] The Commission may delegate its authority to review and approve erosion control plans to local governments with State-approved erosion control programs.[58]

The Commission and local governments with delegated authority are authorized to inspect sites, issue notices of violation, and specify dates for compliance.[59] Further, the Secretary of Environment, Health and Natural Resources is authorized to issue stop-work orders for violations of the Act or Rules if the violation is knowing and willful and: "(1) Off-site sedimentation has eliminated or severely degraded a use in a lake or natural watercourse or ... such degradation is imminent; (2) Off-site sedimentation has caused severe damage to adjacent land or ... such damage is imminent; [or] (3) the land-disturbing activity is being conducted without an approved plan."[60] The Act provides for up to $500 per violation per day for violation of the Act, an ordinance, rule or order; civil penalties of up to $5,000 per violation per day for violation of a stop-work order; and criminal misdemeanor fines of up to $5,000 for knowing and willful violations.[61] The Secretary, or a local government with delegated authority, may also impose restoration requirements or seek an injunction, and "any person injured by a violation" of the Act or the rules may seek injunctive relief and/or damages.[62]

• The Watershed Supply Water Protection Act requires the Environmental Management Commission to "adopt rules for the classification of water supply watersheds and that establish minimum statewide water supply watershed protection requirements applicable to each classification to protect surface water supplies by (I) controlling development density, (ii) providing for performance-based alternatives to development density controls that are based on sound engineering principles, or (iii) a combination of both (I) and (ii)."[63] Further, the Commission "may designate water supply watersheds or portions thereof as critical water supply watersheds and impose management requirements that are more stringent than the minimum statewide water supply watershed management requirements," and adopt rules that require that any permit issued by a local government for a development or construction activity conducted by that local government within a designated water supply watershed be approved by the Department [of Environment, Health, and Natural Resources] prior to issuance."[64]

Under the Act, local governments are required to develop a water supply watershed protection program and ordinances for enforcing the minimum management requirements, and they "may adopt such ordinances pursuant to their general police power, power to regulate the subdivision of land, zoning power, or any combination of such powers."[65] The Commission must assume enforcement authority where a local government "fails to adopt a program that meets the requirements of this section or whenever a local government fails to adequately administer and enforce the provisions of its program."[66] However, if a local government wishes to adopt an ordinance more stringent than Commission requirements, it must give notice to the Commission;[67] and local ordinances governing agricultural and silvicultural activities "shall be no more restrictive than those adopted by the Commission."[68] Local governments that fail to adopt or enforce water supply watershed management programs are subject to civil penalties of up to $10,000 per month; persons who violate the management requirements are subject to civil penalties of up to $10,000 per violation per day.[69]

• Under the Natural and Scenic Rivers Act, "the State Utilities Commission may not permit the construction of any dam, water conduit, reservoir, powerhouse transmission line, or any other project works on or directly affecting any river that is designated as a component or potential component of the State Natural and Scenic Rivers System. No department or agency of the State may assist by loan, grant, license, permit, or otherwise in the construction of any water resource project that would have a direct and adverse affect on any river that is designated as a component or potential component of the State Natural and Scenic Rivers System."[70] The Act's provisions "shall not, however, preclude licensing of or assistance to a development below or above a designated or potential component."[71] The Act authorizes the Department of Environment, Health and Natural Resources to adopt rules to implement the Natural and Scenic Rivers System,[72] and violations of the Act or rules is subject to injunctive relief and to a misdemeanor fine of no more than $50 per violation per day.[73]

• The Coastal Area Management Act applies only to counties within the coastal zone, and requires the "development and adoption of State guidelines for the coastal area and the development and adoption of a land-use plan for each county within the coastal area, which plans shall serve as criteria for the issuance or denial of development permits."[74] The guidelines "shall consist of statements of objectives, policies, and standards to be followed in public and private use of land and water areas within the coastal area," and "shall give particular attention to the nature of development which shall be appropriate within the various types of areas of environmental concern that may be designated by the [Coastal Resources] Commission.[75] "Areas of environmental concern" are defined to include coastal wetlands, estuarine waters, renewable resource areas (public water supplies and forest land), fragile or historic areas, areas with rights of public access or public trust, natural-hazard areas, outstanding resource waters, and fisheries;[76] there is a public procedure for designating areas of environmental concern.[77] Once areas of environmental concern are designated, all local land-use plans, local ordinances, and permits issued within the areas must be consistent with the state guidelines.[78]

Within the coastal zone, city and county governments must submit implementation and enforcement plans to the state, which either approves the plan and delegates enforcement authority or assumes enforcement until an adequate plan is approved.[79] The Act authorizes the Secretary to seek injunctive relief, misdemeanor criminal penalties for knowing and willful violations, and administrative civil penalties of up to $250 for "minor developments" or $2500 for "major developments."[80] Local officials also may seek injunctions for minor developments.[81]

Endnotes

1. N.C. Gen. Stat. § 143-215.1(a)(6).
2. N.C. Gen. Stat. § 143-213(9).
3. N.C. Gen. Stat. § 143-213(18).
4. N.C. Gen. Stat. § 143-213(18)(d).
5. N.C. Gen. Stat. § 143-215.2.
6. N.C. Gen. Stat. § 143-213(19).
7. N.C. Gen. Stat. § 143-214.2(c).
8. N.C. Gen. Stat. § 143-215.1(a)(10).
9. N.C. Gen. Stat. § 143-215.1(a)(11).
10. N.C. Gen. Stat. §§ 143-215.6A, .6B, .6C.
11. N.C. Gen. Stat. § 130A-19.
12. N.C. Gen. Stat. § 153A-140.
13. N.C. Gen. Stat. § 1-539.
14. N.C. Gen. Stat. § 106-701(a).
15. N.C. Gen. Stat. § 106-701(c).
16. N.C. Gen. Stat. § 143-215.3(a)(7).
17. N.C. Gen. Stat. § 143B-279.7.
18. N.C. Gen. Stat. § 143-215.3(a)(7).
19. N.C. Gen. Stat. § 113A-52.1.
20. N.C. Admin. Code T15A:1I.0101-.0209.
21. N.C. Gen. Stat. § 113A-52.1.
22. *See* N.C. Gen. Stat. § 113A-50 et seq., which is discussed below.
23. N.C. Gen. Stat. § 139-8.
24. N.C. Gen. Stat. § 139-8.
25. N.C. Gen. Stat. § 139-9.
26. N.C. Gen. Stat. § 139-10.
27. N.C. Gen. Stat. § 139-11.
28. N.C. Gen. Stat. § 143-215.10A.
29. N.C. Gen. Stat. § 143-215.10B(1).
30. N.C. Gen. Stat. § 143-215.10B(3).
31. N.C. Gen. Stat. § 143-215.10C(b).
32. N.C. Gen. Stat. §§ 143-215.10C(a), (d), (e). The detailed animal waste management regulations are found at N.C. Admin. Code T15A:02H.0200 et seq.
33. N.C. Gen. Stat. §§ 143-215.10D, .10E, .10F.
34. N.C. Gen. Stat. § 143-215.
35. N.C. Gen. Stat. § 106-800 et seq.
36. N.C. Gen. Stat. § 106-803(a).
37. N.C. Gen. Stat. § 106-803(b).

[38] N.C. Gen. Stat. § 106-804.
[39] N.C. Gen. Stat. § 106-804(a), (c).
[40] N.C. Gen. Stat. § 143-434 et seq.
[41] N.C. Gen. Stat. §§ 143-441(b), (c).
[42] N.C. Gen. Stat. §§ 143-442, -443.
[43] N.C. Gen. Stat. §§ 143-437,-441(a).
[44] N.C. Gen. Stat. §§ 143-448 to -459.
[45] N.C. Gen. Stat. §§ 143-461, -466.
[46] N.C. Gen. Stat. §§ 143-469(a), (b). Penalties for violations of an applicators' license are limited to $500. N.C. Gen. Stat. § 143-469(d).
[47] N.C. Gen. Stat. §§ 143-461, -447.
[48] N.C. Gen. Stat. § 143-214.5(a).
[49] *See* N.C. Gen. Stat. § 143-215.74.
[50] N.C. Gen. Stat. § 143-214.5(d1).
[51] N.C. Gen. Stat. § 113A-50 et seq.
[52] N.C. Gen. Stat. § 113A-52(6).
[53] N.C. Gen. Stat. § 113A-52.01.
[54] N.C. Gen. Stat. § 113A-57.
[55] N.C. Gen. Stat. § 113A-54.
[56] N.C. Gen. Stat. § 113A-54.
[57] N.C. Gen. Stat. § 113A-54.1.
[58] N.C. Gen. Stat. §§ 113A-60, -61.
[59] N.C. Gen. Stat. § 113A-61.1.
[60] N.C. Gen. Stat. § 113A-65.1.
[61] N.C. Gen. Stat. §§ 113A-64(a), (b).
[62] N.C. Gen. Stat. §§ 113A-64.1, -65, -66.
[63] N.C. Gen. Stat. § 143-214.5(b).
[64] N.C. Gen. Stat. § 143-214.5(b).
[65] N.C. Gen. Stat. § 143-214.5(d).
[66] N.C. Gen. Stat. § 143-214.5(e).
[67] N.C. Gen. Stat. § 143-214.5(d).
[68] N.C. Gen. Stat. § 143-214.5(d1). *See also* N.C. Gen. Stat. § 143-214.5(a) (notwithstanding the Watershed Supply Water Protection Act, "the reduction of agricultural nonpoint source discharges shall be accomplished *primarily* through the Agriculture Cost Share Program for Nonpoint Source Pollution Control.")
[69] N.C. Gen. Stat. § 143-214.5(g).
[70] N.C. Gen. Stat. § 113A-44.
[71] N.C. Gen. Stat. § 113A-44.
[72] N.C. Gen. Stat. § 113A-36(d).
[73] N.C. Gen. Stat. § 113A-42.
[74] N.C. Gen. Stat. § 113A-106.
[75] N.C. Gen. Stat. § 113A-107.
[76] N.C. Gen. Stat. § 113A-111.
[77] N.C. Gen. Stat. § 113A-115.
[78] N.C. Gen. Stat. §§ 113A-108, -111. The permit requirement and procedures and criteria for permit issuance are found at N.C. Gen. Stat. §§ 113A-118 to -123.
[79] N.C. Gen. Stat. § 113A-117.
[80] N.C. Gen. Stat. § 113A-126.
[81] N.C. Gen. Stat. § 113A-126(b).

NORTH DAKOTA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

North Dakota's water pollution control law includes a provision that may be used to take enforcement action against nonpoint sources that pollute the waters of the state. Another provision may allow enforcement action against certain unpermitted nonpoint source activities that cause pollution.

- North Dakota's Water Pollution Act empowers the state Department of Health ("Department") generally to prevent "new or existing pollution of waters of the state" and, in cooperation with the state water commission, to formulate water quality standards.[82] More specifically, North Dakota law makes it unlawful "to cause pollution of any waters of the state or to place or cause to be placed any wastes in a location where they are likely to cause pollution of the waters of the state."[83] This provision is not restricted to point sources nor to "discharges."

- State law also requires a permit for a range of activities and facilities that would cause a "discharge" or "*would otherwise alter the physical, chemical, or biological properties of any waters of the state in any manner not already lawfully authorized.*"[84] Although the term "discharge" is defined as limited to discharge from a point source,[85] the remaining language may allow the state to apply this provision to some nonpoint sources that cause pollution.

Enforcement provisions authorize the Department to initiate court action, administrative enforcement proceedings, issue emergency orders or seek emergency injunctions.[86] Fines of up to $25,000 for the first and $50,000 for subsequent convictions for willful violations and/or jail terms of one or two years are available. Civil penalties of up to $10,000 per day are also available for violations without willful intent.[87]

Other Discharge Limitations

- State law establishes water resource districts that are empowered, among other acts, "to make rules and regulations concerning the management, control, regulations, and conservation of waters and *prevent the pollution, contamination, or other misuse of water resources*, streams, or bodies of water included within the district"[88] and, also, to protect native woodland bordering within two hundred feet of a riverbank subject to overflow flooding by ordering or taking "appropriate legal action" (civil suits and administrative orders) to halt its destruction or ordering "appropriate planting of a shelterbelt."[89] Violation of these provisions constitutes a Class B misdemeanor, which means up to 30 days in jail and a $500 fine.[90]

- Municipalities have the authority "to prevent the pollution" of a municipal or public water supply within one mile of the municipal limits and "to compel cleaning, abatement or removal of...any other unwholesome nauseous thing..."[91] Municipalities may order abatement of violations and seek fines and penalties as set by ordinance.[92]

• Under North Dakota law, "nuisance" is defined as an act that interferes with or obstructs "a lake, navigable river, bay, stream, canal, basin..." However, this statute protects an agricultural operation from a nuisance action if it has been in operation for more than one year and was not a nuisance at the time the operation began, except where there is negligence or improper operation.[93] Any action taken under "the express authority of a statute" cannot be deemed a nuisance.[94] A range of actions on behalf of the state are possible to abate a nuisance, including actions brought by the attorney general, the state health officer, local boards of health, state's attorney or any citizen of the county where a nuisance exists.[95] A private nuisance may be abated by a public body or officer and is actionable by a private person to whom the nuisance is "specially injurious."[96] Sanctions include an action for abatement and/or past damages[97] and, for public nuisances, criminal sanctions of up to one year in prison and a $1000 fine.[98]

• Municipalities have their own power to determine what constitutes a nuisance and "to prevent, abate and remove the same."[99]

Fish/Fisheries Laws

• State law prohibits the "deposit [of] any refuse or other matter which may prove harmful to fish or fish eggs," in waters in which the state or federal government "has deposited or may deposit, fish, fish eggs, or fry, or in which fish naturally abound..."[100] These are considered criminal actions that are Class B misdemeanors punishable by a maximum of 30 days in jail and a $500 fine.[101]

OPERATIONAL REQUIREMENTS

Forestry Requirements

North Dakota does not appear to have laws relating to forestry that contain enforceable provisions with respect to nonpoint source discharges, apart from the water resource district law described above.

Agriculture Requirements

• North Dakota law provides for the creation of soil conservation districts to prevent and control soil erosion through the formulation of land use regulations.[102] These districts may set up boards that grant variances from the regulations and that are also authorized to bring enforcement actions for violations that increase erosion. In the absence of compliance, the court may empower the district to enter upon the land, force compliance and assess costs and interest.[103]

• The water quality regulations require the Department's approval of concentrated livestock feeding operations.[104] The Department enforces these provisions as part of the water pollution program. See enforcement mechanisms outlined <u>supra</u> under the general discharge limitations section.

• The Commissioner of Agriculture ("Commissioner") is charged with enforcement of the state pesticide laws. The Commissioner is authorized to develop pollution prevention criteria for areas utilized for mixing and storing agricultural chemicals at the retail and end use levels.[105] In addition, the state pesticide law makes it illegal to discard, store, display or dispose of pesticide "in such a manner as to endanger the environment."[106] The Commissioner may seek civil action, issue an administrative order or file a criminal complaint if the administrative order is ignored.[107]

• State law directs the Commissioner to adopt rules "to minimize the possibility of chemical, pesticide, fertilizer, or other contamination of irrigation water supply"[108] and may issue an administrative order for compliance or seek relief in court.[109] The statute provides for civil penalties of up to $5000 or, for criminal proceedings, a fine of up to $1000 of a year in jail.[110] A violation also constitutes a Class A misdemeanor.[111]

Development and Other Earth-Disturbing Activities

• North Dakota statutes contain general language delegating various zoning authorities to cities and counties. Counties are authorized to regulate property development through zoning regulations that are designed to promote certain purposes, including "to conserve and develop natural resources"[112] a violation of which is a Class B misdemeanor. Local authorities determine the "means and methods" for enforcement of zoning ordinances,[113] and affected property owners may seek civil enforcement of township regulations.[114]

No specific enforcement requirements relating to earthmoving or construction activities were identified, apart from any that may implement urban stormwater programs under the Clean Water Act.

Endnotes

[82] N.D. Cent. Code 61-28-04(2) & (15).
[83] N.D. Cent. Code 61-28-06(1).
[84] N.D. Cent. Code 61-28-06(2).
[85] N.D. Cent Code 61-28-02(3).
[86] N.D. Cent. Code 61-28-04(22), 61-28-07, & 61-28-08.
[87] N.D. Cent. Code 61-28-08.
[88] N.D. Cent. Code 61-16.1-09(8).
[89] N.D. Cent. Code 61-16.1-09(17)
[90] N.D. Cent. Code 61-16.1-63.
[91] N.D. Cent. Code 40-05-01(49), (61).
[92] N.D. Cent. Code 40-05-01(1),(44).
[93] N.D. Cent. Code 42-04-02.
[94] N.D. Cent. Code 42-01-12.
[95] N.D. Cent. Code 42-02-01, 23-05-04.
[96] N.D. Cent. Code 42-01-09.
[97] N.D. Cent. Code 42-01-03 & 42-01-11.
[98] N.D. Cent. Code 42-01-07 to 11 & 12.1-32-01(5).
[99] N.D. Cent. Code 40-05-01(44).
[100] N.D. Cent. Code 20.1-06-09.
[101] N.D. Cent. Code 20.1-06-01 & 12.1-32-01(6).

[102] N.D. Cent. Code 4-22-27.
[103] N.D. Cent. Code 4-22-35 to 39.
[104] N.D. Admin. Code 33-16-03.
[105] N.D. Cent. Code 23-33-09.
[106] N.D. Cent. Code 4-35-20.
[107] N.D. Cent. Code 4-35-24(1) - (3).
[108] N.D. Cent. Code 4-35.1-03.
[109] N.D. Cent. Code 4-35.1-06.
[110] N.D. Cent. Code 4-35.1-06(3), 12.1-32-01(5).
[111] N.D. Cent. Code 4-35.1-06.
[112] N.D. Cent Code 11-33-03(5).
[113] N.D. Cent. Code 40-47-01.
[114] N.D. Cent. Code 58-03-14.

OHIO

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Ohio has a broad prohibition that prohibits nonpoint source water pollution as well as point source water pollution. However, it has exemptions that are intended to assure that certain nonpoint source discharges regulated under other state laws are not subject to this section. It also exempts nonpoint source animal waste discharges.

• "No person shall cause pollution or place or cause to be placed any sewage, industrial waste, or other wastes in a location *where they cause pollution* of any waters of the state, and any such action is hereby declared to be a public nuisance, except in such cases where the director of environmental protection has issued a valid and unexpired permit, or renewal thereof...or an application for renewal is pending."[1] The prohibition is enforced by administrative orders, injunctions, and civil penalties of up to $10,000 per day.[2] However, this prohibition exempts "[a]pplication of materials to land for agricultural purposes or runoff of such materials from such application[,] or pollution by animal waste or soil sediment including attached substances, resulting from farming, silvicultural, or earthmoving activities regulated by Chapter 307 or 1515 of the Revised Code."[3] The referenced sections are laws under which Ohio counties regulate earthmoving associated with development, and under which soil and water conservation districts regulate nonpoint source discharges of sediment as described below. The broad prohibition also does not apply to excrement of domestic and farm animals and runoff therefrom.[4]

Other Discharge Limitations

• Ohio has multiple provisions in its general nuisance laws applicable to nonpoint source pollution.[5] The water pollution law expressly preserves common law nuisance remedies for water pollution.[6] Local governments also have inherent power to abate nuisances.[7] However, Ohio law provides that complaints regarding agricultural nuisances may only be made to the chief of the Department of Natural Resources' Soil and Water Conservation Division, so that they may be investigated by the division.[8] In a private civil action for a nuisance involving agricultural pollution it is an affirmative defense that the defendant is operating under a management plan approved by the division.[9]

State law also defines the following offenses:

• "No person, regardless of intent, shall deposit litter or cause litter to be deposited on any public property, or private property not owned by him or in or on waters of the state..."[10] "Litter" means "garbage, trash, waste, rubbish, ashes, cans, bottles, wire, paper, cartons, boses, automobile parts, furniture, glass, or anything else of an unsightly or unsanitary nature."[11] This provision is enforceable by any sheriff, police officer, constable, wildlife officer, conservancy district officer or any other law enforcement officer.[12] Forest officers are specifically directed to enforce this provision "in or along any water course within, abutting, or upstream of any area administered by" the Department of Natural Resources.[13] This is a misdemeanor of the third degree (no more than 60 days and/or $500). The court may also impose restitution for all or part of any property damage. And the court may, in lieu of or in addition to any penalty, require such person to "remove litter from any public or private property, or in or on waters of the state.[14]

• "No person shall cause or allow offal, filth, or noisome substances to be collected or remain in any place to the damage or prejudice of others or of the public."[15] The law exempts persons engaged in agriculture provided they are operating outside the city limits of a municipal corporation and "in such manner so as not to have a substantial effect on the public health, safety or welfare." This exemption also applies to "any similar ordinances, resolutions, rules, or other enactments of a state agency or political subdivision"[16] This offense is a misdemeanor of the third degree (no more than 60 days and/or $500); The court may also impose restitution for all or part of any property damage.[17]

• "No person shall....corrupt or render unwholesome or impure, a watercourse, stream, or water."[18] This is a misdemeanor of the third degree (no more than 60 days and/or $500); the court may also impose restitution for all or part of any property damage.[19]

• "No person shall intentionally throw, deposit, or permit to be thrown or deposited [various wastes associated with coal and coal products, cheesemaking, and petroleum handling]" either into water "or a place from which it may wash therein."[20] This is a misdemeanor of the first degree (no more than 6 months and/or $1,000); the court may also impose restitution for all or part of any property damage.[21]

• "No person shall put the carcass of a dead animal, or the offal from a slaughterhouse, butcher's establishment, packing house, or fish house, or spoiled meat, spoiled fish, or other putrid substance or the contents of a privy vault" into the waters or lands where it may enter the water.[22] "No person shall maliciously put a dead animal, carcass, or part thereof, or other putrid, nauseous, or offensive substance into, or befoul, a well, spring, brook, or branch of running water, or a reservoir of a water works, of which use is or may be made for domestic purposes."[23] These offenses are minor misdemeanors punishable by up to $100 fine; the court may also impose restitution for all or part of any property damage.[24]

Fish/Fisheries Laws

• Ohio's wildlife law contains a provision stating that "No person shall place or dispose of in any manner, any garbage, waste, peelings of vegetables or fruits, rubbish, ashes, cans, bottles, wire, paper, cartons, boxes, parts of automobiles, wagons, furniture, glass, oil, or anything else of an unsightly or unsanitary nature...in any ditch stream, river, lake, pond, or other water course...or upon the bank thereof where the same is liable to be washed into the water either by ordinary flow or floods."[25] However, this provision does not apply to substances placed in accordance with a permit under the water pollution control provision referenced above "or exempted by such section" -- hence exempting runoff of waste or sediment from agriculture, silviculture, and earthmoving where otherwise regulated, and exempting animal manure generally. The wildlife law prohibition is enforced in local courts as a misdemeanor by wildlife officers or local law enforcement officials.[26] The first offense is punishable by no more than 60 days and/or $500 fine; subsequent offenses by no more than 6 months and/or $1,000 fine.[27] The court may also impose restitution for all or part of any property damage.

OPERATIONAL REQUIREMENTS

Forestry and Agriculture Requirements

• Ohio law specifically provides a program for control of sediment and related runoff from agricultural and silvicultural activities. The law directs Ohio DNR's Division of Soil and Water Conservation, with the approval of the Soil and Water Conservation Commission, to adopt rules establishing "technically feasible and economically reasonable standards to achieve a level of management and conservation practices in farming or silvicultural operations that will abate wind or water erosion of the soil or abate the degradation of the waters of the state by animal waste or by soil sediment including substances attached thereto."[28] The law further empowers the Division to "establish procedures for...enforcement of rules for agricultural pollution abatement."[29] The law is implemented at the farm and forest level by soil and water conservation districts.[30]

The regulations under this program provide for control of sheet and rill erosion, wind erosion, and concentrated channel erosion.[31] Farmers are required to apply and maintain "Field Office Technical Guide" measures.[32] The regulations specifically provide that there shall be no earth disturbing practices (including tillage) immediately adjacent to waters of the state "except for those practices constructed or implemented in accordance with generally accepted agricultural, silvicultural and engineering practices."[33] The regulations make Best Management Practices enforceable, and provide that operation and maintenance plans "may" be filed with county soil and water conservation districts.[34] The districts must approve operations and management plans.[35]

The statute expressly does not regulate the excrement of domestic or farm animals or runoff therefrom into the waters of the state, however, except from concentrated animal feeding operations (CAFOs).[36] With respect to CAFOs the regulations provide that to abate pollution by animal waste from collection, storage, or treatment facilities, the operator shall "design, construct, operate, and maintain" such facilities to prevent discharge, and follow the standards in the "Field Office Technical Guide."[37] The operator must prevent seepage from animal waste management facilities and "if pollution of waters of the state occurs from an existing facility, corrective measures shall be taken."[38] CAFO pollution from land application, flooding, waste waters, and other related activities must also be prevented.[39]

If the sediment and erosion control program is being administered by the local soil and water conservation district, complaints may be investigated by the district and -- after the district invites the violator to comply, provides any assistance, and gives a voluntary period to correct the problem[40] -- orders may be issued by the Division based on the district's findings of violation, subject to an administrative hearing.[41] The Division of Soil and Water Conservation may order compliance with an operation and maintenance plan, after conducting an adjudicatory hearing.[42] However, the Division may not issue an order requiring the recipient to implement a pollution abatement practice eligible for cost sharing unless public funds are actually available at not less than 75 percent of the cost (not to exceed $15,000/person/yr).[43] Division enforcement orders are appealable to the court of common pleas.[44] The orders are also judicially enforceable.[45] Violation of an order is a misdemeanor punishable by imprisonment up to 6 months, up to $1,000 per day, and restitution.[46] Also the state may recover any expenditures from the "agricultural pollution abatement fund" for expenditures to protect public health.[47] In addition, the Division may seek a court order against a discharger at any time if the violation "causes pollution of the waters of the state and constitutes a danger to public health."[48]

• Ohio law provides for pesticide regulation, including custom applicator licensing, public operator licensing, and private applicator certification.[49] It sets out prohibitions including uses inconsistent with labeling "or other restrictions imposed by the director of agriculture."[50] It also provides that "no person shall transport, store, dispose of, display, or distribute any pesticide or pesticide container in such manner as to have unreasonable adverse effects on the environment."[51] Enforcement includes misdemeanor prosecution, and injunction, as well as civil penalties not to exceed $5,000 for a first offense and $10,000 for any subsequent offense.[52]

Although Ohio has numerous laws relating to agricultural ditching and drainage, none speaks directly to the issue of preventing or controlling nonpoint source water pollution.[53]

Development and Other Earth-Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act, or that may be authorized by general land use regulation, such as zoning, state law also provides the following authorities applicable to nonpoint source discharges.

• State law empowers the Division of Soil and Water Conservation, subject to approval of the Ohio Soil and Water Conservation Commission, to adopt rules for "technically feasible and economically reasonable standards to achieve a level of management and conservation practices that will abate wind or water erosion of the soil or abate the degradation of the waters of the state by soil sediment in conjunction with land grading, excavating, filling, or other soil disturbing activities on land used or being developed for nonfarm commercial, industrial, residential, or other nonfarm purposes."[54] Municipalities and counties may develop their own programs. The division "may recommend" criteria and procedures for "approval of urban sediment pollution abatement plans and issuance of permits" prior to the disturbance of five or more acres; while areas less than five acres do not need plans or permits, they are not exempt from the "other provisions of this chapter and rules adopted under them."[55] Developments of five or more acres must develop an "erosion and sediment control plan" which must be approved by the state or local approving agency, and must institute stormwater controls.[56] Areas of any size require use of conservation practices including sediment trapping, stabilization of denuded areas, stream crossing work; no dumping into water resources or into such proximity that it may slough, slip, or erode into the waters unless authorized.[57]

• Coastal erosion areas are designated for Lake Erie jurisdictions by DNR. Rules govern "erection, construction, and redevelopment" of structures in these erosion areas; a permit is required and may be granted only if "the proposed site is protected by an effective erosion control measure approved by the director."[58] Enforcement mechanisms include stop work orders, injunctions, fines, and civil penalties of up to $5,000.[59] A state permit is not required if the county or municipality has its own equivalent program.

Endnotes

1. Ohio Rev. Stat. § 6111.04.
2. Ohio Rev. Stat. §§ 6111.06, 6111.07, 6111.08.
3. Ohio Rev. Stat. § 6111.04(C).
4. Ohio Rev. Stat. § 6111.04(D).
5. Ohio Rev. Stat. Chapter 3767.
6. Ohio Rev. Stat. § 6111.08: "Chapter 6111 of the Revised Code [Water Pollution] does not abridge any rights of action or remedies in equity or under the common law, nor does such chapter, or any act done under such chapter, estop the state or any municipal corporation or person, as riparian owners or otherwise, in the exercise of their rights in equity or under the common law to suppress nuisances or to abate pollution."
7. See e.g., Ohio Rev. Stat. § 715.44 (municipalities).
8. Ohio Rev. Stat. § 1511.021(B).
9. Ohio Rev. Stat. § 1511.021(c).
10. Ohio Rev. Stat. § 3767.32(A).
11. Ohio Rev. Stat. § 3767.32(D).
12. Ohio Rev. Stat. § 3767.32(E).
13. Ohio Rev. Stat. § 1503.29.
14. Ohio Rev. Stat. § 3767(C); § 2929.21(E).
15. Ohio Rev. Stat. § 3767.13(B).
16. Ohio Rev. Stat. § 3767.13(D).
17. Ohio Rev. Stat. §§ 3767.13, 2929.21(E).
18. Ohio Rev. Stat. § 3767.13(C).
19. Ohio Rev. Stat. §§ 3767.13, 2929.21(E).
20. Ohio Rev. Stat. § 3767.14.
21. Ohio Rev. Stat. § 2929.21(E).
22. Ohio Rev. Stat. § 3767.16.
23. Ohio Rev. Stat. § 3767.18.
24. Ohio Rev. Stat. § 2929.21(E).
25. Ohio Rev. Stat. § 1531.29.
26. Ohio Rev. Stat. § 1531.131.
27. Ohio Rev. Stat. § 1531.99; see § 2929.21.
28. Ohio Rev. Stat. § 1511.02(E)(1).
29. Ohio Rev. Stat. § 1511.02(E)(2).
30. Ohio Rev. Stat. §§ 1515.08(L),(R),(S),(T) provide for soil and water conservation districts to agree to carry out the program under Chapter 1511.
31. Ohio Admin. Code §§ 1501:15-5-08, -09, -10.

[32] Ohio Admin. Code § 1501:15-5-08.
[33] Ohio Admin. Code § 1501:15-5-11.
[34] Ohio Admin. Code § 1501:15-5-12.
[35] Ohio Admin. Code § 1501:15-5-15.
[36] Ohio Rev. Stat. § 1511.02.
[37] Ohio Admin. Code § 1501:15-5-02.
[38] Ohio Admin. Code § 1501:15-5-03.
[39] Ohio Admin. Code §§ 1501:15-5-04 to -07.
[40] Ohio Admin. Code § 1501:15-5-15.
[41] Ohio Admin. Code § 1501:15-5-16.
[42] Ohio Rev. Stat. § 1511.02(G).
[43] Ohio Rev. Stat. § 1511.02(H).
[44] Ohio Rev. Stat. § 1511.08.
[45] Ohio Rev. Stat. § 1511.07(B).
[46] Ohio Rev. Stat. § 1511.99; Ohio Admin. Code § 1501:15-5-16(A)(2).
[47] Ohio Rev. Stat. § 1511.071.
[48] Ohio Rev. Stat. § 1511.07(A)(2).
[49] Ohio Rev. Stat. Chap. 921.
[50] Ohio Rev. Stat. § 921.25.
[51] Ohio Rev. Stat. § 921.15.
[52] Ohio Rev. Stat. §§ 921.26, 921.99; Ohio Admin. Code § 901:5-11-11.
[53] See e.g., Ohio Rev. Stat. Chaps. 6131, 6135, 6137.
[54] Ohio Rev. Stat. § 1511.02(E)(2).
[55] Ohio Rev. Stat. § 1511.02(E)(3).
[56] Ohio Admin. Code § 1501:15-1-03, § 1501:15-1-05.
[57] Ohio Admin. Code § 1501:15-1-04.
[58] Ohio Rev. Stat. § 1506.07.
[59] Ohio Rev. Stat. §§ 1506.07, .08, .99.

OKLAHOMA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Oklahoma's water pollution control law contains a general prohibition against water pollution or placement of wastes that are likely to cause pollution. This prohibition has been construed by regulation to apply to nonpoint sources and to be enforceable by the state's Department of Environmental Quality (DEQ). However, Oklahoma law also removes agricultural and silvicultural nonpoint sources from the DEQ's jurisdiction, and places them under voluntary or cost-share programs.

• The water quality code makes it "unlawful for any person to cause pollution of any waters of the state or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any air, land or waters of the state," and declares any such action to be a public nuisance.[1] This provision is expressly construed by regulations to include nonpoint sources.[2] The regulations also expressly state that nonpoint sources of pollution are to be investigated and enforced as in other cases of pollution.[3] Generally, in water pollution cases, the Executive Director of the Department of Environmental Quality "shall make an order requiring such pollution to cease within a reasonable time, or requiring such manner of treatment or of disposition of the sewage or other polluting material as may in his judgment be necessary to prevent further pollution. It shall be the duty of the person to whom such order is directed to fully comply with the order of the Executive Director."[4] In cases of noncompliance, the Department may institute an action in the proper court, and seek an injunction, a civil penalty of up to $10,000 per violation, and/or misdemeanor criminal penalties of $200 to $10,000, imprisonment for up to 6 months, or both.[5]

However, Oklahoma law divests the DEQ of jurisdiction over agricultural and silvicultural nonpoint sources, instead assigning jurisdiction to the Department of Agriculture for agricultural discharges and to the Conservation Commission for erosion control.[6] Neither of these entities appears to have enforcement authorities applicable to nonpoint source discharges.[7]

Other Discharge Limitations

• The Oklahoma code provides that "a nuisance consists in unlawfully doing an act ... which either: (1) [a]nnoys, injures or endangers the comfort, repose, health, or safety of others; or (2) [o]ffends decency; or (3) [u]nlawfully interferes with, obstructs or tends to obstruct, or renders dangerous for passage, any lake or navigable river, stream, canal or basin, or any public park, square, street or highway; or (4) [i]n any way renders other persons insecure in life, or in the use of property, provided, this section shall not apply to preexisting agricultural activities."[8] It also states that "a public nuisance is one which affects at the same time an entire community or neighborhood, or any considerable number of persons, although the extent of the annoyance or damage inflicted upon the individuals may be unequal."[9] The statutory definition of "nuisance" has been held to encompass both private and public nuisances in the context of a water pollution case.[10] However, prior existing agricultural activities are presumed reasonable and not a nuisance unless they have "substantial adverse effects."[11]

Remedies against public nuisance include indictment or information, civil actions, or abatement.[12] A "private person may maintain civil action for a public nuisance if it is specially injurious to himself."[13] Public nuisances also are subject to abatement by "any public body or officer,"[14] or by the person injured.[15] Public nuisance also is a misdemeanor offense where penalties are not otherwise prescribed.[16] While most Oklahoma nuisance cases dealing with water pollution stem from petroleum industry operations, there are cases finding liability for discharge of improperly treated municipal sewage,[17] ejection of excess storm water,[18] and crop damage from drifting herbicides.[19] One case enjoined development of a landfill based on anticipatory nuisance theory.[20]

• The Oklahoma code also provides that "no person, firm, [etc.] shall pollute or permit the pollution of the water supply of a municipality, or any stream, pond, spring, lake, or other water reservoir or groundwater aquifer, which is used or which is being held for use as a water supply by a municipality."[21] For purposes of this section, "pollution" is defined as "contamination or other alteration of the physical, chemical, or biological properties of any natural waters of the state, or such discharge of any liquid, gaseous, or solid substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful or detrimental or injurious to the health, safety, or welfare of the general public, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, or fish or other aquatic life."[22] To enforce this section, "a municipality may bring an action in the district court to enjoin any activity that will cause pollution of the water supply of a municipality whether or not such activity is regulated, licensed, or inspected."[23] Municipalities also may bring a civil action in which "the measure of damages shall be the amount which will compensate for the detriment caused" by the pollution.[24]

• Finally, "every person who throws or deposits any gas tar, or refuse of any gas house or factory, into any public waters, river or stream, or into any sewer or stream emptying into any such public waters, river or stream, is guilty of a misdemeanor."[25]

Fish/Fisheries Laws

• The Wildlife Conservation Code provides that "no person may deposit, place, throw, or permit to be deposited, placed or thrown, any lime, dynamite or other explosive, poison, drug, sawdust, salt water, crude oil or any other deleterious, noxious or toxic substance in any waters of this state, or in any place where such substances may run or be washed into such waters."[26] Violators are subject to a criminal fine of from $100 to $500 per day.[27] In addition, restitution damages "may be recovered by a state environmental regulatory agency on behalf of the state in a civil action brought in the district court."[28] Offending parties are "liable to pay the state an amount equal to the sum of money reasonably necessary to restock such waters, [including] the replacement cost of fish killed, costs of shipment and handling, and costs incurred in investigating, locating or establishing the responsible person."[29]

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OPERATIONAL REQUIREMENTS

Forestry Requirements

• The State Board of Agriculture "shall administer silviculture best management practices in cooperation with forestry land users under the provisions of state and federal water pollution laws, which include the process to identify silviculturally-related nonpoint sources of pollution as defined by the Oklahoma Environmental Quality Code and setting forth procedures and methods to control to the extent feasible such sources."[30] The statute does not expressly set out enforcement authority for best management practices.

Agriculture Requirements

• The boards of county commissioners are "authorized to devise methods and means to stop and/or prevent soil erosion or soil drifting in their respective counties."[31] The board may issue orders directing "that the land subject to soil erosion and drifting be cultivated, plowed, listed or planted, or may in any other manner take such steps as are necessary to prevent such soil erosion and drifting."[32] If the land owner fails to comply with the order, the board is authorized to enter the land to take action to prevent soil erosion and drifting. In this case, the board also may assess reasonable restitution charges for the services taken against the affected lands. There also is a Conservation District Act,[33] which establishes a Conservation Commission that administers cost-share programs to encourage the adoption of management practices to prevent soil erosion and nonpoint source pollution. However, "[t]he Commission is not authorized to implement mandatory compliance with management practices to abate agricultural nonpoint source pollution," and does not appear to have enforcement authority.[34]

• The Oklahoma Feed Yards Act establishes a license requirement for animal feed yards, and states that "owners and operators who are granted a feed yards license shall ... provide adequate drainage from feed yards premises of surface waters falling upon the area occupied by such feed yards; [and] take such action as may be necessary to avoid pollution of any stream, lake, river or creek."[35] Regulations implementing the act require that Best Management Practices (BMPs) shall be utilized by concentrated animal feeding operations. The Act also requires that "a Pollution Prevention Plan shall be developed for each licensed facility. Pollution Prevention Plans shall ... include measures necessary to limit pollutants in runoff or groundwater."[36]

It is unlawful to operate a feed yard without a permit from the State Board of Agriculture.[37] The Board is authorized to enter premises to determine whether there are any violations,[38] and may revoke a permit after a hearing and an administrative determination that the operator has violated the act or regulations.[39] The Board also may institute a civil action or criminal prosecution; a feed yard owner or operator "who fails to take such action as may be reasonable and necessary to avoid pollution of any stream, lake, river or creek ... or who violates any rule or regulation of the Board adopted to prevent water pollution from feed yards pursuant to this act shall, upon conviction, be deemed guilty of a misdemeanor, and upon conviction thereof may be punished by a fine of $200 to $10,000 for each violation, by imprisonment for not more than 6 months for each violation, or by the assessment of a civil penalty up to $10,000 for each violation, or by any of such fine, imprisonment, and civil penalty."[40]

In 1998, amendments provided additional coverage, including requiring annual training for employees responsible for treatment, storage or application of animal waste, increased setback requirements, and additional specific requirements for the Pollution Prevention Plan and design standards for waste retention structures.[41]

• In 1998, Oklahoma also enacted legislation to regulate poultry waste in order to protect water quality. The law requires submittal of an animal waste management plan by every poultry feeding operation. It prohibits application of waste to land when the ground is frozen, during rainstorms, or where the land is already saturated by phosphorous or subject to severe erosion. Soil testing is require every three years, except in watersheds threatened by nutrients, where it is required annually. Commercial and private applicators of poultry waste must be certified by the state. All poultry feeding operations must register with the state annually and must utilize Best Management Practices, including no discharge of poultry wastes to the waters of the state, and isolation of stored poultry wastes from outside surface drainage by dikes and other structures. Penalties for violations will be under a point system established by the Board of Agriculture; applying poultry waste without a certificate is punishable by a $5,000 fine.[42]

• Under the agriculture code, "no person owning or operating a fertilizer storage facility or a commercial fertilizer facility shall discharge, ... place or cause to be placed any fertilizer material in a location where it is likely to cause contamination of any surface water or groundwater of this state."[43] However, "the provisions of this subsection shall not prohibit or otherwise restrict the land application of fertilizer for agriculture purposes or plant growth."[44] After a public hearing, the Board of Agriculture has authority to assess an administrative penalty of $100 to $1,000 for each violation.[45] The Board or its agent also may apply to court for an injunction, notwithstanding the existence of other remedies at law. Violations also are reported to the district attorney, who may institute appropriate proceedings to prosecute. Criminal violations are misdemeanors, punishable by a fine of $200 - $10,000, and/or imprisonment of up to 6 months.[46]

• The water quality code contains prohibitions on the agricultural use of sewage sludge near water. Under these provisions, "sludge shall not be applied within two (2) feet of the highest seasonal water table nor applied to the land within one hundred (100) feet of a stream or body of water; and ... sludge shall not be applied within two hundred fifty (250) feet of a public or private water supply.[47] As in other kinds of pollution cases, the Executive Director of the Department of Environmental Quality "shall make an order requiring such pollution to cease within a reasonable time, or requiring such manner of treatment or of disposition of the sewage or other polluting material as may in his judgment be necessary to prevent further pollution."[48] For noncompliance, the Department may institute an action in the proper court, and seek an injunction, a civil penalty of up to $10,000 per violation, and/or misdemeanor criminal penalties of $200 to $10,000, imprisonment for up to 6 months, or both.[49]

• The pesticide law [50] includes registration of pesticides and licensing of pesticide applicators, but no provisions directly applicable to nonpoint pollution. The Board of Agriculture is authorized to adopt regulations on pesticide use as appropriate.[51]

Development and Other Earth-Disturbing Activities

• The water quality code directs the Environmental Quality Board to promulgate rules bringing stormwater discharges into the state point source permitting program.[52] These regulations require "construction sites associated with industrial activity, that will result in the disturbance of 5 or more acres total land area" to obtain a permit for discharge of stormwater.[53] The permit requires a storm water pollution prevention plan to be developed for each construction site covered by the permit. Enforcement of the prohibitions is through the state pollution discharge elimination system. Thus, strictly speaking, such sites are treated as point sources.

• The municipality code requires that "lands [acquired by the municipality for waterworks] within 660 feet of the margin of a reservoir at maximum high water and necessary for natural drainage into the reservoir, shall not be used ... for any purpose other than the protection of the reservoir and the waters thereof from contamination and pollution. No structures shall be placed on such lands by the municipality, individual or corporation, except as are necessary in the furtherance of the protection of the reservoir from contamination or pollution, and in the use of the water.[54] A municipality has a right of action for damages resulting from pollution of its water supply, and damages "shall be the amount which will compensate for the detriment caused thereby."[55]

Endnotes

1. 27A Okla. Stat. § 2-6-105.
2. Okla. Regs. 252:610-7-1.
3. Okla. Regs. 252:610-7-4.
4. 27A Okla. Stat. § 2-6-105.
5. 27A Okla. Stat. § 2-6-901.
6. 27A Okla. Stat. §§ 1-3-101(B)(2), (D), (F).
7. As noted below, the Conservation Commission administers a cost-share program to encourage the adoption of management practices to prevent soil erosion and nonpoint source pollution. 27A Okla. Stat. §§ 3-2-106(A)(20). However, the same section also states that "[t]he Commission is not authorized to implement mandatory compliance with management practices to abate agricultural nonpoint source pollution." Id.
8. 50 Okla. Stat. § 1.
9. 50 Okla. Stat. § 2.
10. N.C. Corff Partnership v. Oxy USA, Inc., 929 P.2d 288 (Okla. 1996).
11. 50 Okla. Stat. § 1.1.
12. 50 Okla. Stat. § 8.
13. 50 Okla. Stat. § 10.
14. 50 Okla. Stat. § 11.
15. 50 Okla. Stat. § 12.
16. 21 Okla. Stat. § 1191.
17. City of Bethany v. Municipal Securities Co., 274 P.2d 363 (Okla. 1954).
18. City of McAlester v. King, 317 P.2d 265 (Okla. 1957).

[19] Young v. Darter, 363 P. 2d 829 (Okla. 1961).
[20] Sharp v. 251st Street Landfill, 925 P.2d 548 (Okla. 1996).
[21] 11 Okla. Stat. § 37-115.
[22] 11 Okla. Stat. § 37-115.
[23] 11 Okla. Stat. § 37-115.
[24] 11 Okla. Stat. § 37-116.
[25] 21 Okla. Stat. § 1194.
[26] 29 Okla. Stat.§ 7-401.
[27] 29 Okla. Stat. § 7-401.
[28] 29 Okla. Stat. § 7-401a.
[29] 29 Okla. Stat. § 7-401a.
[30] 2 Okla. Stat. § 1301-103.
[31] 82 Okla. Stat. § 521.
[32] 82 Okla. Stat. § 521.
[33] 27A Okla. Stat. § 3-1-101 et seq.
[34] 27A Okla. Stat. § 3-2-106(A)(20); see also 27A Okla. Stat. § 3-2-107.
[35] 2 Okla. Stat. § 9-210(3).
[36] Okla. Regs. 35:30-35-9(2).
[37] 2 Okla. Stat. § 9-208.
[38] 2 Okla. Stat. § 9-206.
[39] 2 Okla. Stat. § 9-211.
[40] 2 Okla. Stat. § 9-212.
[41] S.B. 1175 (June 10, 1998, effective August 1, 1998).
[42] S.B. 1170 (May 20, 1998, effective July 1, 1998).
[43] 2 Okla. Stat. § 8-68a.
[44] 2 Okla. Stat. § 8-68a.
[45] 2 Okla. Stat. § 8-74.
[46] 2 Okla. Stat. § 8-74.
[47] 27A Okla. Stat. § 2-6-501.5.
[48] 27A Okla. Stat. § 2-6-105.
[49] 27A Okla. Stat. § 2-6-901.
[50] 2 Okla. Stat. § 3-61 et seq.
[51] 2 Okla. Stat. § 3-85.
[52] 27A Okla. Stat. § 2-6-205(B).
[53] Okla. Regs. 252:605, App. E.
[54] 11 Okla. Stat. § 37-104.
[55] 11 Okla. Stat. § 37-116.

OREGON

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Oregon's water pollution control law includes some provisions that may be used to take enforcement action against nonpoint source discharges that pollute the waters, that consist of wastes or that result in water quality violations except for forestry conducted in compliance with BMPs.

• Oregon's general discharge limitation provision prohibits persons from polluting "any waters of the state," from placing waste where it is "likely to escape or be carried into the waters of the state by any means," and from discharging wastes into water if the discharge reduces water quality "below the standards established by rule for such waters..."[1] There are exemptions for discharges in accordance with a valid discharge permit.[2] The general prohibition is not expressly limited to point sources and thus can address nonpoint source discharges as well. Violations of the general prohibition provision are deemed a "public nuisance."[3]

Other Discharge Prohibitions

• As noted above, public nuisance law applies to pollution discharges. However, Oregon law preempts any local government laws that make a forest or farm practice a nuisance, and the statute grants immunity from private nuisance actions for farming or forest practices "occurring on lands zoned for those uses" or "allowed as preexisting nonconforming use," unless the claim is for damage to crops, death, or serious physical injury.[4]

Fish/Fisheries Laws

• Oregon state law establishes liability "where the injury, death, contamination or destruction of fish or other wildlife...or other wildlife habitat results from pollution" or from a permit violation. The Oregon Department of Environmental Quality ("DEQ"), Department of Fish and Wildlife or Attorney General may bring a civil suit if 60 days have passed following state agencies issuing a notice of violation and demand for reparations without compliance.[5] The person is liable to the state for the value of the injured or destroyed fish or wildlife and for all costs of restoring fish and wildlife production and habitat.[6]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• Under the Forestry Practices Act (or "Act"), forest operations in Oregon must be conducted in accordance with the rules and standards "relating to air and water pollution control..." Further, state law requires the state Forestry Board to establish best management practices ("BMPs") "to insure that to the maximum extent practicable nonpoint source discharges of pollutants resulting from forest operations on forestlands do not impair the achievement and maintenance of water quality standards."[7] Operators are required to comply with BMPs, unless they can demonstrate that alternative practices yield better results.[8] BMPs are subject to review pursuant to a petition on the basis that forestry operations being conducted in accordance with them is contributing to violations of water quality standards. The Forestry Board must revise the BMPs within two years or dismiss the petition.[9] The State Forester enforces these requirements through inspection, enforcement, notice of violation, and issuance/service of administrative orders, such as cease and desist or reparation orders.[10] The Act provides for general criminal and civil penalties,[11] including potential civil sanctions of up to $5000 per violation.[12] However, where forest operators are in compliance with the BMPs, then the operations are not considered in violation of any water quality standards.[13] Also, forestry operations are immune from private nuisance actions if they are in compliance with the Act and with BMPs.[14]

• The Act contains other requirements governing forestry operations, including authorizing the Forestry Board to require a written plan for forestry operations if operations are within one hundred feet of a stream used by fish or for domestic use.[15] Also, operators must give written notice of chemical applications to the State Forester who in turn must notify persons who request it, are within 10 miles of the application and hold downstream surface water rights.[16] Enforcement authorities are the same as those identified above under the Act.

• State law only permits the state Environmental Quality Commission and DEQ to impose "effluent limitations" on nonpoint source discharges resulting from forest operations if such limitations are federally mandated.[17] See supra enforcement of general discharge limitations.

Agriculture Requirements

• The Oregon Department of Agriculture ("DOA") is required to develop rules "that directly regulate farming practices...that are for the purpose of protecting water quality" and that are applicable to "exclusive farm zones" under the state planning law or other agricultural lands.[18]

• The DOA may also designate areas to be governed by a water quality management plan and adopt rules that require landowners in the affected area to perform those actions necessary to carry out the plan.[19] In general, all activities, which include pesticide use, irrigation, grazing, within the affected area of the plan must be conducted "in full compliance with the plan and rules implementing the plan and with all rules and standards of the EQC relating to water pollution control..."[20] The DOA is authorized to determine compliance with the management plan through entry and inspection and must give notice of violation and opportunity for compliance prior to assessing a civil penalty which can be up to $2500 for the first violation and up to $10,000 for a second violation.[21] In addition, violations of the plan and/or rules are subject to all remedies and sanctions available to the DEQ or the EQC.[22]

• In general, pesticide use is regulated under the water quality management plan discussed above, but Oregon law also contains a specific pesticide registration and labeling requirement with concomitant civil penalties.[23] However, "reasonable and prudent" pesticide use is an accepted farm practice and thus immune from private nuisance suits.[24]

• State law establishes a permit requirement for confined animal feeding operations containing conditions that "assure that wastes are disposed of in a manner that does not cause pollution of the surface and ground waters of the state."[25] The program is administered by the DOA which has the authority "to enter and inspect" and to conduct investigations at any time that a complaint alleges a violation presenting "an immediate threat to public health and safety."[26] The statute also authorizes civil penalties for operating without a permit and for violations "relating to the control and prevention of water pollution from a confined animal feeding operation."[27]

• Also Oregon regulations encourage all government agencies to coordinate planning and implementation of nonpoint source controls including "possible modification of irrigation practices to reduce or minimize adverse impacts from irrigation return flows" and "streambank erosion reduction projects."[28]

Development and Other Earth-Disturbing Activities

• Oregon has an integrated state land use planning process. When the state planning commission ("commission") prepares comprehensive land use plans, setting the parameters for local land use planning, it must "give consideration to" a variety of environmentally sensitive areas, including flood plains, estuarine areas, tide, marsh and wetland areas, lakes and lakeshores, coastal areas, and wilderness and scenic areas.[29] The commission also has authority to designate "areas of critical state concern" as part of the planning process.[30] In terms of enforcement, the commission is authorized to order local governments to bring land use requirements into compliance with the comprehensive plan.[31] The commission, as well as the county governing bodies, has investigative and hearing authority for alleged violations in the "areas of critical state concern," and injunctive relief is available.[32] Remedies for noncompliance include withholding state grant money to local governments and legal and equitable remedies.[33] Construction erosion control measures are authorized under the statewide land use planning law.

Endnotes
[1] Ore. Rev. Stat. 468B.025(1).
[2] Ore. Rev. Stat. 468B.050.
[3] Ore. Rev. Stat. 468B.025(3).
[4] Ore. Rev. Stat. 30.934-7.
[5] Ore. Rev. Stat. 468B.060(2).
[6] Ore. Rev. Stat. 468B.060(1).
[7] Ore. Rev. Stat. 527.765.
[8] OAR 629-24-102.
[9] Ore. Rev. Stat. 527.765.
[10] Ore. Rev. Stat. 527.680.

[11] Ore. Rev. Stat. 527.990 & 527.992.
[12] Ore. Rev. Stat. 527.683-687.
[13] Ore. Rev. Stat. 527.770.
[14] Ore. Rev. Stat. 30.936.
[15] Ore. Rev. Stat. 527.670(3)(a)(A).
[16] Ore. Rev. Stat. 527.670(6).
[17] Ore. Rev. Stat. 527.765(3).
[18] Ore. Rev. Stat. 561.191.
[19] Ore. Rev. Stat. 568.909 & 568.912.
[20] Ore. Rev. Stat. 568.930.
[21] Ore. Rev. Stat. 568.915, 568.918 & 568.933.
[22] Ore. Rev. Stat. 568.930.
[23] Ore. Rev. Stat. 634.xxx & OAR 603-57-xxx. (cite?)
[24] Ore. Rev. Stat. 30.939.
[25] Ore. Rev. Stat. 468B.215.
[26] Ore. Rev. Stat. 468B.217, 468B.224, & 468B.226.
[27] Ore. Rev. Stat. 468B.220, 468B.230.
[28] OAR 340-41-026(11)(c).
[29] Ore. Rev. Stat. 197.230(1)(c).
[30] Ore. Rev. Stat. 197.405.
[31] Ore. Rev. Stat. 197.320.
[32] Ore. Rev. Stat. 197.430 & 197.410.
[33] Ore. Rev. Stat. 197.335(4)-(6).

PENNSYLVANIA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Pennsylvania's Clean Streams Law contains several provisions that may be used to take enforcement action against nonpoint source discharges.

- "It shall be unlawful for any person or municipality to put or place into any of the waters of the Commonwealth, or allow or permit to be discharged from property owned or occupied by such person or municipality into any of the waters of the Commonwealth, any substance of any kind or character resulting in pollution as herein defined."[1] "Pollution" under the Clean Streams Law "shall be construed to mean contamination of any waters of the Commonwealth such as will create or is likely to create a nuisance or to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, municipal, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish, or other aquatic life, including but not limited to such contamination by alteration of the physical, chemical or biological properties of such waters, or change in temperature, taste, color or odor thereof, or the discharge of any liquid, gaseous, radioactive, solid, or other substances into such waters."

- Regulations further specify that "The waters of the Commonwealth may not contain toxic substances attributable to point or nonpoint source waste discharges in concentrations or amounts that are inimical to the water uses to be protected."[2] And further that "Persons and municipalities engaged in an activity which includes the impoundment, production, processing, transportation, storage, use, application or disposal of polluting substances shall take necessary measures to prevent the substances from directly or indirectly reaching waters of this Commonwealth, through accident, carelessness, maliciousness, hazards of weather or from another cause."[3]

- "No person or municipality shall place or permit to be placed, or discharged or permit to flow, or continue to discharge or permit to flow, into any of the waters of the Commonwealth any industrial wastes, except as hereinafter provided in this Act."[4] The term industrial waste includes any substance other than sewage resulting from any "establishment."

- The Department of Environmental Protection also has the authority to regulate and "enforce reasonable orders and regulations for the protection of any source of water for present or future supply to the public, and prohibiting the pollution of any such source of water rendering the same inimical or injurious to the public health or objectionable for public water supply purposes."[5]

Violation of the Clean Streams Law is a summary offense punishable by a fine of not less than $100 nor more than $10,000 for each offense, and, in default of payment of such fine, imprisonment for ninety days.[6] Willful or negligent violations are

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misdemeanors of the third degree punishable by a fine of not less than $2,500 nor more than $25,000 for each separate offense and/or imprisonment in the county jail for a period of not more than one year.[7] Civil penalties may be assessed not to exceed $10,000 per day per violation,[8] and the department may issue orders or seek injunctive relief.[9]

Other Discharge Limitations

• Nuisance law is available as an enforcement mechanism, and the Clean Streams Law declares certain water pollution discharges abatable as nuisances. "The discharge of...any substance into the waters of this Commonwealth, which causes or contributes to pollution as herein defined or creates a danger of such pollution is hereby declared not to be a reasonable or natural use of such waters, to be against public policy and to be a public nuisance."[10] "Any activity or condition declared by this act to be a nuisance or which is otherwise in violation of this act, shall be abatable in the manner provided by law or equity for the abatement of public nuisances."[11]

While Pennsylvania law does limit nuisance claims against agricultural operations that have been in existence for a year or more, these limitations expressly do not restrict or impede the authority of the Commonwealth to protect the public health, safety and welfare, nor do they affect or defeat private actions for damages resulting from violations of law or "on account of any pollution of, or change in condition of, the waters of any stream."[12]

Fish/Fisheries Laws

• No person shall: "Allow any substance, deleterious, destructive, or poisonous to fish, to be turned into or allowed to run, flow, wash or be emptied into any waters ..."[13] "In criminal prosecutions under this section for water pollution known to be injurious to fish, it is not necessary to prove that the violation has actually caused the death of, or damage to, any particular fish."[14]

• "No person shall alter or disturb any stream, stream bed, fish habitat, water or watershed in any manner that might cause damage to, or loss of, fish without the necessary permits."[15]

• "It is unlawful for any person to throw, discard, leave, emit, deposit or allow the depositing of any garbage, bottles, cans, rubbish, wire, glass, paper, cardboard or wooden boxes, or cartons or any other type of debris, trash or other thing or substance in or along any waters or on any lands adjacent or contiguous to waters or in such manner that the thing or substance deposited flows into or is carried by wind into such waters or lands."[16] The Commonwealth may recover damages in a civil action against "any person who kills any fish or who injures any streams or stream beds by pollution or littering."[17]

The Fish & Boat Commission may pursue criminal prosecution for violations of the law and regulations. Sanctions are up to $5,000 and/or imprisonment for up to five years, and a fine of $10 per fish killed.[18]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• With respect to erosion and sediment control, forest harvesting activities involving earthmoving must comply with the regulatory program described under "Development and Other Earth-Disturbing Activities" below, including obtaining the necessary permit. Enforcement is under the Clean Streams Law.

Agriculture Requirements

• With respect to erosion and sediment control, although they do not need to obtain a permit, landowners engaged in plowing and tilling must nevertheless develop and implement an erosion and sediment control plan.[19] Enforcement is under the Clean Streams Law.

• The Nutrient Management Act requires livestock operations to engage in nutrient management planning for all operations where the animal density exceeds two Animal Equivalent Units per acre. All such plans must be developed for operators by nutrient management specialists, and must be fully implemented within three years of their approval by local conservation districts. Also, any agricultural operation found in violation of the Clean Streams Law may be required to submit a plan within three months thereof.[20] Final regulations under the Act were published in June 1997. Violations of plans are punishable by a civil penalty of not more than $500 for the first day of each offense and $100 for each additional day of continuing violation. The State Conservation Commission may issue a warning in lieu of penalty where the owner or operator takes mediation action to resolve the violation. Enforcement orders and injunctive relief are available.[21]

• Special water pollution control regulations provide that manure storage facilities and land application of animal manures are exempt from water pollution control permitting if the design and operation are in accordance with practices described in Pennsylvania publications of best practices for these activities.[22] Otherwise, permitting is needed under the Clean Stream Law.

• Pennsylvania requires certification of pesticide applicators,[23] and provides that "An application of a pesticide may not be made where weather conditions are such that it can be expected that the pesticide will move off of the proposed application site."[24]

Development and Other Earth-Disturbing Activities

• Earthmoving activities within the Commonwealth must "be conducted in such a way as to prevent accelerated erosion and the resulting sedimentation." The person engaged in such activities "shall develop, implement and maintain erosion and sedimentation control measures which effectively minimize accelerated erosion and sedimentation. The erosion and sedimentation control measures shall be set forth in a plan ... and be available at all times at the site of the activity."[25] A permit is required prior to commencement of the activity. A permit is not required if the activity involves "plowing or tilling for agricultural purposes" or if the earthmoving activity disturbs less than 25 acres. DEP can reduce the acreage limitation on a statewide basis, for special areas, or for counties or municipalities.[26] Administration and enforcement of the program may be delegated to counties and other units of local government that have an acceptable plan approved by the DEP.[27] Enforcement is under the Clean Streams Law, source of the discharge provisions discussed above, but also includes the withholding of building permits.[28]

Endnotes

1. 3 P.S. section 691.401.
2. 25 Pa. Admin. Code § 93.8a(a).
3. 25 Pa. Admin. Code § 101.3(a).
4. 3 P.S. § 691.301.
5. 3 P.S. section 691.501.
6. 3 P.S. § 691.602(a).
7. 3 P.S. § 691.602(b).
8. 3 P.S. § 691.605.
9. 3 P.S. § 691.610.
10. 3 P.S. § 691.3; see also § 691.401, § 691.503.
11. 3 P.S. § 691.601.
12. 3 P.S. §§ 954, 955.
13. 30 Pa.C.S.A. § 2504(a)(2).
14. 30 Pa.C.S.A. § 2504(b).
15. 30 Pa.C.S.A. § 2502(a).
16. 30 Pa.C.S.A. § 2503(a).
17. 30 Pa.C.S.A. § 2506(a).
18. 30 Pa. C.S.A. §§ 2102, 2502-2506, 923(b).
19. Pa. Admin. Code § 101.4(b).
20. 3 P.S. § 1706.
21. 3 P.S. § 1712, § 1714.
22. 25 Pa. Admin. Code § 101.8.
23. 7 Pa. Admin. Code §§ 128.1 et seq.
24. 7 Pa. Admin. Code § 128.103(c).
25. 25 Pa. Admin. Code § 102.4.
26. 25 Pa. Admin. Code § 102.31.
27. 25 Pa. Admin. Code § 102.41.
28. 25 Pa. Admin. Code §§ 102.42, 102.43.

PUERTO RICO

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Puerto Rico's water pollution control law includes one provision that may be used to take enforcement action against nonpoint source discharges capable of leading to violation of water quality standards, and another that allows the Commonwealth's regulatory authority to adopt enforceable prohibitions on unpermitted discharges that could be used to regulate nonpoint sources.

- "It shall be unlawful for any person, directly or indirectly, to throw, discharge, pour or dump, or permit to be thrown, discharged, poured or dumped into the waters, any organic or inorganic matter capable of polluting or of leading to the pollution of such waters in such manner as to place them out of the minimum standards of purity that the Secretary of Health [now Board of Environmental Quality] may establish..."[1] This provision is enforceable by a notice, and after one year, final order requiring cessation of water pollution.[2] Injunctive relief and penalties for violations are available.

- The Board of Environmental Quality is authorized "to forbid any discharge of pollutants by any natural or juridical person...which do not have the corresponding permit issued by the Board."[3] This provision allows the Commonwealth to regulate nonpoint source pollution by permit if it chooses to do so. Enforcement is via administrative orders, injunctions, and penalties.

Other Discharge Limitations

- Statutory authority over public health nuisances includes authority to promulgate regulations "guarding from contamination all streams from which water for drinking or domestic purposes is taken."[4] Violations of any such regulations are subject to fines of $25 to $100 and/or jail sentence of 1-2 months.[5]

- Placing "any dead animal, or the offal or filth from any slaughterhouse, pen or butcher shop" into a water body used for drinking water is prohibited, and is punishable by a fine up to $1000 and/or jail sentence up to one year.[6]

- There is also general authority to abate nuisances. Nuisance is defined as "anything which is injurious to health, or indecent, or offensive to the senses, or an obstruction to free use of property, so as to interfere with the comfortable enjoyment of life or property."[7] Public nuisance defined as "anything which is injurious to health, or indecent, or offensive to the senses, or an obstruction to free use of property, so as to interfere with the comfortable enjoyment of life or property by an entire community or neighborhood."[8]

Fish/Fisheries Laws

• "It is prohibited to throw or cause to be thrown or deposited into any lake, lagoon, spring, river, brook, channel, or any body of water of Puerto Rico, oils, acids, poisons, or any other substance which kills or destroys fish, crustacea, or mollusca."[9] But there is an exception from the prohibition for "the residue or waste of any factory or industrial or agricultural enterprise" if a permit is obtained from the Secretary of Agriculture and Commerce [later Secretary of Natural Resources]. Violations by legal persons are subject to a minimum fine of $500; by natural persons, a maximum fine of $200 and/or jail sentence of up to 90 days.

OPERATIONAL REQUIREMENTS

Forestry Requirements

Puerto Rico laws do not appear to contain specific enforceable requirements regarding forest practices.

Agriculture Requirements

• Soil conservation districts are authorized "to formulate regulations governing the use of lands within the district to formulate soil resources and prevent and control erosion....Land regulations adopted pursuant to this section shall have the force and effect of law in the said district, and shall be binding upon all occupiers of lands within such district."[10] Regulations may include: prohibition of operations or practices; requiring particular methods of cultivation or land use; cropping programs or tillage practices; "and provisions requiring any other means, measures, operations, and programs as may assist conservation of soil resources and prevent or control soil erosion in the district." Supervisors may file for judicial enforcement of regulations.[11] Violation of land-use regulations is a misdemeanor, punishable by fine of $25-$100.[12]

• "Cattle or horses shall be bathed or watered only at the places set aside for this purpose."[13]

• Laws regulating pesticide applicators may provide some basis for addressing nonpoint source pollution resulting from improper practices.[14]

Development and Other Earth-Disturbing Activities

No operating requirements are set forth, apart from any that may be contained in urban stormwater programs under the Clean Water Act or that may be authorized by general land use regulations. However, land use regulations, particularly in the coastal zone, address some activities that may result in nonpoint source discharges.

Endnotes

1. P.R. Laws Ann. tit.24, § 595.
2. P.R. Laws Ann. tit. 24, § 596.
3. PR. Laws Ann. tit. 12, § 1131(13)(A)(1).

[4] P.R. Laws Ann. tit. 3, § 178.
[5] P.R. Laws Ann. tit. 3, § 187.
[6] P.R. Laws Ann. tit. 33 § 1368.
[7] P.R. Laws Ann. tit. 32, § 2761.
[8] P.R. Laws Ann. tit. 33, § 1365.
[9] P.R. Laws Ann. tit. 12, § 61.
[10] P.R. Laws Ann. tit. 5, § 246.
[11] P.R. Laws Ann. tit. 5, § 248.
[12] P.R. Laws Ann. tit. 5, § 247.
[13] P.R. Laws Ann. tit. 12, § 803.
[14] P.R. Laws Ann. tit. 5 §§ 1001-1016.

RHODE ISLAND

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Rhode Island's water pollution law includes a provision that may be used to take enforcement action against nonpoint source discharges of pollutants that are placed on land, or nonpoint source discharges of solid waste or debris.

- "It shall be unlawful for any person to place any pollutant in a location where it is likely to enter the waters or to place or cause to be placed any solid waste materials, junk, or debris of any kind whatsoever, organic or non organic, in any waters."[1] These prohibitions on the placement of "any pollutant" on land where it may enter water, and on the placement of solid wastes, junk, and debris in any water, can be applied to nonpoint source water pollution. (In contrast, another subsection prohibits "discharge [of] any pollutant" from a "point source.)"[2] Enforcement includes notices of violation, compliance orders, injunctive relief, criminal liability, and civil penalties of up to $25,000 per day.[3]

Other Discharge Limitations

- Common law nuisance liability may be available with respect to some instances of nonpoint source discharges. However, nuisance liability under Rhode Island law does not apply to odors or dust from farming practices, nor to the use of pesticides, rodenticides, insecticides, herbicides or fungicides.

- A state wetlands law contains a provision that may also provide some enforceable authority with respect to certain nonpoint discharges. "No person, firm, industry, company, corporation, city, town, municipal or state agency, fire district, club, nonprofit agency, or other individual or group, may...place trash, garbage, sewage, highway runoff, drainage ditch effluents [sic], earth, rock, borrow, gravel, sand, clay, peat or other materials or effluents upon... or otherwise change the character of any fresh water wetland as herein defined without first obtaining the approval of the director of the department of environmental management."[4] However, normal farming and ranching activities are exempt from the permitting process.[5]

Fish/Fisheries Laws

- "No person shall place, deposit, or explode any substance injurious to the health or life of a fish in any stream or fresh water pond within this state..."[6] This provision is enforceable by the attorney general in court; and the sanction is a misdemeanor punishable "by a fine of not more than $500 or imprisonment for up to 90 days or both."[7]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• Cutting of trees for commercial forest products requires registration with the department of environmental management as a "woods operator" and cutting without such registration is a misdemeanor punishable by a fine of $100 to $500.[8] This provision may serve as a basis for imposing some requirements.

Agriculture Requirements

The state's agriculture laws do not appear to contain independently enforceable provisions relating to regulation of agricultural nonpoint source discharges.

• Pesticides being used in violation of any requirements may be subject to an order, and violations may give rise to civil penalties of up to $10,000 and criminal penalties for knowing violations of up to $25,000 and/or 60 days imprisonment.[9]

Development and Other Earth-Disturbing Activities

Apart from any requirements that may be contained in urban stormwater programs under the Clean Water Act or that may be authorized by general land use regulation such as zoning, Rhode Island law provides some additional authority.

• Cities and towns may adopt a model soil erosion and sediment control ordinance that is an enforceable mechanism.[10]

• The state's Coastal Resources Management Program can adopt regulations affecting activities within 200 feet of shoreline features, which includes some limits relevant to nonpoint source pollution. Enforcement is via cease and desist orders, and administrative penalties of up to $1000 plus $100 per day (with aggregate limit of $5000); or misdemeanor convictions for knowing violations, with a $500 fine and/or 3 months imprisonment.[11]

Endnotes

1. R.I. Gen. Laws § 46-12-5(a).
2. R.I. Gen. Laws §§ 46-12-5(b), 46-12-1.
3. R.I. Gen. Laws §§ 46-12-9 to -16.
4. R.I. Gen. Laws § 2-1-21.
5. R.I. Rule 6.08.
6. R.I. Gen. Laws § 20-11-10.
7. R.I. Gen. Laws §§ 20-1-11, 20-1-16.
8. R.I. Gen. Laws §§ 2-15-1, 2-15-4.
9. R.I. Gen. Laws § 23-25-21, § 23-25-28.
10. R.I. Gen. Laws §§ 45-46-2, 45-46-5.
11. R.I. Gen. Laws §§ 46-23-2, 46-23-6, 46-23-7.1 to -7.3.

SOUTH CAROLINA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

The state has a broad general pollution prohibition, applicable to nonpoint sources as well as point sources.

• "It shall be unlawful for any person, directly or indirectly, to throw, drain, run, allow to seep or otherwise discharge into the environment of the State organic or inorganic matter, including sewage, industrial wastes and other wastes, except as in compliance with a permit issued by the Department [of Health and Environmental Control]."[1] Enforcement includes administrative "orders requiring the discontinuance of the discharge of sewage, industrial waste, or other wastes into any waters of the state," injunctive relief, civil penalties of up to $10,000 per day, and criminal penalties for willful or negligent violation of $500 to $25,000 per day and/or imprisonment for up to two years.[2]

Other Discharge Limitations

• Common law and statutory nuisance remedies for water pollution are preserved by the state's Pollution Control Act.[3]

• Some nuisance-related provisions related to navigable waterways may have limited utility with respect to some forms of nonpoint source water pollution. Cutting trees, tree tops, brush or logs or "throwing any refuse material whatever into any navigable river or harbor" is a misdemeanor punishable by fine of up to $250 or imprisonment for up to two years.[4] "Any person who shall fell, cut, or throw or cause to be felled, cut, or thrown across or into any of such streams any tree, log or other timber or any trash, brush, debris or obstruction of any kind whatsoever will be guilty of a misdemeanor" and is punishable by fine of up to $50 or imprisonment for up to 30 days.[5] Obstruction of a navigable stream without a permit or authorization is a nuisance.[6]

Fish/Fisheries Laws

• "Any person who discharges organic or inorganic matter into the waters of this State ... to the extent that the fish, shellfish, aquatic animals, wildlife or plant life indigenous to or dependent upon the receiving waters or any property are damaged or destroyed shall be liable to the State for such damages as may be proved [in court]... The civil remedy herein provided shall not be exclusive and any agency, commission, department or political subdivision of the State with appropriate authority may undertake in its own name an action to recover such damages as it may deem advisable independent of this subsection." [7]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• State law requires registration of foresters and licensing, but does not directly regulate forest practices on private lands. Violation of registration requirements is punishable as a misdemeanor.[8]

• The "Erosion and Sediment Reduction Act,"[9] discussed at greater length under "built environment" below, applies to forestry and other land-disturbing activities on State-owned lands. "The Department [of Health and Environmental Control] must promulgate regulations for erosion and sediment reduction and stormwater management only on land either owned by the State, a State agency, or a quasi-state agency or land under the management or control of such an entity..."[10] A state agency found by DHEC in noncompliance must take steps to correct the problem. In addition, the State Engineer must ensure that the regulations are followed on all land and land disturbing activities within the State Engineer's jurisdiction. However, the DHEC regulations do not apply to lands controlled by the State Forestry Commission,[11] which applies its own "Erosion, Sediment and Stormwater Management Plan" on state forest lands.[12] The State Forestry Commission must develop this "plan" in consultation with DHEC to reduce erosion, sediment on forest land owned or managed by the Forestry Commission, and must implement these regulations.[13]

Agriculture Requirements

• "The commissioners of any [soil and water conservation] district may formulate regulations governing the use of lands within the district in the interest of conserving soil and soil resources and preventing and controlling soil erosion."[14] The process may include a public hearing, but must be approved by a referendum by landowners and garner at least 2/3 support; however, commissioners are not obliged to adopt regulations even if the 2/3 vote approves them.[15] A court may order the landowner to perform the work necessary to comply, or may authorize the commissioners to enter upon the land and do so and recover their costs from the landowner.[16]

• The state's chemigation law provides that any irrigation system which is designed or used for the application of fertilizer, pesticide, or chemicals must be equipped with an anti-syphon device adequate to protect against contamination of the water supply. Violations are punishable by a civil penalty of up to $500 per day.[17]

• South Carolina law provides for registration of pesticides, licensing of dealers, and certifying applicators, but has no specific water pollution provisions. Enforcement is via license actions, civil penalties, and misdemeanor prosecutions.[18]

Development and Other Earth-Disturbing Activities

• The Stormwater Management and Sediment Reduction Act applies throughout the state on lands not owned by the state.[19] It is administered by DHEC in coastal counties, elsewhere by local government - as a delegated program subject to DHEC oversight.[20] Unless exempted, no person may engage in a land disturbing activity without first submitting a stormwater management and sediment control plan to the appropriate implementing agency and obtaining a permit to proceed."[21] The law further provides for development of watershed master plans in designated watersheds, and all projects must be consistent with these plans.[22] Under the regulations, projects less than 2 acres must submit a simplified plan (no permit, but inspection and enforcement); projects 2-5 acres require a permit, meeting design and performance standards; projects 5 acres or greater require a permit (integrated with NPDES stormwater program); and projects 10 acres or greater must have sediment basin or other practice meeting an 80 % removal efficiency standard. The regulations also specify maintenance requirements and correction of offsite damage.[23] The law exempts: agricultural activities (except buildings larger than 1 acre); forestry activities; mining activities; single family residences not part of a common development; activities otherwise licensed or permitted where conditioned on compliance, public service corporation activities otherwise regulated, railroad activities, and state-owned or managed lands where the activities are regulated by the Erosion and Sediment Reduction Act, discussed below.[24] Enforcement includes issuance of stop work orders, required submission of plans, and correction of violations,[25] and civil actions for civil penalties of up to $1,000 per day, and injunctive relief.[26] This law also provides for designation of special protection areas. "In addition to the other regulatory requirements in this chapter, designated watersheds shall have the regulatory requirements for land disturbing activities within the watershed clearly specified through a watershed management plan which includes nonpoint source pollution control, stormwater management, and flood control components..."[27]

• The Erosion and Sediment Reduction Act applies only to state lands, and is administered by DHEC with the cooperation of various affected state agencies and land managers.[28] "The Department must promulgate regulations for erosion and sediment reduction and stormwater management only on land either owned by the State, a State agency, or a quasi-state agency or land under the management or control of such an entity..."[29] The DHEC and Dept. of Transportation are to promulgate regulations together for transportation related matters.[30] Regulations provide that there can be no land disturbing activity without an "erosion and sediment control and stormwater management plan approved by the State Engineer or the former Land Resource Conservation Commission.[31] Furthermore, all erosion, sediment, and stormwater problems not addressed by the plans must be corrected.[32] A state agency found by DHEC in noncompliance must take steps to correct the problem. In addition, the State Engineer must ensure that the regulations are followed on all land and land disturbing activities within the State Engineer's jurisdiction. No sanctions are specified in the law.[33]

• State law establishes a comprehensive regulatory scheme for South Carolina' 8 coastal counties.[34] The law provides for a management plan by DHEC's Coastal Division,[35] and that zoning ordinances in critical areas are adopted as part of the plan if they meet its provisions.[36] The law provides for a permit required for uses in the critical area,[37] gives DHEC exclusive regulatory authority,[38] and provides the criteria for permit approval or denial - including effects on marine life, erosion, etc.[39] Enforcement is via injunction, administrative order, permit revocation, civil penalties of up to $1,000 per day, or misdemeanor prosecutions.[40]

• Scenic river regulations and prohibitions apply only to lands and easements that have been acquired by the state.[41]

• A permit is required to obstruct navigable waters, and enforcement is via permit actions, abatement, and misdemeanor sanctions.[42]

Endnotes

1. S.C. Code Ann. § 48-1-90.
2. S.C. Code Ann. §§ 48-1-50(3), 48-1-50(4), 48-1-50(110, 48-1-330, 48-1-320.
3. S.C. Code Ann. § 48-1-240.
4. S.C. Code Ann. § 49-1-20.
5. S.C. Code Ann. § 49-1-40.
6. S.C. Code Ann. § 49-1-10.
7. S.C. Code Ann. § 48-1-90(b).
8. S.C. Code Ann. §§ 48-27-100, 48-27-120, 48-27-250.
9. S.C. Code Ann. § 48-18-10.
10. S.C. Code Ann. § 48-18-40(5), repeated in § 48-18-70.
11. R. 72-104.
12. S.C. Code Ann. § 48-18-70(5).
13. S.C. Code Ann. § 48-18-70.
14. S.C. Code Ann. § 48-9-1510.
15. S.C. Code Ann. §§ 48-9-1520, -1530, -1540.
16. S.C. Code Ann. § 48-9-1610.
17. S.C. Code Ann. § 46-1-140.
18. S.C. Code Ann. § 46-13-10 et seq.
19. S.C. Code Ann. § 48-14-10 et seq.
20. S.C. Code Ann. § 48-14-60.
21. S.C. Code Ann. § 48-14-30(A).
22. S.C. Code Ann. § 48-14-130.
23. R. 72-305, 72-307, 72-308.
24. S.C. Code Ann. § 48-14-40.
25. S.C. Code Ann. § 48-14-95.
26. S.C. Code Ann. §§ 48-14-140, -150.
27. S.C. Code Ann. § 48-14-130.
28. S.C. Code Ann. § 48-18-10 et seq.
29. S.C. Code Ann. § 48-18-40(5), repeated in § 48-18-70.
30. S.C. Code Ann. § 48-18-70.
31. R. 72-06, R. 72-01.
32. R. 72-108.
33. S.C. Code Ann. § 48-18-70.
34. S.C. Code Ann. § 48-39-10 et seq.
35. S. C. Code Ann. § 48-39-80.
36. S.C. Code Ann. § 48-39-100.
37. S.C. Code Ann. § 48-39-130.
38. S.C. Code Ann. § 48-39-210.
39. S.C. Code Ann. § 48-39-150.
40. S.C. Code Ann. § 48-39-160, -170, -180.
41. S.C. Code Ann. § 49-29-150.
42. S.C. Code Ann. § 49-1-10.

SOUTH DAKOTA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

The South Dakota water pollution control law prohibits discharges of waste that result in water quality violations, and the placement of wastes in locations where they are likely to cause pollution.

• No person may discharge any wastes into any waters of the state which reduce the quality of such waters below the water quality level existing on March 27, 1973,[1] or place or cause to be placed any wastes in a location where they are likely to cause pollution of any waters of the state.[2] "Wastes" are defined as "sewage, industrial wastes, pollutants and all other liquid, gaseous, solid, radioactive, or other substances which may pollute or tend to pollute any waters of the state."[3]

The statute does not limit "discharge" to point sources, but the regulations provide permits only for point source discharges,[4] and expressly exclude from permitting requirements nonpoint discharges from agriculture.[5] This exclusion from permitting does not address the "place or cause to be placed" language of the statute.

The water management board is required to promulgate rules to establish water quality standards and classify water according to its beneficial uses.[6] The standards must protect public health, use of waters for public water supplies, propagation of fish and aquatic life and wildlife, recreational purposes and agricultural, industrial, and other legitimate uses.[7] Discharge of wastes is allowed when it is demonstrated to the water management board, after a hearing, that there may be a discharge that will not result in the violation of applicable water standards and that is justifiable as a result of "necessary economic or social development."[8] The water management board may not allow a discharge if the discharge results in a violation of the existing water standards. The state's antidegradation policy provides that regulatory requirements are to be achieved for point sources and that nonpoint sources are to be "controlled through cost-effective and reasonable best management practices."[9]

The water management board may issue an order for a violation of the water quality law or any rule or permit issued under it.[10] Violations may be abated as a public nuisance, and the department of water and natural resources also may bring an action for an injunction against the continuation of any threatened or actual violation or any final order of the secretary or the water management board.[11] In addition to or instead of issuing an order, the board or secretary may initiate an appropriate action for recovery of penalties.[12] Any person who violates an order is liable for a civil penalty not to exceed $10,000 or for damages to the environment, or both.[13] Criminal violations are Class 1 misdemeanors subject to a fine not to exceed $10,000 and/or a sentence of up to one year imprisonment.[14]

Other Discharge Limitations

• In addition to the prohibition in the water quality law, no person may dispose of or place solid waste in state waters without authorization.[15] "Solid waste" is defined as "any garbage, refuse, sludge from a waste treatment plant and other discarded materials, including solid, liquid, semisolid or contained gaseous material resulting from industrial, commercial and agricultural operations."[16] However, the solid waste statute may not be construed to prohibit a farmer or rancher from disposing of solid waste from normal farming operations or ordinary domestic activities upon his own land, provided such disposal does not create a nuisance or a hazard to public health, does not violate a local ordinance, will not unlawfully pollute ground or surface waters or does not violate the chapter.[17]

Suspected violations of this chapter may be addressed by notice, proposed corrective action, an administrative hearing, or suit for an injunction.[18] A violation is a Class 2 misdemeanor, and the violator is also subject to a civil action for recovery of penalties of not more than $10,000 per day per violation, for damages to compensate the state for impairment of the environment, or both.[19] Actions for civil penalties or damages shall, upon demand, be tried by a jury.

• The South Dakota Code defines a nuisance as, among other things, unlawfully doing an act which annoys, injures, or endangers the comfort, repose, health, or safety of others, or in any way renders other persons insecure in life or in the use of property.[20] Water pollution has been held to be a nuisance in specific cases.[21] Remedies for a nuisance include injunction, damages, abatement and, in cases of public nuisance, indictment or information as prescribed by statute.[22] By statute, no agricultural operation may be deemed a nuisance if it has been in operation for more than one year and was not a nuisance at the time that operation began, unless the nuisance results from negligent or improper operation.[23] However, this exemption does not apply to actions to recover damages for any injuries sustained as a result of pollution or other change in the quantity or quality of water, or as a result of any overflow of land.[24]

• In addition, boards of county commissioners have power to enact ordinances to regulate and prevent the placing of ashes, dirt, garbage or any offensive matter in any body or stream of water within the county (as long as it is outside of an incorporated municipality).[25] They also have the power to enact ordinances to regulate and compel the cleansing, abatement or removal of any sewer, cesspool, or any "unwholesome or nauseous thing or place."[26] Municipalities have similar powers within their jurisdictions.[27] If there is a violation or threatened violation of an ordinance, a board of county commissioners may institute an appropriate action to seek an injunction, to be brought by the state's attorney.[28] Counties and municipalities also may use their authority to enforce ordinances with fines not to exceed $200, imprisonment not to exceed 30 days, or both.[29]

Fish/Fisheries Laws

• The fish and wildlife code makes it a Class 1 misdemeanor to empty or place any sawdust, manure, refuse matter, sedimentary materials, pollutants or chemicals of any kind in the waters of the state containing fish and wildlife, or to deposit the same within such distance that it may be carried into such waters by natural causes, except as expressly permitted.[30] A knowing or willful violator is liable to compensate the department of game, fish and parks for restoration of losses.[31] However, liability may not be imposed upon an agricultural producer if the fish or wildlife kill occurred as a result of normal farming practices.[32] Enforcement is the responsibility of the department of game, fish and parks, as well as the state's attorney, sheriff, constables and other peace officers.[33]

OPERATIONAL REQUIREMENTS

Forestry Requirements

State forestry laws do not appear to contain enforceable provisions relating to nonpoint source discharges.

Agriculture Requirements

• Soil conservation districts may be organized upon petition of ten percent of the voters in a territory.[34] Districts may adopt conservation standards for the control of erosion and sediment resulting from land-disturbing activities.[35] "Land-disturbing activity" is defined as "any clearing, tilling, grazing, grading, excavating, transporting and filling of land, and the implementation of silviculture activities resulting in soil erosion from water or wind and the movement of sediments into any and all waters of the state."[36] Districts may also designate "fragile land" areas where the land is so erosive as to cause a public hazard when converted to cropland use.[37]

If conservation standards are adopted, each permit-issuing agency must include those provisions in its permit procedure for activities within the district to ensure compliance with the standards.[38] However, no person engaging in land-disturbing activities is required to prepare a plan, file an application or otherwise report these activities directly to the conservation district, unless the conservation district determines that an activity is violating adopted standards, in which case the land disturber shall be required to prepare an erosion and sediment control plan and have it approved by the district.[39]

Any person adversely affected by land-disturbing activities may file a petition alleging a violation of the chapter with the conservation district or the permit-issuing agency. The "petitioned agency" shall investigate and "take appropriate action and advise the petitioner of its disposition of his petition."[40] Any person who intentionally refuses or fails to comply with the action directed by the petitioned agency may lose eligibility for financial assistance from any state agency or political subdivision involved in natural resources.[41] Either a permit-issuing authority or a soil conservation district may, upon petition or upon its own volition, in the enforcement of its orders, commence an action in circuit court for an injunction or other relief to enforce the provisions of the chapter.[42]

• The pesticide law provides that "no person may transport, store, use, dispose of or handle any pesticide, pesticide container, rinsate or application equipment in such a manner as to endanger or cause injury to humans, vegetation, crops, livestock, wildlife or beneficial insects or to pollute the groundwater or surface water."[43] The secretary of agriculture may promulgate rules governing these activities, and commercial pesticide applicators are required to obtain a license.[44] Violation of the rules or the license requirement is subject to a civil penalty not to exceed $5000 per violation, and applying pesticides without a license is a Class 2 criminal misdemeanor.[45] The secretary of agriculture also may bring an action to enjoin violation of the chapter.[46]

• The water management board is required to promulgate rules for chemigation equipment standards, performance standards and installation requirements and for requirements regarding the use and location of antipollution devices.[47] Failure to comply with the board's rules is a Class 2 misdemeanor; in addition, a civil fine of not more than $500 may be imposed.[48]

• Counties and municipalities may adopt ordinances for the purpose of protecting public groundwater supplies from pollution.[49] The ordinances must be consistent with the voluntary wellhead protection strategies and guidelines established under the federal Safe Drinking Water Act,[50] and may include ordinances to: 1) establish wellhead protection areas; 2) zone for the purpose of protecting such areas from pollution; 3) monitor and regulate activities and sources of potential or actual pollution within the areas; and 4) provide for the containment and cleanup of pollution or other remedial action.[51] If there is a violation or threatened violation of an ordinance, a board of county commissioners may institute an appropriate action to seek an injunction, to be brought by the state's attorney.[52] County and municipal governments also may use their general authority to enforce ordinances with fines not to exceed $200, imprisonment not to exceed 30 days, or both.[53]

• A new provision prohibits confined animal feeding operations built after July 1, 1997 from being located over a shallow aquifer unless a groundwater discharge permit has been approved.[54]

Development and Other Earth-Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act or that may be authorized by general land use regulation such as zoning, state law provides the following authorities.

• As noted above, counties and municipalities may adopt ordinances for the purpose of protecting public groundwater supplies from pollution.[55] The ordinances must be consistent with the voluntary wellhead protection strategies and guidelines established under the federal Safe Drinking Water Act,[56] and may include ordinances to: 1) establish wellhead protection areas; 2) zone for the purpose of protecting such areas from pollution; 3) monitor and regulate activities and sources of potential or actual pollution within the areas; and 4) provide for the containment and cleanup of pollution or other remedial action.[57] If there is a violation or threatened violation of an ordinance, a board of county commissioners may institute an appropriate action to seek an injunction, to be brought by the state's attorney.[58] County and municipal governments also may use their general authority to enforce ordinances with fines not to exceed $200, imprisonment not to exceed 30 days, or both.[59]

Endnotes

[1] S.D. Codified Laws Ann. § 34A-2-22.
[2] S.D. Codified Laws Ann. § 34A-2-21.
[3] S.D. Codified Laws Ann. § 34A-2-2(11).
[4] S.D. Code Reg. 74:03:17:01-03.
[5] S.D. Code Reg. 74:03:17:03.01.
[6] S.D. Codified Laws Ann. § 34A-2-11.
[7] S.D. Codified Laws Ann. § 34A-2-11.
[8] S.D. Codified Laws Ann. § 34A-2-24.
[9] S.D. Code Reg. 74:03:02:49, 74:03:02:53.
[10] S.D. Codified Laws Ann. §§ 34A-2-53, 34A-2-60.
[11] S.D. Codified Laws Ann. § 34A-2-73.
[12] S.D. Codified Laws Ann. § 34A-2-74.
[13] S.D. Codified Laws Ann. §§ 34A-2-60, -75.
[14] S.D. Codified Laws Ann. §34A-2-75.
[15] S.D. Codified Laws Ann. § 34A-6-1.4.
[16] S.D. Codified Laws Ann. § 34A-6-1.3.
[17] S.D. Codified Laws Ann. § 34A-6-1.4.
[18] S.D. Codified Laws Ann. §§ 34A-6-1.22, -1.24, -1.29.
[19] S.D. Codified Laws Ann. § 34A-6-1.4.
[20] S.D. Codified Laws Ann. § 21-10-1.
[21] E.g., Watson v. Great Lakes Pipeline Co., 182 NW 2d 314 (1970).
[22] S.D. Codified Laws Ann. §§ 21-10-5, -9.
[23] S.D. Codified Laws Ann. § 21-10-25.2. "Agricultural operation" is defined as a facility used in the production or processing for commercial purposes of crops, timber, livestock, swine, poultry, livestock products, swine products or poultry products.
[24] S.D. Codified Laws Ann. § 21-10-25.4.
[25] S.D. Codified Laws Ann. § 7-8-20(14).
[26] S.D. Codified Laws Ann. § 7-8-20(15).
[27] S.D. Codified Laws Ann. § 9-32-10.
[28] S.D. Codified Laws Ann. § 11-2-34.
[29] S.D. Codified Laws Ann. §§ 7-18A-2, 9-19-3.
[30] S.D. Codified Laws Ann. § 41-13-1.
[31] S.D. Codified Laws Ann. § 41-13-1.
[32] S.D. Codified Laws Ann. § 41-13-1.1.
[33] S.D. Codified Laws Ann. §§ 41-15-1, -3.
[34] S.D. Codified Laws Ann. § 38-8-1.
[35] S.D. Codified Laws Ann. § 38-8A-11.
[36] S.D. Codified Laws Ann. § 38-8A-2.
[37] S.D. Codified Laws Ann. § 38-8A-6.
[38] S.D. Codified Laws Ann. § 38-8A-16.
[39] S.D. Codified Laws Ann. §§ 38-8A-17, 38-8A-18.
[40] S.D. Codified Laws Ann. § 38-8A-20.
[41] S.D. Codified Laws Ann. § 38-8A-18.1.
[42] S.D. Codified Laws Ann. § 38-8A-21.
[43] S.D. Codified Laws Ann. §§ 38-21-15.
[44] S.D. Codified Laws Ann. §§ 38-21-15, -17, -38.
[45] S.D. Codified Laws Ann. §§ 38-21-15, -17, -50.1.
[46] S.D. Codified Laws Ann. §§ 38-21-55.
[47] S.D. Codified Laws Ann. § 34A-2A-3.
[48] S.D. Codified Laws Ann. § 34A-2A-2.
[49] S.D. Codified Laws Ann. §§ 7-18-20, 9-12-7.

50. See S.D. Codified Laws Ann. §§ 34A-3A-17, 34A-2-103 et seq. These provisions include a directive that the secretary of environment and natural resources "periodically review and revise the groundwater protection strategy to reflect additional knowledge concerning the extent of groundwater contamination from fertilizers, pesticides, petroleum products, and other pollutants, nonpoint sources of groundwater pollution, any practices or sources which may contribute to contamination of groundwater from both point and nonpoint sources, ..." S.D. Codified Laws Ann. § 34A-2-106.
51. S.D. Codified Laws Ann. §§ 7-18-20.
52. S.D. Codified Laws Ann. § 11-2-34.
53. S.D. Codified Laws Ann. §§ 7-18A-2, 9-19-3.
54. S.D. Codified Laws Ann. § 34A-3A-24.
55. S.D. Codified Laws Ann. §§ 7-18-20, 9-12-7.
56. See S.D. Codified Laws Ann. §§ 34A-3A-17, 34A-2-103 et seq.
57. S.D. Codified Laws Ann. § 7-18-20.
58. S.D. Codified Laws Ann. § 11-2-34.
59. S.D. Codified Laws Ann. §§ 7-18A-2, 9-19-3.

TENNESSEE

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Tennessee's water pollution law contains general discharge provisions that may be enforceable against some nonpoint source discharges that consist of sewage or wastes. However, agricultural and silvicultural activities are exempted.

• The state's Water Quality Control Act of 1977 prohibits "the discharge of sewage, industrial wastes or other wastes into waters, or a location from which it is likely that the discharged substance will move into waters...."[1] The Act further provides that it is unlawful and a public nuisance to "discharge any substance into the waters of the state or to place...any substance...in any location where such substances, either by themselves or in combination with others" will cause damage as specified in the law.[2] The damages enumerated include: harm to the public health, safety or welfare; harm to the health of animals, birds, fish or aquatic life; hindering the uses of the waters of the state; or leaving waters of the state in a condition that violates state water quality standards.[3] The prohibition does not apply to discharge that are due to an unavoidable accident or that have been properly authorized.

However, the Act states that it does not apply to "any agricultural or forestry activity or the activities necessary to the conduct and operations thereof or to any lands devoted to the production of any agricultural or forestry products, unless there is a point source discharge from a discernible, confined, and discrete water conveyance."[4] And it "grants no new authority over non-point sources" that was not established under the previous Water Quality Control Act.[5]

Enforcement of the Act is through corrective action orders, civil penalties up to $10,000 per day, criminal (Class C misdemeanor) prosecution, and injunctions.[6] Violators are also subject to a cause of action for damages.[7]

Other Discharge Limitations

• Under the Sanitary Engineering Law, "(t)he defiling by any person of any water supply of a public water system or the damaging of any pipe or other part of a public water system, unless due to an act of God" is prohibited.[8] In addition, "(t)he discharge by any person of sewage or other waste at such location as will or will likely come into contact with the public water system intake, except in accordance with a permit issued by the department" is prohibited.[9] Enforcement of these provisions is through corrective action orders, civil penalties of not less than $50 nor more than $5,000, injunctions and criminal (Class E felony) prosecutions.[10] The law also provides that the state may recover damages for "any reasonable expenses incurred in investigating and enforcing violations...or any other actual damages caused by the violation."[11] The Water Quality Control Act explicitly states that the Act takes precedence in all cases of conflict with the state's Sanitary Engineering Law.

• Tennessee's Public Utilities and Carriers law provides that it is unlawful to "willfully corrupt or permit anything to run or fall into any stream or reservoir from which the (water company) takes water...which will corrupt the same or render it unpalatable, unwholesome, or unfit for use for any purpose for which it may be supplied....[12]

• Under the Tennessee Solid Waste Disposal Act it is unlawful to "place or deposit any solid waste into the waters of the state except in manner approved by the department or the Tennessee water quality control board...."[13] Solid waste is defined as "any garbage, refuse, including...solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, and agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or...irrigation return flows or industrial discharges which are point sources subject to permits...."[14]

Enforcement is through corrective action orders, civil penalties of not less than $100 nor more than $5,000 per day, injunctions and criminal (Class B misdemeanor) prosecution.[15] Enforcement may be delegated to local health officers.[16]

• In addition to the above provisions, Tennessee statutes provide for a variety of misdemeanor criminal offenses that involve activities related to water pollution.

For example, it is a Class A misdemeanor for any person to "knowingly [cause] damage to or the destruction of any real or personal property of another or of the state...knowing that he does not have the owner's effective consent."[17] Under the law, damage means destroying, polluting or contaminating property. Polluting is defined as "the contamination by manmade or man-induced alteration of the chemical, physical, biological or radiological integrity of the atmosphere, water, or soil to the material injury of the right of another."[18] Pollutant is defined broadly to include dredged soil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste.[19] This vandalism statute has been applied to water pollution by state courts.

Under Tennessee law, it is a Class B misdemeanor to knowingly place, drop or throw litter on any public or private property without permission and not immediately remove it.[20] Litter is defined to include garbage, refuse, rubbish, and "all other waste material."[21]

It is also a Class B misdemeanor to negligently discharge sewage, minerals, oil products or litter into any public waters or lakes within the state.[22]

It is a Class C misdemeanor to "unlawfully dispose of water carrying human waste, household or business waste, or to pipe or transmit raw sewage or the effluent from any septic tank or other system of any type, into or on public or private property."[23]

Fish/Fisheries Laws

• The state Wildlife Resources Code provides that "(n)o pollution, including, but not limited to, dye waste, petroleum products, brine waste, refuse from a mine, sawmill or construction activity, industrial or domestic sewage, or any deleterious or poisonous substance or activity shall be thrown or be caused, or allowed to run into, wash into or take place in any waters, either private or public, in a manner injurious to fish life or other aquatic organisms, or which could be injurious to the propagation of fish, or which results in the destruction of habitat for fish and aquatic life."[24] This provision is enforceable through criminal (Class A misdemeanor) prosecution. Each five days' continuous violation also constitutes a public nuisance, subject to abatement by permanent injunction.[25]

OPERATIONAL REQUIREMENTS

Forestry

State forestry laws do not appear to contain enforceable provisions relating to nonpoint source discharges.

Agriculture

• The supervisors of a soil conservation district organized under the Tennessee agriculture code may formulate regulations governing the use of the lands within the soil conservation district that are "in the interest of conserving soil and soil resources and preventing and controlling soil erosion."[26] The regulations may include necessary engineering operations, methods of cultivation, specifications of cropping programs and tillage practices, etc.[27] The regulations are contained in a proposed ordinance which must be passed by a two-thirds vote of the landowners. The land use regulations prescribed in the ordinances have the force and effect of law in the district and are binding on all landowners.[28]

When the supervisors identify a violation of the land use regulations and determine that the violation "tends to increase erosion on such lands and is interfering with the prevention or control of erosion on other lands within the district," the supervisors can request the court to require compliance or to allow them to perform the practice if compliance is not forthcoming.[29] The court may require compliance with the ordinance, and may require a landowner to reimburse the supervisors for performing the work.[30] In addition, a landowner may recover damages against a violator.[31]

• Tennessee's agriculture code provides that it is unlawful for any person to "handle, transport, store, display or distribute pesticides in such a manner as to endanger health and the environment" or to "dispose of, discard or store any pesticide or pesticide containers in such a manner as to cause injury to man, vegetation, crops, livestock, wildlife, beneficial insects or to pollute any water supply or waterways."[32] Enforcement is through injunction. The commissioner of agriculture may apply to chancery court for injunction restraining the violation.[33]

Development and Other Earth-Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act and general planning and zoning authority, there appear to be no specific enforceable requirements relating to land-disturbing activities.

Endnotes

1. Tennessee Code Annotated 69-3-108(b)(6).
2. TCA 69-3-114(a)
3. TCA 69-3-103(22).
4. TCA 69-3-1209(g).
5. TCA 69-3-120(h).
6. TCA 69-3-109, 69-3-115
7. TCA 69-3-116
8. TCA 68-221-711(4).
9. TCA 68-221-711(5).
10. TCA 68-221-712, 713, 715.
11. TCA 68-221-713(e).
12. TCA 65-27-109.
13. TCA 68-211-104.
14. TCA 68-211-103(8).
15. TCA 68-211-112, 114, 115, 117.
16. TCA 68-211-108.
17. TCA 39-14-408.
18. TCA 39-14-408(b)(2).
19. *Id.*
20. TCA 39-14-502(1).
21. TCA 39-14-501(2).
22. TCA 39-14-502(3).
23. TCA 39-17-102.
24. TCA 70-4-206.
25. *Id.*
26. TCA 43-14-219(a).
27. TCA 43-14-219(d).
28. TCA 43-14-219(b).
29. TCA 43-14-221(a).
30. TCA 43-14-221(c),(d).
31. TCA 43-14-220.
32. TCA 43-8-104.
33. TCA 43-8-105.

TEXAS

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Texas' water pollution law contains general prohibitions that may be enforced against nonpoint source discharges that cause pollution of waters of the states. Certain polluting activities under the jurisdiction of other agencies, including some agricultural and silvicultural activities, are exempted.

• The state water code provides that, except as authorized, no person may "discharge sewage, municipal waste, recreational waste, agricultural waste, or industrial waste into or adjacent to any water in the state," discharge other waste which in itself or in conjunction with any other discharge or activity causes pollution of any water of the state, or commit any other act which causes pollution of any water in the state.[1] Exempted from this prohibition are: discharges authorized by permit, discharges in compliance with a certified water quality management plan as provided under the state agriculture code (see below), and activities under the jurisdiction of the Parks and Wildlife Department, the General Land Office (coastal management) or the Railroad Commission of Texas.

Enforcement of the water code, or any rule, permit or order issued pursuant to it, is through administrative penalties up to $10,000 per day, civil penalties of between $50 and $10,000, and injunctions.[2] The Parks and Wildlife Department may enforce the law where it appears that the violation affects aquatic life or wildlife, and local governments may bring suit for injunctive relief and/or civil penalties.[3] The water code also provides for certain criminal offenses. For example, it is a criminal offense to discharge or permit to discharge any waste or pollutant into any state water that causes or threatens to cause water pollution unless in strict compliance with all required permits.[4] It is also a crime (subject to greater fine and term of imprisonment) to "intentionally or knowingly discharge" a pollutant into or adjacent to water that causes or threatens to cause water pollution unless in strict compliance with permit.[5]

Other Discharge Limitations

• "No person may deposit in any canal, lateral, reservoir or lake...the carcass of any dead animal...garbage, ashes...earth, offal, or refuse of any character or any other article which might pollute the water or obstruct the flow of a canal or similar structure."[6] Enforcement is through local (misdemeanor) prosecution.

• Nuisance law may also apply. The water code requires the Department of Health to continue to apply its authority in the abatement of nuisances resulting from pollution not otherwise covered by the code.[7] The state agriculture code provides that no nuisance action may be brought against an "agricultural operation" that was in operation one year or more prior to the action, if the actions that were the basis of the nuisance action existed unchanged since the establishment of the operation. An agricultural operation includes the raising of stock or livestock, producing crops, viticulture, horticulture, as well as other activities.[8] However, the provision does *not* restrict the authority of the state or a municipality to enforce the law.

• A city may establish a water pollution control and abatement program. If watershed quality assessments or other assessment identify water pollution attributable to non-permitted sources in a city with a population of 10,000 or more, the Texas Natural Resources Conservation Commission (TNRCC), after providing the city an opportunity to correct the problem and after a public hearing, may require the city to establish such a program.[9] The law lists a number of program components, including "the development and execution of reasonable and realistic plans for controlling and abating pollution or potential pollution resulting from generalized discharges of waste which are not traceable to a specific source, such as storm sewer discharges and urban runoff from rainwater."[10]

• The water code authorizes the creation of various utility and water districts which may adopt rules and regulations to preserve water quality. These districts may also set reasonable civil penalties for the breach of a district rule. They are enforced by complaints in appropriate courts of jurisdiction in the county in which the district is located.[11]

• The state water codes's provisions on groundwater management authorize the creation of groundwater conservation districts with the approval of a majority of the voters in the area.[12] The district may make and enforce rules to provide for "conserving, preserving, protecting, and recharging of the groundwater...in order to control subsidence or prevent waste of groundwater...."[13] Waste includes "the pollution or harmful alteration of groundwater."[14] Enforcement of a district's rules is by injunction in court, as well as by "reasonable civil penalties....that shall not exceed the jurisdiction of a justice court...."[15]

Fish/Fisheries Laws

• Under the state parks and wildlife code, no person may place in the water an explosive, poison or other substance or thing deleterious to fish.[16] This does not apply to the use of explosives for construction purposes, if authorized. Enforcement is through local criminal (Class B misdemeanor) prosecution.[17]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• The state agriculture code provisions discussed below, governing the Soil and Water Conservation Board and the soil and water conservation districts, are applicable to silviculture activities.

Agriculture

• The state Soil and Water Conservation Board is the lead agency for the abatement of agricultural and silvicultural nonpoint source pollution.[18] The Board is required to plan, implement and manage programs and practices for abating such pollution, and other state agencies with responsibilities in this area must coordinate their actions with the Board. If the Board identifies an area as having agricultural or silvicultural nonpoint source water quality problems, or as being in a "coastal zone" designated by the Coastal Coordination Council, the state board establishes a "water quality management plan certification program" that provides, through the local soil and water conservation districts, for the supervision of individual water quality management plans for these areas. The state board adopts rules for these plans in compliance with state water quality standards.[19]

For those areas with "agricultural or silvicultural nonpoint source water quality problems" or for coastal zone areas, all complaints about violations of the water quality management plan or other rules relating to nonpoint source pollution are referred to the State Board. The State Board, in cooperation with the conservation district, investigates and if necessary, develops a corrective action plan. If the violator refuses to take corrective action, the state board refers the complaint to the TNRCC for enforcement.[20]

• The directors of a soil and water conservation district may propose an ordinance "in the interest of conserving soil and soil resources and preventing and controlling soil erosion."[21] An ordinance may require certain engineering operations, such as terraces, check dams, dikes, ponds, ditches; require the observance of certain methods of cultivations such as contour cultivating, furrowing, planting with erosion-preventing plants, forestation and reforestation; specify cropping programs and tillage practices; or adopt other land-use regulations that may assist conservation of soil resources and erosion.[22] Once an ordinance prescribing land use regulations is approved by 90 percent of the voters, it is adopted and has the "force and effect of law" and is "binding" on all owners of land in the district.[23] If the regulation is not being observed and that nonobservance "tends to increase erosion on that land and is interfering with the prevention and control of erosion on other land in the conservation district," the directors may bring suit in civil court.[24] After a hearing, the court may require the defendant to perform the work; order that if the defendant fails to perform the directors may enter the land and perform; and order that the directors recover their costs. The court retains jurisdiction until the work is done.[25]

• The water code authorizes the TNRCC to adopt rules to prohibit "the discharge of agricultural waste from a concentrated animal feeding operation into a playa; or...the use of a playa as a wastewater retention facility for agricultural waste."[26] Playa is defined as "a flat-floored, clayey bottom of an undrained basin that is located in an arid or semi-arid part of the state, is naturally dry most of the year, and collects runoff from rain but is subject to rapid evaporation."[27] An exception is provided for operations that were authorized to undertake these activities prior to the adoption of the rules. However, CAFOs that use a playa as a waste water retention facility are required to collect annual water samples; if the results show significant increases in chlorides or nitrates, and the TNRCC determines that the CAFO is the source of the pollution, the commission shall require "action to correct the problem."[28]

• The Department of Agriculture is authorized to adopt rules governing the storage and disposal of pesticides and pesticide containers for the purpose of preventing injury and "preventing any waterway pollution that is harmful to man or wildlife provided, however, that such rules be consistent with the Texas Natural Resources Conservation Commission rules" adopted under the state water code.[29] Enforcement is through administrative penalties not to exceed $4,000, injunctions, and civil penalties of not less than $50 nor more then $10,000.[30]

Development and Other Earth-Disturbing Activities

Apart from any programs that may be authorized by general land use regulation such as zoning, Texas law does have several other enforceable authorities applicable to nonpoint sources.

• The state water code requirement that certain cities adopt a water pollution control and abatement program, discussed above, is potentially applicable to the control of nonpoint source pollution from land-disturbing activities.

• While the agriculture code establishes the Soil and Water Conservation Board as the lead agency for abatement of agricultural and silvicultural nonpoint source pollution, the natural resources code provides that the General Land Office is the lead agency for the coordination of *coastal* erosion avoidance, remediation and planning. "The commissioner shall...promulgate rules, recommendations, standards, and guidelines for erosion avoidance and remediation...."[31] Thus, the law may potentially reach some land-disturbing activities in the coastal zone that result in nonpoint source pollution.

Endnotes

1. Vernon's Texas Code Annotated Water Code 26.121(a).
2. VTCA Water Code 26.123, 26.122(a), 26.136.
3. VTCA Water Code 26.124(a),(b).
4. VTCA Water Code 26.2121(g).
5. VTCA Water Code 26.2121(a).
6. VTCA Water Code 11.090.
7. VTCA Water Code 26.130.
8. VTCA Water Code 251.004.
9. VTCA Water Code 26.177(a).
10. VTCA Water Code 26.177(b). In addition, certain municipalities must adopt a nonpoint source water pollution control and abatement program before the municipality adopts an ordinance creating an extraterritorial jurisdiction. VTCA Water Code 26.179.
11. VTCA Water Code 49.001, *et seq.*
12. VTCA Water Code 36.011.
13. VTCA Water Code 36.101.
14. VTCA Water Code 36.001(8).
15. VTCA Water Code 36.102.
16. VTCA Parks & Wildlife Code 66.003.

[17] VTCA Parks & Wildlife Code 66.012.
[18] VTCA Water Code 26.1311, VTCA Agriculture Code 201.026.
[19] VTCA Agriculture Code 201.026.
[20] VTCA Agriculture Code 201.026.
[21] VTCA Agriculture Code 201.121(a).
[22] VTCA Agriculture Code 201.121(b).
[23] VTCA Agriculture Code 201.123, 201.124.
[24] VTCA Agriculture Code 201.128.
[25] VTCA Agriculture Code 201.128.
[26] VTCA Water Code 26.048.
[27] VTCA Water Code 26.048(d).
[28] VTCA Water Code 26.048(b).
[29] VTCA Agriculture Code 76.131(a).
[30] VTCA Agriculture Code 76.154 - 76.156.
[31] VTCA Natural Resources Code 33.601.

UTAH
Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

The Utah water pollution control law includes a general provision that may be enforced against nonpoint water pollution or placement of wastes that is likely to cause water pollution.

• It is unlawful for any person to discharge a pollutant into waters of the state or to cause pollution which constitutes a menace to public health and welfare, is harmful to wildlife, fish or aquatic life, or impairs domestic, agricultural, industrial, recreational or other beneficial uses of water.[1]

• The same provision of the Code also makes it unlawful to place any waste in a location where there is probable cause to believe that it will cause water pollution.[2]

Violations of these prohibitions are treated as a public nuisance. Moreover, when the Water Quality Board determines there are reasonable grounds to believe that a violation has been committed, it may give written notice with an order to appear before the board.[3] The board also may seek injunctive relief in a civil action.[4] Violators are subject to a civil penalty not to exceed $10,000; and a violation committed willfully or with gross negligence is subject to a fine not to exceed $25,000.[5]

Other Discharge Limitations

• Nuisance is defined as "any item, thing, manner, condition whatsoever that is dangerous to human life or health or renders soil, air, water, or food impure or unwholesome."[6] The county attorney, the city attorney, or the attorney general is empowered to institute an action to abate a public nuisance, and a person who creates a nuisance is guilty of a class B misdemeanor.[7]

There is an exemption for agricultural operations that are consistent with sound agricultural practices, which are presumed to be reasonable and do not constitute a nuisance unless the agricultural operation has a substantial adverse effect on public health and safety. Agricultural operations undertaken in conformity with federal, state, and local laws, regulations and zoning ordinances are presumed to be operating within sound agricultural practices.[8] "Agricultural operations" are defined as "any facility for the production for commercial purposes of crops, livestock, poultry, livestock products, or poultry products."[9]

• In addition to regulating nuisance, municipalities are authorized to enact ordinances "preventing pollution or contamination of the streams or watercourses from which the inhabitants of cities derive their water supply, in whole or in part, for domestic and culinary purposes."[10] Presumably these ordinances are enforced under the municipality's inherent police powers.

Fish/Fisheries Laws

• The Utah fish and wildlife code makes it "unlawful for any person to pollute any waters deemed necessary by the Wildlife Board for wildlife purposes or any waters containing protected aquatic wildlife and stoneflies, mayflies, dragonflies and damsel flies, water bugs, caddis flies, spongilla flies, and crustaceans."[11] Each day of pollution is a separate violation, and violations are treated as class B misdemeanors.[12] However, a person who violates the statute with intentional, knowing or reckless conduct and thereby injures or destroys protected wildlife is guilty of "wanton destruction of protected wildlife."[13] This violation is a third degree felony if the aggregate value of the protected wildlife is more than $500, a class A misdemeanor if the value is more than $250 but less than $500, and a class B misdemeanor if the value is less than $250.[14]

OPERATIONAL REQUIREMENTS

Forestry Requirements

State forestry laws do not appear to contain enforceable provisions relating to nonpoint source discharges.

Agriculture Requirements

• Soil conservation districts may be organized by petition of 25 or more land occupiers.[15] Each district is a political subdivision and has the authority to "devise and implement measures for the prevention of soil erosion, floodwater and sediment damages, nonpoint water pollution...."[16] Each district also is authorized to make recommendations governing land use within the district, including provisions requiring the observance of particular methods of cultivation, requiring specific crop programs and tillage practices, prohibiting the tillage and cultivation of highly erosive areas where erosion may not be adequately controlled if cultivated, and requiring the construction of terraces, terrace outlets, check dams, dikes, ponds, and other structures.[17] It appears that these "recommendations" may be made enforceable as ordinances, since the same statute also grants the district court jurisdiction to decide all cases and controversies involving construction, application, or enforcement of land use ordinances within the district.[18]

• A person is guilty of a Class B misdemeanor if he: "1) constructs or maintains a corral, sheep pen, goat pen, stable, pigpen, chicken coop, or other offensive yard or outhouse where the waste or drainage therefrom shall flow directly into the waters of any stream, well or spring of water used for domestic purposes; 2) deposits, piles, unloads, or leaves any manure heap, offensive rubbish, or the carcass of any dead animal where the waste or drainage will flow directly into the waters; 3) dips or washes sheep in any stream or in such close proximity to a stream used by inhabitants for domestic purposes as to make the waters impure or unwholesome; 4) constructs a yard for shearing or dipping sheep within 12 miles of a city where the refuse would naturally find its way into any stream used by the inhabitants; 5) establishes and maintains any corral, camp, or bedding place for the purpose of herding, holding or keeping any cattle, horses, sheep, goats, or hogs within seven miles of any city or town, where the refuse or filth from it will naturally find its way into any stream of water used by the inhabitants for domestic purposes."[19]

• The county legislative body may promulgate regulations to prevent the destruction or obstruction of channels, storm sewers, and drains that serve as natural channels for the carrying away and the safe disposal of natural storm and flood waters.[20] It may also provide by ordinance for the protection and use of flood channels and present flood plains on rivers, streams, and canals located within the county.[21] All laws and sanitary regulations against pollution of water in natural streams, canals and lakes shall be enforced by the county executives in their respective counties, or by the state, through the attorney general and in cooperation with the state board of health, state fish and game commission and the several county legislative bodies.[22]

• The Utah Department of Agriculture is authorized to adopt any rule consistent with federal regulations under FIFRA, including rules relating to the sale, distribution, use, and disposition of pesticides as deemed necessary to prevent damage and to protect public health.[23] The department shall serve notice of violation on alleged violators of the rules, and may order corrective action.[24] Any violator of an order issued under the title is subject to a penalty not to exceed $5000 in a civil proceeding, and in a criminal proceeding may be found guilty of a class B misdemeanor.[25]

Development and Other Earth-Disturbing Activities

• The Division of Parks and Recreation has the authority to regulate and control types of development along rivers and streams, designated by the Division, within their present flood plains.[26] "The division may not permit construction of any structures, subdivisions, or other developments on or along rivers or streams, or within their present flood plains, which are in violation of any ordinances of any political subdivision having jurisdiction in that area but may in respect to this development impose requirements in excess of and in addition to those provided in those ordinances."[27] The more restrictive of the requirements are applicable.[28] Any person who violates regulations adopted pursuant to this provision is guilty of a class B misdemeanor.[29]

No other specific operating requirements are set forth, other than those that may be found in urban stormwater programs under the federal Clean Water Act or that may be authorized by general land use regulation such as zoning.

Endnotes

1. Utah Code Ann. § 19-5-107.
2. Utah Code Ann. § 19-5-107.
3. Utah Code Ann. § 19-5-111.
4. Utah Code Ann. § 19-5-115. The state engineer is separately authorized to bring suit in courts of competent jurisdiction to prevent waste, loss or pollution of the waters of the state. See Utah Code Ann. § 73-2-1.
5. Utah Code Ann. § 19-5-115.
6. Utah Code Ann. § 76-10-801.
7. Utah Code Ann. §§ 76-10-806, -804.

[8] Utah Code Ann. § 78-38-7.
[9] Utah Code Ann. § 78-38-8.
[10] Utah Code Ann. § 10-8-15.
[11] Utah Code Ann. § 23-15-6.
[12] Utah Code Ann. §§ 23-15-6, 23-13-11.
[13] Utah Code Ann. § 23-20-4.
[14] Utah Code Ann. § 23-20-4.
[15] Utah Code Ann. § 17A-3-801.
[16] Utah Code Ann. § 17A-3-805.
[17] Utah Code Ann. § 17A-3-806.
[18] Utah Code Ann. § 17A-3-807.
[19] Utah Code Ann. § 76-10-802.
[20] Utah Code Ann. § 17-8-5.
[21] Utah Code Ann. § 17-8-5.5.
[22] Utah Code Ann. § 17-8-5.
[23] Utah Code Ann. § 4-14-6.
[24] Utah Code Ann. § 4-2-12.
[25] Utah Code Ann. § 4-2-15. A subsequent criminal violation within two years is a class A misdemeanor.
[26] Utah Code Ann. § 63-11-17.5.
[27] Utah Code Ann. § 63-11-17.5(3).
[28] Utah Code Ann. § 63-11-17.5(3).
[29] Utah Code Ann. § 63-11-17.3.

VERMONT

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Vermont's Water Pollution Control Act draws no distinction between point and non-point sources, and its general prohibition is fairly broad.

• It prohibits "discharge [of] any waste, substance or material into the waters of the state" without a permit.[1] "Discharge" is defined as "the placing, depositing or emission of any wastes, directly or indirectly, into an injection well or into the waters of the state".[2] The law exempts from this prohibition "proper application of fertilizer to fields and crops".[3] While the broad prohibition of discharges applies to agriculture and silviculture, specific prohibitions on discharges to Class A and Class B waters "shall not regulate accepted agricultural or silvicultural practices, as are defined by the commissioners of agriculture, food and markets and forests, parks and recreation, respectively...nor shall those provisions prohibit stormwater runoff or the discharge of nonpolluting wastes..."[4] Essentially, this is interpreted to mean that those agricultural operations compliant with "accepted agricultural practices (AAPs)" and silvicultural operations compliant with "accepted management practices (AMPs)" are not required to obtain permits. They must not, however, cause water quality violations. With respect to violations of water quality standards, Vermont law further provides that persons engaged in farming and following accepted agricultural practices as described by the commissioner of agriculture, food and markets by rule "shall be presumed to be in compliance with water quality standards."[5] However, the rules implementing this provision clarify that this presumption is rebuttable "by water quality data or results from a water quality study deemed conclusive by the Secretary."[6]

The water pollution law is enforceable by a variety of mechanisms. [7]. These include administrative orders,[8] emergency orders,[9] administrative penalties of up to $25,000 for a single violation, and $10,000 per day (but not more than $100,000 total for a continuing violation),[10] civil enforcement,[11] and criminal enforcement.[12]

Other Discharge Limitations

• Towns, cities, and incorporated villages have the power to define what constitutes a public nuisance.[13] Boards of health may bring actions to abate nuisances.[14] But "Agricultural activities conducted on farmland, if consistent with good agricultural practices and established prior to surrounding non-agricultural activities, shall be entitled to a rebuttable presumption that the activity is reasonable and does not constitute a nuisance." This presumption is not available in suits brought by the local board of health, however.[15]

• While statutory nuisance law does not specifically address pollution of surface water, any person may seek equitable relief or damages "for unreasonable harm caused by another person withdrawing, diverting or altering the character of groundwater."[16] However, the law provides that in such an action, "a person who alters groundwater quality or character as a result of agricultural or silvicultural activities, or other activities regulated by the commissioner of the department of agriculture, food and markets, shall be liable only if the alteration was either negligent, reckless or intentional."[17] Similarly, "An owner or lessee of agricultural lands shall not be liable for personal injury or property damage resulting from contamination of a permitted [public drinking] water source so long as the owner or lessee was utilizing accepted agricultural practices...and the lands were agricultural at the time the [water supply] permit was issued."[18]

Fish/Fisheries Laws

• "A person shall not place in any waters lime, creosote, coculus inducus or other drug or poison destructive to fish."[19] The statute is silent on whether a violation requires intent to take fish, or even an intent to place the poison in the water. The list of substances suggests a narrow scope for any possible prosecution of nonpoint source pollution. The general penalty for violation is a fine of up to $1000.[20]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• State timber harvest rules are advisory for most operations.[21] But, In 1997, the legislature enacted a law regulating "heavy cutting," defined as a harvest of more than forty acres which leaves a residual stocking level of acceptable growing stock (at least 4.5 in. dba) which is below the C-line as defined by the U.S. Dept. of Agriculture guidelines for the applicable timber type. Heavy cutting operations on 40 acres or more must be preceded by a notice of intent to cut. The notice is filed by the landowner with the state forestry agency; if the state field forester determines that the cut is exempt, no further review is necessary. Exemptions include cuts for agricultural conversion, conversion regulated by Act 250 (see below under "Development"), or cuts consistent with a forest management plan in effect under the state's program for current use assessment taxation or several other forest planning programs. If an exemption does not apply, the forester must review the proposed heavy cut to determine its compliance with timber harvest rules. These rules include silvicultural guidelines and forestry standards, and requirements with respect to water quality, wetlands, and riparian zones.[22] After review, the state field forester will issue an authorization to proceed or denial of authorization to proceed, appealable to the commissioner of forests, parks, and recreation. Violation of the law or rules may result in a penalty of up to $50,000 and up to $25,000 per day for a continuing violation.

• As noted above, compliance with forestry AMPs can provide some shelter from permitting under the state's water pollution control law. Thus, these can be construed as indirectly enforceable mechanisms.

Agriculture Requirements

• Vermont's Agricultural Nonpoint Source Pollution Reduction Program,[23] includes two kinds of enforceable standards: 1) Farmers generally must follow "accepted agricultural practices"(AAPs) as designated by rule by the commissioner of agriculture, food and markets. 2) The commissioner may also require farmers to implement "best management practices" (BMPs) on a case-by-case basis. Both types of standards must be "practical and cost effective to implement."[24]

The rules for accepted agricultural practices prohibit the direct discharge of waste into surface waters; the "concentrated overland flow of waste into adjoining waters"; discharge of manure runoff from storage areas; overland flow of manure runoff following stacking of manure on fields; construction of manure, fertilizer, or pesticide storage structures in floodways; construction of the same in floodplains except in conformance with National Flood Insurance Program Standards; and field stacking of manure or fertilizers within 100 feet of neighbors' wells or springs or on lands subject to annual flooding (unless there is no practical alternative). They further limit unnecessary applications of plant nutrients or applications of nutrients or pesticides in specific ways likely to lead to runoff. They set an acceptable limit for soil loss and require management of agricultural wastes to "eliminate adverse water quality impacts." They require perennial vegetative buffer zones between row croplands and water, and require structures to be set back from surface waters.[25]

For enforcement purposes, the commissioner must, after responding to a complaint, first send the offender a written warning with proposed corrective action. After thirty days, the commissioner must offer opportunity for a public hearing, then issue an order or seek enforcement in civil court. Farmers may appeal administrative orders to the courts. Violation of an order may be punished by assessment of civil penalties, as well as enforced by injunction in court.[26]

BMPs may be required in order to meet water quality standards in particular places. The BMP rules provide that the commissioner, "upon receipt of a petition from a person with an interest in the agricultural nonpoint source component of the basin planning process," or acting on the commissioner's own initiative, is to determine "whether to require BMPs beyond AAPs on farms or in a specific basins in order to achieve compliance" with water quality goals.[27] A petition for imposition of BMPs must include identification of each farmer whose actions violate water quality standards, documentation as to the water quality violation, including a study conducted pursuant to USEPA quality assurance/quality control program standards for the Clean Water Act, a description of the specific actions sought by the petitioner, a detailed narrative as to which AAPs are insufficient, and other information. The petition, if complete, is set for public hearing, leading to a written decision. The decision may be appealed by the farmer or petitioner, resulting in a hearing *de novo* before the water resources board.[28] Imposing BMPs requires a finding that sufficient financial assistance is available to the farmer to implement the BMPs.[29] The BMP rules provide that a grant to the farmer of 85 percent of the cost is to be considered sufficient to make this finding.[30]

• Vermont also regulates large farm operations, based on animal units. (Regulatory thresholds are defined differently from federal CAFO requirements, but basically cover animal operations that are 95% the size of the federal threshold). The law requires the operator to obtain from the commissioner permits for construction of barns, and for operation of the large livestock operation. The operating permit must include demonstration of an adequately sized manure management system, and a nutrient management plan "to dispose of wastes in accordance with accepted agricultural practices" described above.[31] State regulations for this program are to be no stricter than the corresponding federal CAFO regulations, as adjusted for the differing size threshold.[32] Enforcement is under the general provisions applicable to the commissioner of agriculture, food, and markets, and may include civil penalties and injunctive relief.

• The commissioner of agriculture, food and markets has broad authority to regulate pesticide use, storage, and disposal.[33] Also, permit regulations for use of herbicides to maintain rights-of-way require applicants to prepare a long-term plan including establishments of standards for wetlands, wildlife, erosion control, and aesthetic considerations. Prior to spraying, permit holders must flag water supplies and other sensitive areas designed by the commissioner and must not spray near flagged areas. Permits must specify buffer strip distances to protect the waters of the state.[34] Golf courses must obtain permits to apply pesticides, and this includes "buffer strips to protect surface waters and environmentally sensitive areas."[35] The commissioner may enforce the standards administratively by revoking or suspending licenses, entering into consent agreements with violators, requiring "correction of sources of pesticide contamination that threaten human health or the environment", seeking injunctive relief,[36] or assessing administrative penalties of up to $1,000 by notice and hearing process.[37] Criminal penalties are also available.[38]

Development and Other Earth Disturbing Activities

• State law regulates the alteration of streams.[39] Permits are required to alter or modify the course, current, or cross-section of any watercourse with a drainage area greater than ten square miles at the location of the proposed modification, or any outstanding resource waters. This law does not apply to accepted agricultural practices or accepted management practices for silvicultural as defined by the respective commissioners. A permit may be issued only if the change will not increase flood hazards, significantly damage fish or wildlife, significantly damage the rights of riparian owners, or adversely affect outstanding resource waters. Violations are punishable by civil fine of not more than $10,000 per day, and restoration.

• State law also provides for regulations for the protection of "significant" wetlands.[40] Some of the activities affecting wetlands are also nonpoint sources of water pollution. The rules list activities that are allowed within protected wetlands and their buffer zones; other activities are considered "conditional uses" and require a conditional use determination from the state's wetlands office in the Department of Environmental Conservation. Enforcement is under the authorities described above for the water quality control program.

• Vermont has comprehensive land use regulation under its "Act 250," the Land Use and Development Law.[41] This law requires a land uses permit for numerous activities, some of which affect nonpoint sources. It does not, however, regulate the construction of improvements for farming, logging, or forestry unless they are 2500 feet or more above sea level. District environmental commissions must evaluate the grant of an Act 250 permit under a variety of criteria, several of which address water quality, water supply, and erosion.

• The municipal and regional planning and development laws allow municipalities to adopt restrictions and requirements as bylaws. The state program calls for regional plans, which must include a land use element, including areas "which require special consideration for aquifer protection, wetland protection, or for other conservation purposes". [42] Municipal plans must be consistent with regional plans, and must include elements parallel to the ones just outlined.[43] Once a municipality has a plan in place, it may adopt bylaws to enforce it.[44]

• Municipalities are also empowered to adopt bylaws governing shorelands, either as part of or in addition to zoning bylaws.[45] These bylaws may regulate design and maintenance of sanitary facilities, regulate alterations to wetlands and wildlife areas, control building locations, and require maintenance of vegetation. "Shorelands are "lands being between the normal mean water mark of a lake, pond or impoundment exceeding twenty acres and a line not less than five hundred feet nor more than one thousand feet from such mean water mark."[46]

• Municipalities are authorized to adopt flood hazard area regulations.[47] Specifically municipalities may regulate permitted uses and type of construction "[w]ithin any area designed by the department of environmental conservation as subject to periodic flooding".[48]

Notwithstanding these provisions, municipal bylaws may not restrict "accepted agricultural or farming practices, or accepted silvicultural practices, including the construction of farm structures".[49] Enforcement is by notice of violation, injunction, and penalty of $50 per violation per day.[50]

Endnotes
1. Vt. Stat. Ann. tit. 10, § §1259 (a).
2. Vt. Stat. Ann. tit. 10, § 1251(3).
3. Vt. Stat. Ann. tit. 10, §1259(a).
4. Vt. Stat. Ann. tit. 10, § 1259(f) (exempting such "accepted practices" from subsections (c), (d), and (3)).
5. Vt. Stat. Ann. tit. 6, § 4810.
6. Accepted Agricultural Practice Rules at AAP-ii (June 29, 1995).
7. Vt. Stat. Ann. tit. 10, §§ 8001-8018; see § 8003.
8. Vt. Stat. Ann. tit. 10, § 8008.
9. Vt. Stat. Ann. tit. 10, § 8009.
10. Vt. Stat. Ann. tit. 10, § 8010.
11. Vt. Stat. Ann. tit. 10, § 8221.
12. Vt. Stat. Ann. tit. 10, § 1275.
13. Vt. Stat. Ann. tit. 24, § 2291(14).
14. Vt. Stat. Ann. tit. 18, § 613.
15. Vt. Stat. Ann. tit. 12 § 5753(a),(b).
16. Vt. Stat. Ann. tit. 10, § 1410(c).
17. Vt. Stat. Ann. tit. 10, § 1410(d).

[18] Vt. Stat. Ann. tit. 10, §1676a(a), (d).
[19] Vt. Stat. Ann. tit. 10, § 4606(b).
[20] Vt. Stat. Ann. tit. 10, § 4515.
[21] Vt. Stat. Ann. tit. 10, § 2622.
[22] Vt. Stat. Ann. tit. 10, §§ 2622, 2625.
[23] Vt. Stat. Ann. tit. 6, §§ 4810-4825.
[24] Vt. Stat. Ann. tit. 6, § 4810.
[25] Accepted Agricultural Practice Rules §4 (June 29, 1995).
[26] Vt. Stat. Ann. tit. 6, § 4812.
[27] Best Management Practice Rules § 7.1 (January 27, 1996).
[28] Best Management Practice Rules §§ 7.3-7.7 (January 27, 1996).
[29] Vt. Stat. Ann. tit. 6, § 4810.
[30] Best Management Practice Rules § 7.2 (January 27, 1996).
[31] Vt. Stat. Ann. tit. 6, § 4851.
[32] Vt. Stat. Ann. tit. 6, § 4852.
[33] Vt. Stat. Ann. tit. 6 §§ 1103, 1104.
[34] Vermont Code of Regs. 20 031 012.
[35] Vermont Code of Regs. 20 031 012.
[36] Vt. Stat. Ann. tit. 6, § 1104.
[37] Vt. Stat. Ann. tit. 6, § 1111.
[38] Vt. Stat. Ann. tit. 6, § 1107.
[39] Vt. Stat. Ann. tit. 10, § 1021 et seq.
[40] Vt. Stat. Ann. tit. 10, Chap. 37, § 905 (7-9).
[41] Vt. Stat. Ann. tit. 10, Chap. 151, § 6001 et seq.
[42] Vt. Stat. Ann. tit. 24, § 4348a(a)(2)(A).
[43] Vt. Stat. Ann. tit. 24, § 4382(a)(2) & (5).
[44] Vt. Stat. Ann. tit. 24, § 4401(a).
[45] Vt. Stat. Ann. tit. 24, § 4411; see also id. § 4401(b)(4).
[46] Vt. Stat. Ann. tit. 10, § 1422.
[47] Vt. Stat. Ann. tit. 24, § 4412; see also id. §4401(b)(5).
[48] Vt. Stat. Ann. tit. 24, § 4407(9).
[49] Vt. Stat. Ann. tit. 24, § 4495.
[50] Vt. Stat. Ann. tit. 24, §§ 4444, 4445.

VIRGINIA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Virginia's water pollution control law includes some basis for enforcement actions against nonpoint source discharges that are not authorized by state permits and that either consist of wastes or that result in impairment of the state's waters.

• "Except in compliance with a certificate issued by the Board, it shall be unlawful for any person to (I) discharge into state waters sewage, industrial wastes, other wastes, or any noxious or deleterious substances, or (ii) otherwise alter the physical, chemical or biological properties of such state waters and make them detrimental to the public health or to animal or aquatic life, or to the uses of such waters for domestic or industrial consumption, or for recreation, or for other uses."[1] Enforcement is by special order, which may be issued "only after a hearing with at least thirty days' notice to the affected owners, of the time, place and purpose thereof, and they shall become effective not less than fifteen days after service..."[2] Injunctive relief and civil penalties of up to $25,000 per day are available.[3]

• "Except as otherwise permitted by law, it shall be unlawful for any person to dump, place, or put, or cause to be dumped, placed or put into, upon the bank of or into the channels of any state waters, any object or substance, noxious or otherwise, which may reasonably be expected to endanger, obstruct, impede, contaminate or substantially impair the lawful use or enjoyment of such waters and their environs by others." Violations are misdemeanors and upon conviction are punishable by "a fine of not less than $100 nor more than $500 or by confinement in jail not more than twelve months or both such fine and imprisonment." In addition, whether there is a criminal conviction or not, "upon a bill in equity, filed by the attorney for the Commonwealth of such county or by any person whose property is damaged or whose property is threatened with damage" the court may "award an injunction enjoining any violation of this law..."[4]

Other Discharge Limitations

• Nuisance law also may provide enforceable remedies. A special grand jury will be summoned when five or more citizens complain to a circuit court about the existence of a public or common nuisance.[5] Nuisance remedies are available and may result in abatement as against the property giving rise to the nuisance. "Every judgement in rem under this chapter shall be enforced in the same manner as an attachment levied on real estate."[6] If found guilty, a person may be fined not more than $10,000 and the nuisance may be ordered removed and abated.[7]

Fish/Fisheries Laws

• One provision directed at protection of fisheries provides some enforceable authority potential relevant to some forms of nonpoint source water pollution. "It shall be unlawful to knowingly cast any noxious substance or matter into any watercourse of the Commonwealth where fish or fish spawn may be destroyed, or to place or allow to pass into the waters of the Commonwealth any sawdust, ashes, lime, gas, tar, or refuse of gas works, injurious to fish." Violation of this provision is a misdemeanor.[8]

OPERATIONAL REQUIREMENTS

Forestry Requirements

• Virginia has an enforceable mechanism for silvicultural activities causing or threatening to cause pollution. "If the State Forester determines that an owner or operator is conducting or allowing the conduct of any silvicultural activity in a manner which is causing or is likely to cause pollution, he may advise the owner or operator of corrective measures needed to prevent or cease the pollution." The State Forester has "authority to issue special orders to any owner or operator who is conducting, or allowing to be conducted, any silvicultural activity in a manner which is causing or is likely to cause pollution, to cease immediately all or part of the silvicultural activities on the site, and to implement specified corrective measures within a stated period of time. Such special orders are to be issued only after a hearing with reasonable notice to the owner or operator, or both, of the time, place and purpose thereof, and they shall become effective not less than five days after service..."[9] The State Forester may also issue an emergency order, without advance notice or hearing, if he "finds that any owner or operator is conducting any silvicultural activity in a manner which is causing or is likely to cause an alteration of the physical, chemical or biological properties of any state waters resulting from sediment deposition presenting an imminent and substantial danger to (I) the public health, safety or welfare, or the health of animals, fish or aquatic life; (ii) a public water supply; or (iii) recreational, commercial, industrial, agricultural, or other reasonable uses..."[10] Despite these provisions, "The State Forester shall not issue a special order to any owner or operator who has incorporated generally acceptable water quality protection techniques in the operation of silvicultural activities, which techniques have failed to prevent pollution, if the State Forester determines that the pollution is the direct result of unusual weather events which could not have been reasonably anticipated."[11] A civil penalty of up to $5,000 per violation per day may be assessed by the State Forester after the owner or operator has been given an opportunity for a hearing.[12] Orders may be enforced by injunction.[13]

Agriculture Requirements

• Virginia's Agricultural Stewardship Act established a complaint-driven enforceable mechanism applicable to agricultural nonpoint source water pollution. After April 1, 1997, upon receiving a complaint (except for an anonymous complaint), the Commissioner of Agriculture and Consumer Services shall investigate and if it is determined "that substantial evidence exists to prove that an agricultural activity is creating or will create pollution, the Commissioner shall notify the owner or operator."[14] "The notice shall state that within sixty days of receipt of the notice, the owner or operator shall submit to the Commissioner and [local soil and water conservation] district an agricultural stewardship plan which includes stewardship measures needed to prevent or cease the pollution." If the Commissioner finds that the pollution is "not a threat to human health, animal health, or aquatic life, water quality or recreational or other beneficial uses," or that it is a "direct result of unusual weather events or other exceptional circumstances that could no have been reasonably anticipated," the Commissioner "may forego" any action.[15] If the notice is sent requiring submittal of a agricultural stewardship plan, the soil and water conservation district must review the submitted plan and the Commissioner must approve it within 30 days if sufficient.[16] "Pollution means any alteration of the physical, chemical, or biological properties of any state waters, resulting from sedimentation, nutrients, or toxins." "Stewardship measures means measures for controlling the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution which reflect the pollutant reduction achievable through the application of the best available nonpoint pollution control methods, technologies, processes, siting criteria, operating methods or other alternatives" including use of BMPs.[17]

Failure to implement an approved agricultural stewardship plan subjects the owner or operator to a corrective action order, issued after hearing, which directs the recipient to complete implementation of the plan within a stated period of time, not to exceed 18 months from the date of the original notice.[18] A corrective action order may be enforced by injunction, by entry and abatement by the Commissioner with cost recovery if the court order is not complied with, and by assessment of a civil penalty of up to $5,000 per day.[19] An emergency corrective action order (with subsequent hearing) may be issued if runoff from an agricultural activity "is causing or is likely to cause an imminent or substantial danger to (I) the public health, safety or welfare or to the health of animals, fish or aquatic life, (ii) a public water supply, or (iii) recreational, commercial, industrial, agricultural, or other beneficial uses." An emergency order may direct cessation of all or part of the agricultural activity and require specific stewardship measures.[20] A corrective action order shall not be issued if the operator or land owner is actively implementing the approved agricultural stewardship plan, or actively implementing stewardship measures "that have failed to prevent pollution, if...the pollution is a direct result of unusual weather events or other exceptional circumstances which could not have been reasonably anticipated."[21] Decisions of the Commissioner are appealable first to the Virginia Soil and Water Conservation Board and then to the local circuit courts.[22] Local governments are authorized to adopt ordinances implementing the complaint-driven program set forth in the state law; but the local governments are not granted the power to impose sanctions for failure to implement a plan. They may only submit a complaint to the Commission to start the state process if there is no compliance with the local process.[23]

• In addition, "The Department [of Conservation and Recreation] shall operate a voluntary nutrient management training and certification program to certify the competence of persons preparing nutrient management plans for the purpose of assisting land owners and operators in the management of land application of fertilizers, municipal sewage sludge, animal manures, and other nutrient sources for agronomic benefits and for the protection of the Commonwealth's ground and surface waters."[24] While this is not an enforcement mechanism, the certification regulations provide for denial, suspension, or revocation of certifications.[25]

• For Chesapeake Bay areas, "Land upon which agricultural activities are being conducted, including but not limited to crop production, pasture, and dairy and feedlot operations, shall have a soil and water quality conservation plan."[26]

• Virginia certifies pesticide applicators; it also requires reporting of "significant pesticide accidents or incidents which constitute a threat to humans or the environment to appropriate environmental agencies."[27]

• Virginia law also addresses confined animal feeding operations, in a manner similar to the federal regulations.[28]

Development and Other Earth-Disturbing Activities

• Virginia's Erosion and Sediment Control Law regulates "land-disturbing activities" which include "clearing, grading, excavating, transporting, and filling of land."[29] Each conservation district, county, city, or town "shall adopt and administer an erosion and sediment control program..." to be approved by the Virginia Soil and Water Conservation Board.[30] "No person may engage in any land-disturbing activity until he has submitted to the district or locality an erosion and sediment control plan ... and the plan has been reviewed and approved by the authority."[31] State agency land-disturbing activities require annual submission of specifications and conservation plans.[32] "Agencies authorized under any other law to issue grading, building, or other permits for activities involving land-disturbing activities may not issue any such permit unless the applicant submits with his application an approved erosion and sediment control plan and certification that the plan will be followed."[33] The requirements do not apply to home gardening, underground public utility work, septic tank lines, mining, oil and gas exploration and drilling, agricultural operations, railway maintenance and operations, agricultural land drainage and irrigation, and shore erosion control projects. They also do not apply to activities under 10,000 square feet unless the local jurisdiction chooses to regulate them. [34] Under the regulations, the local plan approving authority "may waive or modify any of the chapters that are deemed inappropriate or too restrictive for site conditions, by granting a variance."[35] "If there is a failure to comply with the plan, notice shall be served upon the permittee or responsible person by certified mail....The notice shall specify the measures needed to comply with the plan and shall specify the time within which such measures shall be completed."[36] Localities may establish civil penalty schedules for violations of the erosion and sediment control program.[37] Upon receipt of a sworn complaint of violation, authority may order activity to cease until corrective measures have been taken. Upon failure to comply with a compliance order, "the permit may be revoked and the responsible person subject to penalties..[38] The authority or damaged party may make application to circuit court to enjoin a violation with prior notification in writing to the alleged violator and authority and as long as no corrective action has been undertaken within 15 days of notice.[39] Violators may be guilty of a Class I misdemeanor; civil penalties or civil charges in place of penalties may be assessed not to exceed $2,000.[40]

• Virginia also allows, but does not require, counties, cities, and towns to adopt further enforceable mechanisms. "Each locality may, by ordinance, to be effective on or after July 1, 1990, establish a local stormwater management program which shall include, but is not limited to" consistency with stormwater regulations of the Board of

Conservation and Recreation, provisions for longterm responsibility for devices and techniques to manage the quality and quantity of runoff, and provision for integration of programs with local erosion and sediment control programs.[41] The Board's regulations specify minimum technical criteria and administrative procedures, including "minimum design criteria for measures to control nonpoint source pollution."[42] "[A]fter the adoption of a local ordinance, a person shall not develop any land for residential, commercial, industrial, or institutional use in that locality until he has submitted a stormwater management plan to the locality...and has obtained approval of the plan from that locality."[43] This program does not apply to agricultural and forestry activities, single family construction, land development projects that disturb less than one acre (unless the locality chooses to apply the program to smaller areas), mining, and certain linear projects.[44] Violations are misdemeanors with a fine not to exceed $1,000 and/or 30 days imprisonment; injunctive relief is available, and civil penalties of up to $2,000.[45]

• "The protection of the public interest in the Chesapeake Bay, its tributaries, and other state waters ... require that: (I) the counties, cities, and towns of Tidewater Virginia incorporate general water quality protection measures into their comprehensive plans, zoning ordinances, and subdivision ordinances..." Localities in the region are required to establish Chesapeake Bay Preservation Areas -- identifying lands, which if improperly developed, "may result in substantial damage to the water quality of the Chesapeake Bay and its tributaries."[46] Local governments outside of Tidewater Virginia are allowed to adopt such provisions.[47] The regulations on land use standards are intended to prevent a net increase in nonpoint source pollution from new development, achieve a 10% reduction in nonpoint source pollution from redevelopment, and achieve a 40% reduction in nonpoint source pollution from agricultural and silvicultural uses.[48] Counties, cities, and towns in the region must incorporate water quality measures into their zoning and subdivision regulations.[49] The state regulations set out general performance criteria to establish performance standards to minimize erosion and sedimentary potential, reduce land application of nutrients and toxics and maximize rainwater infiltration for Chesapeake Bay areas.[50] The criteria become mandatory upon the local program adoption date.[51] Enforcement is under local police and zoning powers.[52]

• Virginia has enforceable programs regulating activities affecting tidal wetlands, water quality certification for activities affecting nontidal wetlands, and activities affecting submerged lands.[53]

Endnotes

1. Va. Code § 62.1-44.5.
2. Va. Code § 62.1-44.15(8b).
3. Va. Code §§ 62.1-44.23, 62.1-44.32.
4. Va. Code § 62.1-194.1.
5. Va. Code § 48.1.
6. Va. Code § 48.6.
7. Va. Code § 48.5.
8. Va. Code § 29.1-533.
9. Va. Code § 10.1-1181.2.

[10] Va. Code § 10.1-1181.2.
[11] Va. Code § 10.1-1181.2.
[12] Va. Code § 10.1-1181.3.
[13] Va. Code § 10.1-1181.6.
[14] Va. Code § 10.1-559.3.
[15] Va. Code § 10.1-559.3.
[16] Va. Code § 10.1-559.3.
[17] Va. Code § 10.1-559.1.
[18] Va. Code § 10.1-559.4.
[19] Va. Code §§ 10.1-559.5, 10.1-559.7.
[20] Va. Code § 10.1-559.4D.
[21] Va. Code § 10.1-559.4E.
[22] Va. Code § 10.1-559.6.
[23] Va. Code § 10.1-559.10.
[24] Va. Code § 10.1-104.2.
[25] 4 VAC § 5-15-110.
[26] 9 VAC 10-20-120(9).
[27] Va. Code §§ 3.1-249.51, 3.1-249.56.
[28] Va. Code § 62.1-44.17:1.
[29] Va. Code § 10.1-560.
[30] Va. Code § 10.1-562.
[31] Va. Code § 10.1-563.
[32] Va. Code § 10.1-564.
[33] Va. Code § 10.1-565.
[34] Va. Code § 10.1-560.
[35] 4 VAC 50-30-50.
[36] Va. Code § 10.1-566.
[37] Va. Code § 10.1-562.
[38] Va. Code § 10.1-566.
[39] Va. Code § 10.1-569.
[40] Va. Code § 10.1-569.
[41] Va. Code § 10.1-603.3.
[42] Va. Code § 10.1-603.4.
[43] Va. Code § 10.1-603.8.
[44] Va. Code § 10.1-603.8.
[45] Va. Code § 10.1-603.14.
[46] Va. Code § 10.1-2100; also see § 10.1-2109.
[47] Va. Code § 10.1-2110.
[48] 9 VAC 10-20-110.
[49] Va. Code § 10.1-2109.
[50] 9 VAC 10-20-120.
[51] 9 VAC 10-20-110.
[52] Va. Code § 10.1-2108.
[53] Va. Code § 28.3-1300, § 62-1-44.15, § 28.2-1200 et seq.

WASHINGTON

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Washington's water pollution control law includes provisions that may be used to take enforcement action against nonpoint source discharges that pollute the waters or that consist of unpermitted disposal of waste, except for forest practices conducted in compliance with the state forest practices law.

• Washington's water pollution control statute prohibits the discharge of "any organic or inorganic matter that shall cause or tend to cause" water pollution[1] and requires a permit for the disposal of solid or liquid waste material into waters of the state.[2] The statute does not authorize the adoption of a permit system for nonpoint source pollution from forest practices, nor the imposition of penalties for nonpoint source pollution arising for forest practices conducted in compliance with the state's forest practices law.[3] The Department of Ecology ("DOE") enforces the law by bringing an action, issuing orders or directives, or imposing penalties. The attorney general, upon the request of DOE, may also bring an action.[4] With respect to bringing an enforcement action for discharges arising from agricultural activity on agricultural land, prior to issuing a notice of violation, the statute directs DOE to consider whether such an action would contribute to conversion of agricultural land to nonagricultural uses and to attempt to minimize the possibility of such conversion.[5] Willful violations are crimes punishable by a fine of up to $10,000 and/or imprisonment for not more than one year. Civil violations incur penalties of up to $10,000 per day per violation.[6]

Other Discharge Limitations

• The state's Public Health and Safety Code ("Code") regulates discharges into public water supplies. Under the Code, it is a gross misdemeanor to deposit "any matter or thing which may or could pollute" into waters that are used for drinking purposes.[7] It is also a misdemeanor for any person to place or cause to be placed "within any watershed from which a city or municipal corporation of any adjoining state obtains it water supply, any substance which either by itself or in connection with other matter will corrupt, pollute or impair the quality of said water supply..." Violation of this provision is punishable by a fine of up to $500.[8]

• State law also protects public water supplies. It provides that a person who does "any of the things which have the effect of polluting any such sources of water supply, or water," and any person who conducts a business or occupation, or allows any condition upon or sufficiently near the water supply or sources for the water supply, or "the property through which the same may be conveyed or conducted so that such water would be polluted..." is guilty of nuisance and may be fined up to $500.[9] Non-tidewater cities with a population of 100,000 or more are prohibited from "discharging, draining or depositing...any...substance, offensive, injurious or dangerous to health" into waters used for "human or animal consumption or for domestic

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purposes." Violation of this provision is a public nuisance, and abatement may be sought by secretary of social and health services or by any person whose water supply is affected.[10] If a violator fails to abate pollution of a water supply, then the sheriff abates the nuisance and assesses the cost against the violator.[11] Cities and towns are authorized to prescribe what acts constitute offenses against the purity of the water supply and the resulting punishment and penalties and enforce them.[12]

• Nuisance law may apply to some instances of nonpoint source pollution. Nuisance is generally defined as unlawfully committing or omitting an act that "endangers the comfort, repose, health of safety of others...or [that] unlawfully interferes with, obstructs or tends to obstruct...any lake or navigable..." water.[13] Any person whose property is affected may bring an action in court and get an order to abate the nuisance.[14]

• It is a public nuisance to "throw...offensive matter" into any waterway" or in any way to corrupt or render unwholesome or impure the water...to the injury or prejudice of others."[15] Any public body or authorized officer may abate a public nuisance,[16] or a private person may bring a civil action or remove and/or destroy the nuisance, if it is "specially injurious."[17] Abatement does not preclude action for private damages.[18] Fines for public nuisances of up to $1000 may be imposed.[19]

• A public nuisance is a crime where an act or omission "unlawfully interfere[s] with, befoul[s]...a lake, navigable river, bay, stream, canal or basin..."[20] The court or magistrate shall order the nuisance abated, in addition to any other fine or punishment.[21] Under this statute, a person who commits or maintains a public nuisance is guilty of a misdemeanor,[22] and a person who deposits an "unwholesome substance" on or near a highway on land or water is guilty of a gross misdemeanor, including maintenance of a business that is "noisome or detrimental to the public health."[23]

• Also see *supra* regarding nuisance actions for pollution of public water supplies.

Agricultural activities and forest practices are not a nuisance if conducted in a manner consistent with good practices and established prior to surrounding nonagricultural and nonforestry activities, unless they have a "substantial adverse effect on the public health and safety."[24] Also, nothing done or maintained under the express authority of a statute is a nuisance.[25]

Fish/Fisheries Laws

• State law declares that any person who acts illegally or otherwise reduces water quality below state standards or causes significant degradation of water quality, "thereby damaging the same; and...causes the death of, or injury to fish, animals, vegetation, or other resources of the state" shall be liable for damages to the state and affected counties and cities.[26] Operations undertaken in compliance with a waste discharge permit are not actionable under this provision.[27] See supra for general enforcement provisions under the Water Pollution Control statute.

OPERATIONAL REQUIREMENTS

Forestry Requirements

• Washington law requires the forest practices board (the "board) to promulgate regulations that establish minimum forest practices standards.[28] Regulations determine which forest practices fall within which of four classes, ranging from Class I, requiring no notification, through Classes II-IV requiring notification on submission of an application for approval. In particular, Class IV forest practices that have "a potential for substantial impact on the environment and therefore require an evaluation," require an application.[29] If an approved application authorizes "a forest practice which, because of...proximity to a water course...has a potential for causing material damage to a public resource," then the Department of Natural Resources ("DNR") may require notification two days before actual operations begin.[30] Additionally, the board and DOE are required to promulgate forest practices regulations relating to water quality from the minimum forest practices standards regulations.[31] The DNR enforces this statute by issuing a stop work order for any violation and taking immediate action if the operator fails to obey such an order; or the DNR may issue a notice setting forth the nature of the violation or damage, the operator's right to a hearing and the specific course of action.[32] Specifically, with respect to a violation relating to water quality, where DNA fails to act, DOE notifies DNR and, failing DNR action, petitions the appeals board chair who must deny the petition or direct DNR to act.[33] The attorney general also may enforce the statute, and a country may bring actions in superior court against the DNR, landowner, timber owner, or operator.[34] Sanctions include civil penalties, collect costs, or disapproval, for up to one year, of a forest practices application.[35]

Agriculture Requirements

• New state legislation requires dairy farms to establish waste management plans and directs the DOE to inspect all dairy operations at least every two years. All dairy farms are required to develop dairy nutrient management plans by July 1, 2002 and obtain approval from the local conservation districts and be implemented by the farmers by December 31, 2003. The sanctions for noncompliance by dairy farmers are fines of $100 per month up to maximum of $5000 for failing to develop the management plan.[36]

• A license is required from the Department of Agriculture (DOA) to operate a certified feed lot.[37] Denial, suspension, or revocation of feed lot licenses may result where violations occur.[38] Violators are guilty of a misdemeanor, and subsequent offenses are a gross misdemeanor.[39]

• The state's Pesticide Application Act requires licenses for commercial pesticide application[40] (with some exceptions including forest owners applying pesticides on their own lands and farmers occasionally applying pesticide themselves),[41] private commercial pesticide application,[42] and private pesticide application.[43] A person damaged by pesticide application may sue agencies, municipal corporation and public utilities, or the DOA director may seek to enjoin a violation.[44] Sanctions include revocation or suspension of licenses, permits or certifications.[45] A maximum of $7500 in civil penalties are available for each violation.[46] First offense is a misdemeanor; subsequent offenses are gross misdemeanors (except an offense committed more than five years after a previous conviction is a first offense).[47]

• The state's Pesticide Control Act regulates labeling and registration requirements, including required registration of all pesticides that are distributed within the state or are transported in or through the state, with some minor exceptions,[48] and licensing of pesticide dealers and consultants.[49] The DOA director and/or the county prosecuting attorney may bring an action,[50] and relevant sanctions include refusal to register pesticide or suspension of registration[51] and denial, suspension, revocation of licenses.[52] Civil penalties ($7500 per violation) are authorized.[53]

Development and Other Earth-Disturbing Activities

Apart from any programs for the control of urban stormwater under the federal Clean Water Act, state law provides the following authorities.

• Comprehensive plans required of counties and cities under the state's Growth Management Act ("GMA") must provide for "drainage, flooding, and storm water run-off...and provide guidance for corrective actions to mitigate or cleanse those discharges that pollute waters of the state."[54] Entities covered under the GMA are to adopt development regulations that assure protection of designated "critical areas,"[55] which include wetlands, "areas with a critical recharging effort on aquifers used for portable water," and fish and wildlife habitat conservation areas.[56] Shore Management Act, see infra, rather than plans under the GMA.) A noncomplying entity shall have up to 180 days to comply.[57] The Governor may modify state appropriation allotments, withhold revenue-sharing or temporarily rescind tax collection authority for counties or cities that fail to comply with GMA provisions.[58]

• The Shoreline Management Act prohibits shoreline development unless consistent with statutory policy and the applicable guidelines, rules or master program and requires a permit for "substantial development."[59] Substantial development, with some exceptions, is development whose total cost exceeds $2500 or "materially interferes with the normal public use of the water or shorelines."[60] If DOE believes permittee is not in compliance with permit, it notifies local government and permittee and, then, may petition shoreline hearings board ("board') for rescission of permit.[61] Appeals regarding permitting decisions or DOE rules may be made to the board.[62] Attorney general or local government attorney may bring injunctive, declaratory or other relief, and civil penalties (up to $1000 per violation) are authorized.[63] A willful violation is a gross misdemeanor punishable by fines and/or imprisonment.[64]

Endnotes
[1] Wash. Rev. Code 90.48.080.
[2] Wash. Rev. Code 90.48.160
[3] Wash. Rev. Code 90.48.420.
[4] Wash. Rev. Code 90.48.037,90.48.120.
[5] Wash. Rev. Code 90.48.450.

[6] Wash. Rev. Code 90.48.140,90.48.144.
[7] Wash. Rev. Code 70.54.010.
[8] Wash. Rev. Code 70.54.030.
[9] Wash. Rev. Code 35.88.030, 35.88.040.
[10] Wash. Rev. Code 35.88.080.
[11] Wash. Rev. Code 35.88.050.
[12] Wash. Rev. Code 35.88.020.
[13] Wash. Rev. Code 7.48.120.
[14] Wash. Rev. Code 7.48.010.
[15] Wash. Rev. Code 7.48.140(2).
[16] Wash. Rev. Code 7.48.220.
[17] Wash. Rev. Code 7.48.210, 7.48.230.
[18] Wash. Rev. Code 7.48.160.
[19] Wash. Rev. Code 7.48.250.
[20] Wash. Rev. Code 9.66.010.
[21] Wash. Rev. Code 9.66.040.
[22] Wash. Rev. Code 9.66.030.
[23] Wash. Rev. Code 9.66.050.
[24] Wash. Rev. Code 7.48.305.
[25] Wash. Rev. Code 7.48.160.
[26] Wash. Rev. Code 90.48.142(1)(b).
[27] Wash. Rev. Code 90.48.142(2).
[28] Wash. Rev. Code 76.09.040.
[29] Wash. Rev. Code 76.09.050.
[30] Wash. Rev. Code 76.09.060(4)
[31] Wash. Rev. Code 76.09.040.
[32] Wash. Rev. Code 76.09.080, 76.09.090.
[33] Wash. Rev. Code 76.09.100.
[34] Wash. Rev. Code 76.09.140.
[35] Wash. Rev. Code 76.09.120-190.
[36] SB 6161.
[37] Wash. Rev. Code 16.58.040.
[38] Wash. Rev. Code 16.58.070.
[39] Wash. Rev. Code 16.58.170.
[40] Wash. Rev. Code 17.21.070, 17.21.110.
[41] Wash. Rev. Code 17.21.200.
[42] Wash. Rev. Code 17.21.122.
[43] Wash. Rev. Code 17.21.126.
[44] Wash. Rev. Code 17.21.220, 17.21.320.
[45] Wash. Rev. Code 17.21.130.
[46] Wash. Rev. Code 17.21.315.
[47] Wash. Rev. Code 17.21.310.
[48] Wash. Rev. Code 15.58.050.
[49] Wash. Rev. Code 15.58.180, 15.58.210.
[50] Wash. Rev. Code 15.58.280, 15.58.340.
[51] Wash. Rev. Code 15.58.110, 15.58.120.
[52] Wash. Rev. Code 15.58.260.
[53] Wash. Rev. Code 15.58.260.
[54] Wash. Rev. Code 36.70A.070.
[55] Wash. Rev. Code 36.70A.060.
[56] Wash. Rev. Code 36.70A.030(5).
[57] Wash. Rev. Code 36.70A.300(1).

[58] Wash. Rev. Code 36.70A.340, 36.70A.345.
[59] Wash. Rev. Code 90.58.140(2).
[60] Wash. Rev. Code 90.58.030(3)(e).
[61] Wash. Rev. Code 90.58.140(8).
[62] Wash. Rev. Code 90.58.180.
[63] Wash. Rev. Code 90.58.210.
[64] Wash. Rev. Code 90.58.220.

WEST VIRGINIA

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

West Virginia's water pollution control law appears not to provide for the regulation or prohibition of nonpoint source discharges.[1]

Other Discharge Limitations

• A separate law establishes criminal penalties for wastes (excluding commercial or industrial wastes regulated under the pollution control law) thrown or released "into any river, creek or stream, or upon the surface of any land adjacent to any river, creek or other stream in such a location that high water or normal drainage conditions will cause such offensive materials to be washed, drained, or cast into the river, creek or other stream". Violation is a misdemeanor subject to a fine of $100 to $1000.[2]

• Another provision establishes criminal penalties for "Any person who knowingly and willfully throws, causes to be thrown or releases any dead animal, carcass, or part thereof, garbage, sink or shower waste, organic substance, human or animal excrement, contents of a privy vault, septic tank, cesspool or the effluent from any cesspool or nauseous or offensive or poisonous substances into any well cistern, spring, brook, pond, stream, or other body of water which is used for domestic purposes".[3] The offense is a misdemeanor subject to a fine of $25 to $200. In addition, conviction creates a duty to remove and properly dispose of the materials as directed by the bureau of public health. Each day of failing to comply is a separate violation of the section.

• It is a misdemeanor "to place, deposit, dump, or throw, or cause to be placed, deposited, dumped or thrown, any litter ... garbage, refuse, trash, can, bottle, paper, ashes, carcass of any dead animal or part thereof, offal, or any other offensive or unsightly matter into any river, stream, creek, branch, brook, lake or pond, or upon the surface of any land within one hundred yards thereof, or in such location that high water or normal drainage conditions will cause any such materials to be washed into any river, stream, creek, branch, brook, lake or pond."[4] For a first offense, the sanction is a fine of $50 to $500 or alternatively, 8 to 16 hours community service cleaning up unlawfully deposited matter along stream or river banks. For a second offense, the sanction is a fine of $250 to $1000 plus a jail term of 24 hours to 6 months, with the court able to substitute 16 to 32 hours of clean-up for the fine or for the incarceration, but not for both. For third and subsequent offenses, the sanction is a fine of $500 to $2000 plus a jail term of 48 hours to one year, with the court able to substitute 32 to 64 hours of clean-up for the fine or for the incarceration, but not both.

• Nuisance remedies are expressly preserved for water pollution. West Virginia's statutory water pollution provisions do not "abridge or alter rights of action or remedies now or hereafter existing, nor shall any provisions of this article, or any act done by virtue of this article, be construed as estopping the state, municipalities, public health officers, or persons as riparian owners or otherwise, in the exercise of their rights to suppress nuisances or to abate any pollution now or hereafter existing, or to collect damages."[5]

Fish/Fisheries Laws

West Virginia does not appear to have enforceable provisions relevant to nonpoint source water pollution in its fisheries laws.

OPERATIONAL REQUIREMENTS

Forestry Requirements

• West Virginia provides enforceable authorities for nonpoint source water pollution resulting from commercial forestry practices. State law also requires a license for commercial timber harvest and purchase of timber or logs for resale, and certification of supervisors of logging sources.[6] "Upon notification of the chief [of the office of water resources of the division of environmental protection] or upon a finding by the director [of the division of forestry of the department of commerce, labor and environmental resources] that failure to use a particular best management practice is causing or contributing, or has the potential to cause or contribute, to soil erosion or water pollution, the director shall issue a written compliance order".[7] The director may issue written compliance orders; issue immediate suspension of work orders (if circumstances endanger life or threaten or result in uncorrectable soil erosion or water pollution); suspend licenses or certificates for 30 to 90 days for the second violation within two years of this article or the water pollution act; or revoke licenses or certificates for third violations within two years.[8] The director may seek civil penalties of up to $2,500 for the first offense and $5,000 for subsequent offenses.

Agriculture Requirements

• Local soil conservation districts, through referenda, may adopt land use regulations "in the interest of conserving soil and soil resources and controlling soil erosion." The regulations may include provisions for construction of soil-protective structures, provisions requiring particular methods of cultivation, specifications of cropping and tillage practices, provisions limiting cultivation of sensitive areas, and other measures.[9] The supervisors of the soil conservation district have authority to seek enforcement of the regulations in court if "nonobservance tends to increase erosion ... and is interfering with the prevention or control of erosion on other lands within the district".[10] Watershed improvement districts, organized within soil conservation districts, can also exercise these powers of a soil conservation district.[11]

• The commissioner of agriculture can develop mandatory BMPs for application and use of fertilizers and manures upon having evidence of groundwater pollution that could be effectively prevented with BMPs.[12]

• The state has authority for general groundwater protection rules for pesticides, including rules intended to prevent non-point pollution.[13] The only two stated rules are (1) to follow the label or special orders by the commissioner of agriculture to protect groundwater, and (2) to comply with the rules for certified applicators and pesticide businesses when applying restricted use pesticides. "Other non-point source management practices, voluntary and/or mandatory are reserved."[14] The commissioner may issue remediation orders, or may seek civil penalties.[15]

Development and Other Earth-Disturbing Activities

West Virginia does not appear to have specific provisions apart from any that may be contained in urban stormwater programs under the Clean Water Act, or that may be authorized by general land use provisions that provide for municipalities and counties to plan, zone, and regulate.[16] State law governing land use regulation notes that local land use plans may include measures for "sewers, sanitation and drainage", "stream pollution", and "conservation of water, soil, agricultural and mineral resources."[17] The law gives municipal and county governments authority to regulate land use and structures to carry out zoning objectives.[18] Enforcement is by civil injunction, or misdemeanor prosecutions with penalties of $10 to $300.[19]

Endnotes

1. W. Va. Code §22-11-8.
2. W. Va. Code §16-9-3.
3. W. Va. Code §16-9-2.
4. W. Va. Code § 20-7-28.
5. W. Va. Code § 22-11-27.
6. W. Va. Code § 19-1B-4; § 19-1B-7.
7. W. Va. Code § 19-1B-5(b).
8. W. Va. Code § 19-1B-5(b)-(e).
9. W. Va. Code § 19-21A-9.
10. W. Va. Code § 19-21A-10.
11. W. Va. Code ch. 19, art. 21B.
12. 61 CSR 6C-4.3. See also 61 CSR 6C-4.4, which appears to require some level of mandatory BMP promulgation if valid data show increases in groundwater contamination from fertilizers or manures in the state.
13. 61 CSR 12G-7.
14. 61 CSR 12G-7.3.
15. 61 CSR 12G-5.1.14 & -8; 61 CSR 12G-9.1.
16. W. Va. Code § 8-24-1.
17. WVC §8-24-17(b)(7),(8),(17).
18. W. Va. Code § 8-24-39.
19. W. Va. Code § 8-24-67.

WISCONSIN

Enforceable Provisions Applicable to Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Wisconsin's water pollution law does not contain a general discharge prohibition. However, the state may issue enforceable orders for the abatement of "significant" nonpoint source pollution, and for critical sites within priority watersheds.

Wisconsin law authorizes the department of natural resources (DNR) to issue general orders and adopt rules applicable throughout the state for "preventing and abating pollution of the waters of the state."[1] Pollution is defined as "contaminating or rendering unclean or impure the waters of the state, or making the same injurious to public health, harmful for commercial or recreational use, or deleterious to fish, bird, animal or plant life."[2]

• The law specifically authorizes the department to issue orders for the abatement of nonpoint source pollution which the department has determined to be "significant" on a case-by-case basis.[3] However, the department may not order abatement or best management practices with respect to pollution caused primarily by animal waste.[4] Investigations involving animal waste are handled under regulations described below under "Agricultural Requirements." Nor may the DNR order abatement of nonpoint source pollution from agricultural sources located in a priority watershed or priority lake area, unless the source has been designated as a "critical site" in the priority watershed plan.[5] The priority watershed program provides state funding for watershed staff and cost-sharing for necessary best management practices to control nonpoint sources of pollution within the watershed.[6]

One year's notice must be provided in orders for abatement or implementation of best management practices, unless the department determines that the pollution will cause severe water quality degradation that could be mitigated by action taken sooner.[7] The department may issue temporary emergency orders to abate nonpoint source pollution if certain statutory conditions are met.[8] Violators of agency orders are subject to administrative penalties of up to $5,000 per day. The state may recover the costs of investigation, as well as attorney's fees.[9] In addition, the department may take the action directed by its order and collect the costs incurred from the owner to whom the order was directed.[10]

• Where agricultural sources are involved, the department must first notify the county land conservation committee (LCC).[11] The department must also notify the state department of agriculture, trade and consumer protection (DATCP), which in turn issues a list of BMPs and financial and technical assistance sources to the person polluting and then submits a report to the department of natural resources within a year describing the actions taken and recommending whether to issue an order to abate pollution or implement best management practices. The DNR may not issue an order until it receives this report, unless it makes a determination of severe water quality degradation, concurred in by the DATCP.[12]

In addition, if the notice of intent is for a critical site in a priority watershed, the LCC may disapprove issuance of an order by acting within 60 days after the notice of intent was issued.[13] The DNR may appeal the disapproval to the state's Land and Conservation Board; the landowner may likewise appeal a proposed order that was not disapproved by the LCC.[14]

• In 1997, the legislature enacted a law requiring the DNR to prescribe performance standards for sources of nonpoint source pollution. For non-agricultural sources, the DNR must develop technical standards to implement the performance standards in order to "achieve water quality standards by limiting nonpoint source water pollution.[15] Provisions relating to agricultural sources are discussed below under "Agricultural Requirements."

Other Discharge Limitations

• The state's environmental health code gives local health officers the authority to order the abatement or removal of "human health hazards."[16] The state's water law, in addition to providing the order authorities described above, gives the department of natural resources authority to "order or cause the abatement of any nuisance affecting the waters of the state."[17] This includes nonpoint sources. However, Wisconsin's nuisance statute provides a general exception to nuisance cases involving agricultural sources. To qualify for the exemption, the agricultural use must be on land that was already used for agricultural purposes, use generally acceptable operating practices, and must not present a substantial threat to public health and safety. Relief granted must not substantially restrict or regulate agricultural uses or practices, unless the agricultural use or practice is a substantial threat to public health and safety.[18]

• Wisconsin's groundwater protection law establishes a framework for addressing activities that cause pollution of groundwater. The department of natural resources assigns groundwater enforcement standards, as well as "preventive action limits" -- more stringent restrictions on the permissible concentration levels of substances in groundwater.[19] A preventive action limit is not an absolute standard, but "shall serve as a means to inform regulatory agencies of potential groundwater contamination problems, to establish the level of groundwater contamination at which regulatory agencies are required to commence efforts to control the contamination and to provide a basis for design and management practice criteria in administrative rules."[20]

Each state agency is required to promulgate design and management criteria for facilities, activities and practices that are regulated by the agency and that affect groundwater.[21] This enforcement is linked to other statutory schemes. The department of natural resources "may not approve a proposed facility, practice or activity at a location where a preventive action limit or enforcement standard...has been attained or exceeded unless an exemption has been granted...."[22] For existing facilities, practices or activities, a response is required if a preventive action limit or an enforcement standard has been attained or exceeded.[23]

State regulations outline a variety of responses to be taken by agencies where a preventive action limit or enforcement standard is attained or exceeded. In cases involving enforcement standards, these response include requiring the following: monitoring; investigation; revision of operational procedures; change in design or construction; alternate methods of waste treatment or disposal; prohibition or closure and abandonment; remedial action to renovate or restore groundwater quality or to minimize further releases of the substance to groundwater; and revision of rules or criteria on facility design, location or management practices.[24] With limited exceptions, the regulations require the department to prohibit the activity or practice and require remedial actions unless the department can demonstrate that other responses will achieve compliance with enforcement standards.[25]

The law provides that regulatory agencies "shall enforce the provisions of this chapter in accordance with enforcement procedures and subject to the penalties established by statute for activities and practices regulated by the regulatory agency."[26]

Fish/Fisheries Laws

- Fisheries laws include the provision that no person shall "throw or deposit, or permit to be thrown or deposited, into any waters within the jurisdiction of the state any lime, oil, tar, garbage, refuse, debris, tanbark, ship ballast, stone, sand...slabs, decayed wood, sawdust, sawmill refuse, planing mill shavings or waste material of any kind, or any acids or chemicals or waste or refuse arising from the manufacture of any article of commerce, or any other substance deleterious to game or fish life."[27] (Exceptions are provided for approved operations involving sewage drainage and industrial waste, as well as certain highway work carried out under the direction of the department of transportation.)[28] This provision is enforced through forfeiture of not more than $200 per day, imprisonment of up to 90 days (for intentional violations), and natural resources damages.[29]

- Wisconsin's fish and game law also provides generally that no person "may take, capture or kill fish...in any waters of this state by means of...poisonous or stupefying substances or devices."[30] The wording may allow prosecution for fish kills even without a showing of intent to take fish. Enforcement is through fines of up to $500 and/or imprisonment up to 90 days.[31]

OPERATIONAL REQUIREMENTS

Forestry Requirements

- Wisconsin has a tax incentive program, which involves submitting a management plan.[32] While participation in the program is voluntary, there are penalties for violating the provisions of the program. For example, failure to file a notice of intent to cut, as required in the law, can result in a forfeiture not to exceed $1,000. In addition, any owner who intentionally cuts merchantable timber in violation of the law is subject to forfeiture equal to 20 percent of the current value of the merchantable timber cut.[33]

• "All slash, which during the process of cutting timber or taking out other forest products, falls into or is deposited in any lake or stream or on the land of an adjoining owner, shall be immediately removed therefrom by the timber owner or cutting operator...when in the opinion of the department such removal is in the public interest."[34] Violators are subject to a forfeiture of not more than $50, however repeat offenders are subject to higher fines and imprisonment.[35]

Agriculture Requirements

• As noted above, Wisconsin's water pollution law specifically authorizes the DNR to order abatement or best management practices with respect to nonpoint source agricultural pollution.[36] Certain limitations apply in priority watersheds.[37]

• The state soil and water conservation law authorizes the enactment of local ordinances for the control of nonpoint source pollution. County land conservation committees are authorized to "develop and adopt standards and specifications for management practices to control erosion, sedimentation and nonpoint source water pollution."[38] LCC's "may carry out preventive and control measures and works of improvement for flood prevention and for conservation, development, utilization and control of water within the county."[39]

In addition, county and municipal governments are authorized to enact ordinances to address nonpoint source pollution. Such ordinances are effective only if approved by referendum. "To promote soil and water conservation or nonpoint source water pollution abatement, a county, city, village or town may enact ordinances for the regulation of land use, land management and pollutant management practices....An ordinance enacted under this section may prohibit land uses and land management practices which cause excessive soil erosion, sedimentation, nonpoint source water pollution or storm water runoff."[40] The county board must adopt an ordinance setting forth administrative enforcement procedures and provide personnel for enforcement of ordinances enacted under the law.[41]

Enforcement is through civil forfeiture or injunction in an action initiated by the county or LCC. The court may award reasonable attorney fees to any plaintiff in a successful action for enforcement through injunction.[42] Notice to landowners or users is required, along with a list of BMPs and available financial assistance "at least one year before" the county or LCC may initiate an action for enforcement.[43]

The DATCP is also responsible for setting and implementing statewide soil and water conservation policies and administering the state's soil and water conservation programs. The department "shall coordinate" its soil and water conservation program with the state's nonpoint source water pollution abatement financial assistance program.[44]

• Wisconsin regulations contain permitting requirements for large animal feeding operations involving at least 1,000 animal units, requiring a WPDES permit. The regulations establish other requirements for smaller operations, where the state has determined through on-site investigation that the operation is responsible for a discharge of *significant* amounts of pollutants to waters of the state.[45] The DNR issues a notice of discharge allowing a specific time for a remedy. The regulations provide that the owner or operator must control the discharge by implementing necessary corrective measures in compliance with the regulations. [46] "Accepted animal waste management practices shall be used...in implementing the necessary corrective measures relative to runoff control, storage or disposal of animal wastes."[47] If an operation *fails to implement* necessary corrective measures, it must obtain a WPDES permit.[48] In addition, owners or operators of animal feeding operations subject to the regulations must design and install permanent runoff control structures, according to specified performances standards.[49] This standard can be modified by the department when the owner or operator demonstrates that such standards are more stringent than necessary to avoid detrimental effect on water quality.[50] Permitted facilities must provide manure storage and a landspreading plan.

• In 1997, the legislature enacted a law directing the DNR, in consultation with the DATCP, to promulgate rules setting performance standards and prohibitions for *agricultural* nonpoint sources, including performance standards and prohibitions for livestock operations.[51] The legislature also authorized local governmental units to regulate livestock operations consistent with state performance standards.[52] Such regulations may not apply to existing operations unless cost-sharing is available.[53]

• Wisconsin's pesticides law authorizes rule making to govern the use of pesticides, including their formulations, and to determine the times and methods of application and other conditions of use.[54] State regulations prohibit any person from using or directing the use of pesticides in a "negligent manner" or "in an manner that results in pesticide overspray or significant pesticide drift."[55] With limited exceptions, the regulations prohibit any person from causing a pesticide to enter waters of the state directly or through sewer systems, and from using a pesticide in a manner which the user knows or should know will result in contamination of state waters.[56] The regulations further require that chemigation systems be designed and operated to prevent pesticides used in the system from contaminating waters of the state.[57]

Enforcement of the state pesticide law is through forfeiture of between $100 and $500, with higher penalties for repeat violators. Commercial applicators, dealers or distributors who knowingly violates the misbranding and licensing provisions of the law are subject to a fine of $5, 000 and/or imprisonment for one year. The state may also apply to a circuit court for a temporary or permanent injunction to prevent, restrain or enjoin violations.[58] "In addition to other enforcement procedures, the department may issue a special order...prohibiting the use, application, storage, distribution or sale of pesticides...to prevent or control pesticide contamination of groundwater...."[59]

Development and Other Earth-Disturbing Activities

• Wisconsin's navigable waters protection law gives the department of natural resources a central role in the adoption of local shoreland zoning ordinances that relate to lands under, abutting or lying close to navigable waters. The purposes of such ordinances are to "further the maintenance of safe and healthful conditions; prevent and control water pollution; protect spawning grounds, fish and aquatic life; control building sites, placement of structure and land uses...."[60] The department is responsible for providing general recommended standards and criteria for navigable water protection regulations and their administration, and for authorizing such regulations.

Counties are required to adopt zoning and subdivision regulations for the protection of all shorelands in unincorporated areas.[61] State regulations require that these county shoreland ordinances include, at a minimum, zoning regulations for shoreland-wetland zoning districts.[62] The ordinances must "provide sufficient control of the use of shorelands to afford the protection of water quality...."[63] The regulations further specify certain minimum components, including building setbacks that "conform to health, safety and welfare requirements, preserve natural beauty, reduce flood hazards and avoid water pollution."[64] The regulations also require limits on alterations to existing nonconforming structures.[65] Exemptions from local shoreland zoning ordinances are provided for state highway and bridge work and for farm drainage ditches in certain circumstances.[66] Where a county has not adopted an ordinance that meets the "reasonable minimum standards," the department is to adopt an ordinance to be administered by the county.[67]

State law also explicitly requires municipalities (cities and villages) to adopt ordinances to regulate zoning of wetlands in shorelands.[68] State regulations establish minimum standards for the municipal ordinances. The regulations establish permitted and prohibited uses and address non-conforming structures and uses. If a municipality fails to establish an ordinance that meets "reasonable minimum standards," the department of natural resources is to adopt an ordinance for the municipality.[69]

Enforcement mechanisms are specified in the local ordinance. However, state law provides generally that county ordinances "shall be enforced by appropriate fines and penalties" and may be enforced as well by injunction in a suit by the local government or local affected property owners.[70] State law also provides that violations of city zoning ordinances are punishable by fine and by imprisonment for failure to pay such fine, and that violations are subject to suit by local government or affected property owners to prevent or correct the unlawful practice.[71] In addition, the department of natural resources may initiate enforcement through fines (not more than $50 per day) and injunctions if it determines that the city or village fails to keep its ordinance "current, effective and enforceable. [72]

- Wisconsin law also authorizes municipal construction site erosion control ordinances "for the efficient use, conservation, development and protection of this state's groundwater [and] surface water..." as well as for the prevention and control of water pollution, and the control of building sites and placement of structures and land uses.[73] State regulations require counties, cities, villages, and towns receiving financial assistance under the state's nonpoint source water pollution plan to adopt a construction site control ordinance if it is required in the watershed plan under the state program. Such ordinances also must require consistency with the Wisconsin Construction Site Best Management Practice Handbook.[74] The local ordinances are enforceable as explained above. A county board may authorize the local land conservation committee to administer and enforce the provisions of certain county zoning or construction site erosion control ordinances.[75]

Endnotes

1. Wisconsin Statutes 281.19(1).
2. WS 281.01.
3. WS 281.20(1)(a).
4. WS 281.20(1)(a),(b).
5. WS 281.20(1)(a),(b).
6. WS 281.65.
7. WS 281.20(3)(a).
8. WS 281.20(3)(d).
9. WS 281.98(1),(2).
10. WS 281.19(7).
11. WS 281.20(3)(b).
12. WS 281.20(3)(a), 281.20(3)(c)2.
13. WS 281.20(3)(b).
14. WS 281.20(5)(a).
15. WS 281.16(2).
16. WS 254.59.
17. WS 281.19(4).
18. WS 823.08.
19. WS 160.07, 160.09, 160.13., 160.15.
20. WS 160.001(8).
21. WS 160.19(2)(a).
22. Wisconsin Administrative Code, Natural Resources 140.28(1).
23. *Id.*
24. WAC NR 140.24(4).
25. WAC NR 140.26(2)(b).
26. WS 160.26.
27. WS 29.29(3)(b).
28. WS 29.29(3)(b).
29. WS 29.29(3)(c).
30. WS 29.29(1).
31. WS 29.29(1).
32. WS 77.82.
33. WS 77.86(5)(a).
34. WS 26.12(7).
35. WS 26.98, 26.985.
36. WS 281.20(1)(a).
37. WS 281.20(1)(b).
38. WS 92.07(2).
39. WS 92.07(6).
40. WS 92.11.
41. WS 92.11(5).
42. *Id.*
43. WS 92.11(5)(b).
44. WS 92.05.
45. WAC NR 243.21.
46. WAC NR 243.23(2).
47. WAC NR 243.26.
48. WS 243.24.
49. WAC NR 243.25.
50. WAC NR 243.05.
51. WS 281.16(3), (4).

[52] WS 92.15, 281.16.
[53] WS 281.16(3)(e), (4), 92.15(4).
[54] WS 94.69(9).
[55] WAC Agriculture, Trade and Consumer Protection 29.50(1)(2).
[56] WAC ATCP 29.51(4).
[57] WAC ATCP 29.54(2)(c).
[58] WS 94.71(1),(3).
[59] WS 94.71(3)(c).
[60] WS 281.31.
[61] WS 59.971.
[62] WAC NR 115.05(1).
[63] WAC NR 115.05(3).
[64] WAC NR 115.05(3).
[65] WAC NR 115.05(e).
[66] WAC NR 115.02, 115.03(5).
[67] WAC NR 115.01(1).
[68] WS 62.231, 61.351.
[69] WS 62.231(6).
[70] WS 59.97(11).
[71] WS 62.23(7)(f).
[72] WS 87.30(2); WAC NR 117.06(3).
[73] WS 281.33. See also WS 59.69 and 59.693, which specifically authorize county zoning ordinances for construction site erosion control at sites where the activities do not include construction of a building.
[74] WAC NR 120.16.
[75] WS 92.07(15).

WYOMING

Enforceable Mechanisms for the Control of Nonpoint Source Water Pollution

DISCHARGE PROHIBITIONS

Water Pollution Control Law

Wyoming's water pollution control law contains a general provision that may be used to enforce against nonpoint source discharges of pollution or waste. In addition, the permitting authority apparently can extend to nonpoint sources, and where permits are required, the state's antidegradation policy requires that permits be conditioned on implementation of best management practices to control nonpoint sources.

• The Wyoming Environmental Quality Act contains a general prohibition against "caus[ing], threaten[ing] or allow[ing] the discharge of any pollution or waste into the waters of the state" or "alter[ing] the physical, chemical, radiological, biological or bacteriological properties of any waters of the state" unless authorized by permit.[1] "Waste" is defined as "sewage, industrial waste and all other liquid, gaseous, solid, radioactive, or other substances which may pollute any waters of the state."[2] The prohibition has been held to apply to all polluting activities, not only those for which a permit could have been obtained.[3]

• The Act authorizes the Wyoming Department of Environmental Quality to issue environmental permits "when the department has, by rule or regulation, required a permit," and allows the department to "impose such conditions as may be necessary to accomplish the purpose of this act."[4] Since the permitting authority is not expressly limited to point sources, it arguably could be applied to nonpoint sources. Further, the water quality section of the Wyoming Administrative Code contains an antidegradation provision, which requires that "reasonable best management practices for nonpoint sources" be implemented before a permit can be issued.[5] In this context, "best management practices" are defined as practices "determined to be the most technologically and economically feasible means of preventing or reducing nonpoint source pollution."[6] The statute allows for variances from environmental permits after a notice-and-comment procedure;[7] however, the DEQ apparently has prohibited issuance of water pollution variances under this section, and this decision has been judicially upheld.[8]

The DEQ may investigate, hold administrative hearings, and issue cease-and-desist orders for violation*s of the environmental code.[9] It may assess administrative civil penalties of up to $10,000 per violation per day; criminal penalties of up to $25,000 per violation per day and/or imprisonment of up to one year; seek temporary and permanent injunctive relief; and receive reparations for violations that "cause the death of fish, aquatic life or game or bird life."[10]

Other Discharge Limitations

The Public Health and Safety Code provides two definitions of criminal nuisance that are relevant to nonpoint source pollution.

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• The first nuisance provision is a prohibition on placing dead animal matter or other waste, including "any refuse or garbage, or any offensive matter or substance whatever" into water bodies or in any place "so located that the said substance shall directly or indirectly cause or threaten to cause the pollution or impairment of the purity and usefulness" of water bodies.[11] This provision expressly exempts municipal garbage disposal systems and sewage systems, but has been held to apply to cattle lots, poultry businesses, and meat processing plants depending on the circumstances of the case.[12] It is apparently enforced by both law enforcement and health authorities, and violations are misdemeanors, punishable by a fine of $50-$200 and/or imprisonment of up to six months.[13]

• The second nuisance provision declares it a nuisance to "in anywise pollute or obstruct any watercourse, lake, pond, marsh or common sewer, or continue such obstruction or pollution, so as to render the same unwholesome or offensive."[14] This provision, enforced by local law enforcement officials, carries a maximum $100 fine per violation; these officials also may seek to abate the nuisance.[15]

Note that under the Wyoming Right to Farm and Ranch Act, farm or ranch operations cannot be held to be a public or private nuisance if they "conform to generally accepted agricultural management practices" and existed prior to a change in land use on the adjacent land.[16] Likewise, proof of compliance with feedlot regulations (discussed below) is an absolute defense against any nuisance action brought by a person whose property ownership is subsequent in time to the date of establishment of the feedlot, if those feedlot activities are also subject to local or DEQ regulation.[17]

Fish/Fisheries Laws

• The Public Health and Safety Code contains a general provision that prohibits manufacturing and industrial works from "throw[ing] or deposit[ing] in, or in any way permit[ting] to pass into any natural stream or lake ... wherein are living fish, any sawdust, chemicals, mill-tailing, or other refuse matter of deleterious substance or poisons ...that will or may tend to the destruction or driving away from such waters any fish...or that will or may tend to pollute, contaminate, render impure for domestic, irrigation, stock or other purposes."[18]

• Similarly, the Fish and Game Code states that "[n]o person shall allow any refuse or substance to pass into any public water: (i) [w]hich drives away or is injurious to fish, or wildlife; or (ii) [w]hich obstructs the natural flow, channels, or condition of any stream or body of water."[19]

Both of these provisions are enforced by the Health Department and the Department of Fish and Game; violation of either of them is a misdemeanor, punishable by fines of $50-$100 and imprisonment of 30 days to six months.[20] Neither of the provisions applies to slag from smelters, or to operations that construct settling ponds.[21]

OPERATIONAL REQUIREMENTS

Forestry Requirements

State forestry laws do not appear to contain enforceable provisions relating to nonpoint source discharges.

Agriculture Requirements

Wyoming law regulates feedlot operations and pesticide management practices that might contribute to nonpoint source water pollution. In addition, soil conservation districts are authorized to prescribe best management practices to combat erosion, and may provide financial incentives for landowners to adopt these BMPs.

• In a chapter titled "Livestock Feedlot Operations," the Wyoming Statutes authorize the Department of Environmental Quality to issue regulations governing livestock feedlots and to establish schedules for compliance with the rules.[22] Operations that are in compliance with the regulations have an absolute defense against a nuisance action brought by a person whose property ownership is subsequent in time to the date of establishment of the feedlot, if the feedlot activities are subject to other local or DEQ regulation.[23] Feedlot operators are also required to comply with applicable local zoning requirements.[24] Until recently, there appears to have been little, if any, regulatory activity under this chapter of the Statutes.

In February 1997, the legislature amended the Environmental Quality Act to require DEQ to promulgate "standards for housed facilities where swine are confined, fed and maintained for a total of forty-five (45) consecutive days or more in any twelve (12) month period and the feedlot or facility is designed to confine an equivalent of one thousand (1,000) or more animal units."[25] The new standards must include financial assurance for facility cleanup and closure; waste management plans; setback requirements that facilities be sited at least one mile from homes, schools and towns and 1/4 mile from domestic water wells and streams; and notice-and-comment provisions for any new permits.[26] If any county adopts a land use plan or zoning law with stricter setback standards, those will prevail over the statute.[27]

• Wyoming also has enacted a general pesticide control regime, which largely consists of registration and labeling requirements and requires that pesticides be applied in accordance with the labeling.[28] It includes a general prohibition against discarding, transporting or storing pesticides or containers "in such a manner as to cause injury to humans, vegetation, crops, livestock, wildlife, beneficial insects or to pollute any waterway in a way harmful to any wildlife therein."[29] The board of certification may promulgate rules governing discarding and storage of pesticides and pesticide containers, and is authorized to enter and inspect premises for enforcement of the pesticide law.[30] Violations of the law are misdemeanors, subject to a fine of up to $500 and/or imprisonment of up to one year for the first offense, and $1,000 and/or imprisonment of up to one year for subsequent offenses; actions for injunctive relief are also possible.[31]

• Finally, the Wyoming Statutes establish soil conservation districts and authorize them to conduct research, demonstration projects, improvement projects, and so on.[32] The districts may develop and publicize comprehensive plans that specify best management practices for soil conservation, but these do not appear to be enforceable.[33] However, the district's provision of loans, grants, and other benefits to private landowners may be conditioned on implementation of best management practices.[34]

Development and Other Earth-Disturbing Activities

• Under the Land Use Planning Act,[35] the state land use commission is authorized to develop a state land use plan, which may include "areas of critical or more than local concern."[36] These are defined as "areas...where uncontrolled or incompatible large scale development could result in damage to the environment, life, or property, where the short or long term public interest is of more than local significance," and can include, inter alia, "fragile or historic lands, natural hazard lands, renewable resource lands."[37] However, enforceability of the Act is doubtful unless local regulations are enacted; the statewide plan apparently is intended to serve as a "guideline" for the development and adoption of local land use plans and zoning regulations. Even in "areas of critical or more than local concern," the state land use commission is authorized only to "establish developmental guidelines" and to "assist local governments" in planning for these areas.[38]

Endnotes

1. Wyo. Stat. § 35-11-301.
2. Wyo. Stat. § 35-11-103(c)(ii).
3. See *People v. Platte Pipe Line Co.*, 649 P.2d 208, 211 (Wyo. 1982).
4. Wyo. Stat. § 35-11-801.
5. Wyo. Admin.Code 020-080-001, § 8.
6. Wyo. Admin. Code 020-080-001, § 2.
7. Wyo. Stat. § 35-11-601.
8. See *U.S. Steel Corp. v. Wyoming Env. Quality Council*, 575 P.2d 749 (Wyo. 1978).
9. Wyo. Stat. § 35-11-701. Citizen suits are authorized by Wyo. Stat. § 35-11-904.
10. Wyo. Stat. §§ 35-11-901, -903.
11. Wyo. Stat. § 35-10-101.
12. Wyo. Stat. § 35-10-101; *Wartensleben v. Willey*, 415 P.2d 613 (Wyo. 1966).
13. Wyo. Stat. § 35-10-102.
14. Wyo. Stat. § 35-10-401.
15. Wyo. Stat. § 35-10-401.
16. Wyo. Stat. § 11-44-103.
17. Wyo. Stat. § 11-39-102.
18. Wyo. Stat. § 35-4-202.
19. Wyo. Stat. § 23-3-204.
20. Wyo. Stat. § 35-4-202; Wyo. Stat. § 23-3-204(c).
21. Wyo. Stat. § 35-4-202.
22. Wyo. Stat. § 11-39-103.
23. Wyo. Stat. § 11-39-102.
24. Wyo. Stat. § 11-39-104.
25. Wyo. Stat. § 35-11-302(a)(ix).
26. Wyo. Stat. § 35-11-302(a)(ix)(A)-(D).
27. Wyo. Stat. § 35-11-302(a)(ix).

[28] Wyo. Stat. § 35-7-350 et seq.
[29] Wyo. Stat. § 35-7-364.
[30] Wyo. Stat. §§ 35-7-364, -367.
[31] Wyo. Stat. § 35-7-366.
[32] Wyo. Stat. § 11-16-101 et seq.
[33] Wyo. Stat. § 11-16-122(b)(xvi)-(xvii).
[34] Wyo. Stat. § 11-16-122(xxvii).
[35] Wyo. Stat. § 9-8-101 et seq.
[36] Wyo. Stat. § 9-8-102(a)(I).
[37] Wyo. Stat. § 9-8-101 et seq.
[38] Wyo. Stat. § 9-8-202(a)(ix)-(x).

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URBAN RUNOFF QUALITY MANAGEMENT

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WEF Manual of Practice No. 23
ASCE Manual and Report on Engineering Practice No. 87

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Urban Runoff Quality Management

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Prepared by a Joint Task Force of the **Water Environment Federation** and the **American Society of Civil Engineers**

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Preface

The quality of urban stormwater was largely ignored in the design of urban drainage systems until approximately 1980. Previously, the focus was on efficient surface drainage and flood control, namely the effects of relatively large storm events. However, a number of engineers and scientists were becoming aware that runoff from the smaller, frequently occurring storm events was the cause of many observed negative effects in the nation's streams, lakes, estuaries, wetlands, and other receiving water systems downstream of, and within, the urban and urbanizing areas. Stream banks experienced accelerated erosion, stream habitat was degraded or lost, lakes and estuaries eutrophied at a faster rate, and the water quality in the receiving waters showed noticeable degradation during and sometimes after wet weather events.

Although many of the observed negative effects could also be attributed to causes other than stormwater runoff from urban areas (for example, nutrient- and sediment-laden runoff from agricultural areas, runoff from industrial areas, and unpermitted point sources), a general concern about the effects of uncontrolled urban growth on the nation's waterways began to take hold. In 1982, Florida became the first state to pass a law requiring that the urban runoff from the first inch of rainfall be treated to remove pollutants. Maryland and Delaware followed suit shortly thereafter. In 1988, the U.S. Environmental Protection Agency (U.S. EPA) promulgated its first draft regulations for the nationwide control of urban runoff quality and, in 1990, published final regulations governing municipalities with populations of more than 100 000 people.

Guidance for designing controls for urban runoff quality management has been published in the literature by many individuals; however, most of these publications are oriented toward a specific geographic region of the country, and guidance for application in other areas is not addressed. Also, many of these publications discuss the design of individual controls but not the subject of planning for urban runoff quality management on a watershed-wide basis.

This manual comprises a holistic view of urban runoff quality management. For the beginner, who has little previous exposure to urban runoff quality management, the manual covers the entire subject area from sources and effects of pollutants in urban runoff through the development of management plans and the design of controls. For the municipal stormwater management agency, guidance is given for developing a water quality management plan that takes into account receiving water use objectives, local climatology, regulation, financing and cost, and procedures for comparing various types of controls for suitability and cost effectiveness in a particular area. This guidance will also assist owners of large-scale urban development projects in cost-effectively and aesthetically integrating water quality control to the drainage plan. The manual is also directed to designers who desire a self-contained unit that discusses the design of specific quality controls for urban runoff.

Chapter 1 provides information on the sources and effects of chemical constituents in urban runoff. The chapter discusses chemical constituents found in urban runoff, with indications of the frequencies and concentrations in which these constituents are found. The effects of urban runoff on receiving waters are also addressed, including effects on water quality and ecology. The chapter also presents a section on environmental resource protection, which looks at urban runoff quality management from the more holistic receiving water management point of view, rather than the narrower and more traditional pollution minimization approach.

Chapter 2 is directed primarily at municipal agencies, who must develop and implement, or regulate, a plan of urban runoff quality management. The chapter addresses the development of such a plan from two perspectives: meeting U.S. EPA requirements of the 1990 regulations and achieving the objective of environmental resource management. Master-planning considerations take into account the type of receiving water, designated and desired beneficial uses, permitting requirements, financing, and integration of quality management with quantity management.

Chapter 3 addresses monitoring, bioassessment, and modeling. Information in this chapter supports the planning activities in Chapter 2 and the monitoring of control practices or devices that have been constructed.

Chapters 4 and 5 provide guidance on the design and implementation of source controls and treatment controls, respectively, for urban runoff quality management. Guidance is provided at the beginning of each chapter on how to evaluate tradeoffs between the various controls addressed. However, if guidance on the design of a specific control is all that is desired, the user may go directly to that section in the chapter and develop the design from the guidance given there. Familiarity with other parts of the manual is not required if the performance requirements of the control are known, or if a particular control is required by ordinance.

The user of this manual should understand that while established scientific practice underlies the treatment controls addressed here, considerable professional judgment is involved in the application. For this reason, the designer should be knowledgeable in aquatic chemistry and aquatic ecology—in addition to hydrology and hydraulics—or seek the advice of someone who is. Designers are advised to use their own common sense in applying the design criteria to a specific situation, combining theoretical concepts with experience in the joint application of the principles embodied in these four disciplines.

Finally, there is no way to separate quality management from quantity management of urban runoff. This manual deals with urban runoff quality;

the quantity aspects of urban runoff management are addressed only in a general way. For more details on quantity concerns, the reader is referred to *Design and Construction of Urban Stormwater Management Systems*, published by the American Society of Civil Engineers and the Water Environment Federation in 1992 (ASCE Manuals and Reports of Engineering Practice No. 77; WEF Manual of Practice No. FD-20), which is the companion manual on urban runoff quantity.

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Chapter 1

Introduction to Urban Runoff

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MATERIAL ADDRESSED IN THIS MANUAL

URBAN RUNOFF EFFECTS AND CONTROL REQUIREMENTS. This manual focuses on the protection and enhancement of urban water resources through control of the transport of constituents into urban waterways by urban stormwater runoff. The manual emphasizes control of constituent discharges, reflecting the fact that chemical and particulate constituents in urban stormwater runoff play a key role in determining the negative effects of that runoff.

To provide a context for control requirements, receiving waters of potential concern are addressed, primarily in Chapters 2 and 3. Of these, streams tend to be the water body primarily affected by urbanization, and they are given special focus later in this introductory chapter. It is noted that the discussion of control addresses both traditional and developing approaches to control. Traditionally, control requirements have often been set without regard to the specific intended use of the receiving water. More recently, there have been attempts to improve the methods for measuring and assessing how constituents of stormwater runoff affect designated beneficial uses (see Chapters 1 and 3).

BEST MANAGEMENT PRACTICES. Best management practice, or BMP, as applied to urban runoff management was a term adopted in the 1970s to represent actions and practices that could be used to reduce the flow rates and the constituent concentrations in urban runoff. It reflects the developing and somewhat empirical engineering that applies to this area of practice and differentiates it from the more highly developed and predictable engineering associated with traditional wastewater treatment facility design.

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A variety of urban BMPs are considered in Chapters 4 and 5. Source control practices and "passive" BMP systems (those not requiring active operational control or adjustment beyond routine maintenance) are described in some detail. Design considerations for "active" treatment technologies (those that are not passive, such as ultraviolet irradiation for bacteria [Craig and Tracy, 1993] or chemical precipitation for phosphorus) are not included in this manual. However, planning approaches, which might lead to the need for such systems, are discussed in Chapter 2. Design objectives for BMPs, and processes by which objectives can be established, are discussed in Chapter 2. It is noted that objectives can be stated in terms of technology (by specifying a particular control device) or in terms of quantitative effect (for example, by specifying a required degree of control or a maximum allowable effect). Because quantitative objectives can be defined for both hydrological parameters and constituent removal performance parameters, both of these are discussed. Examples of objectives based on hydrological parameters include peak flow rate and retention of a defined water volume for a specific period of time, while objectives based on chemical parameters include percent removal of specific chemical constituents and effluent concentration or mass discharge targets.

The understanding of the role of BMPs in reducing the potential toxicity of stormwater runoff is evolving. Data characterizing toxicological properties of urban runoff are sparse, and the scale-up of event-type phenomena to receiving water effects is not well understood. However, significant advances are being made in understanding this issue (see Chapters 1 and 3).

Best management practice technology is imperfect; for example, BMPs may not have a significant effect on the removal of soluble toxic substances. Therefore, pollution prevention (source control) and public education (also inherently a source control) are discussed in Chapter 4 as ways of providing some added improvement to effluent quality.

WATER QUALITY PARAMETERS. Water quality parameters addressed most in this manual are total suspended solids (TSS) and nutrients (nitrogen and phosphorus); this reflects current common practice in BMP design. In fact, TSS and nutrients are the primary constituents of stormwater runoff that can be controlled by the passive BMPs considered in this manual. It is noted that focus on these parameters is not a complete oversight of other parameters, because most other constituents of concern (for example, metals, hydrophobic organics) are reduced by the processes used to remove TSS, and most biochemically removable constituents will be reduced by processes that remove nutrients. Moreover, the two most widely documented effects of urban runoff on receiving waters are associated with sediment and nutrient enrichment.

Benefits do accompany the removal of other substances, such as metals (for example, copper, zinc, iron, and lead) if they are primarily particulate, hydrophobic organics, detritus, and bacteria. However, it is difficult to develop design criteria to control these substances because their removal depends on physiochemical factors that are intractable in design. All things considered, it is not unreasonable that present common practice focuses on particulate removal, and this approach is adopted in this manual.

It is noted that water quality parameters described in this manual typically use the total mass per unit volume (total concentration) as a basis for discussion. This is because the reference quantity used in many water quality standards is the total concentration. It is nevertheless recognized that the ecological significance of total concentration is the subject of much debate. This debate arises because in flowing water, the soluble form of substances (for example, in the case of copper) is the form that most directly causes toxicity to biota. However, the chemistry of the water, the substrate, and other factors make toxicity determination based on chemical speciation a complex process. This level of assessment is considered to be outside the present scope of practice targeted by this manual. References dealing with the details of aquatic toxicity may be sought in the literature.

DEFINITIONS OF TERMS

Constituents, pollutants, and contaminants are terms often used interchangeably in discussions of urban stormwater runoff. This section presents definitions for these and other commonly used terms in this manual. Definitions of various types of constituents of urban stormwater runoff are also presented. These latter definitions have been adapted from a technology-transfer publication of the University of Connecticut (1994):

- Site runoff coefficient—the ratio of direct runoff volume to rainfall volume, calculated over the duration of an event from beginning of rainfall to end of runoff resulting from that rainfall.
- Site imperviousness—the fraction of land surface that does not allow infiltration of rainfall at the start of a rainfall event.
- Constituent—a substance found in dissolved, colloidal, or particulate form in water that can be measured as a concentration.
- Pollutant—(a) a substance discharged at a rate that causes the receiving water ecosystem to become degraded or (b) a constituent in stormwater runoff that has a concentration and discharge rate (mass/time) that causes an impairment of designated beneficial uses of the receiving water. (The basis of a designated beneficial use [such as aesthetics, potability, recreational contact or noncontact, aquatic food consumption, or aquatic ecosystem protection] and its application in setting management objectives for urban stormwater runoff are presented in Chapter 2.)
- Contaminant—a term often used interchangeably with "pollutant" or to represent substances such as trace metals and synthetic organic

chemicals that have not historically been found in aquatic systems at present levels and that have been introduced by anthropogenic activities such as the processing of geological materials (such as lead from lead sulfide ores) or the release of new compounds not previously found in nature (such as pesticides).

- Water quality parameter—a physical, chemical, or biological characteristic, property, or representation of the quality of water. The parameter may be stated in qualitative terms (for example, an aesthetic property such as the presence or absence of trash) or in quantitative terms (for example, the concentration of a constituent in water).
- Pathogens—disease-causing microorganisms such as bacteria, viruses, and protozoan cysts that come from the fecal waste of humans and animals. Pathogens wash off the land from animal and pet waste. A more significant source of pathogens, especially in older urban areas, is the illegal connection of sanitary sewers to "separated storm sewers."
- Nutrients—substances that stimulate plant growth, such as nitrogen and phosphorus. Nutrients in polluted runoff can come from fertilizers, home lawn-care products, plant excretion, and yard and animal wastes. Other sources include cross connections and atmospheric inputs (for example, nitrous oxide emissions from automobiles).
- Sediments—sand, dirt, and gravel eroded by runoff that typically end up in stream beds, ponds, or shallow coastal areas. Poorly protected construction sites, roadways, suburban gardens and other unvegetated areas, and winter maintenance (sanding operations) can be significant sources of sediment. Soil erosion is more severe in areas under construction than in mature urban areas, which are stabilized by vegetation, pavement, houses, and sidewalks.
- Potentially toxic contaminants—substances that can harm the health of aquatic systems or human life. Toxins are created by a wide variety of human practices and products and include heavy metals (such as copper and lead), pesticides, and organic compounds. Oil, grease, and gasoline from roadways and some chemicals used in homes, gardens, and yards are toxic contaminants. An evolving area of knowledge is the role of automobile wear and tear (copper products, brake linings, oil drippings, and crankcase and radiator leaks), corrosion, and emissions and changes in vehicle technology and fuel constituents (for example, the removal of lead from gasoline) in contributing to these substances in urban runoff.
- Debris—trash, or solid waste, that often starts as street litter and is carried by runoff to waterways.

Of special note in further defining a pollutant are the terms "balanced" and "unbalanced," which have been used to describe oxygen concentrations in streams (Streeter and Phelps, 1925) and, in particular, eutrophication, which is associated with the excessive input of nutrients to the receiving water system. In the concept of balance, there are two significant *in situ* processes involved in a biological cycle: planktonic growth (that is, reduction of minerals and synthesis of organic materials) and bacterial degradation (that is, oxidation or decomposition of organic matter to liberate nutrients). When these two processes are in balance, the rate of eutrophication is minimal (Oswald and Golueke, 1966).

Therefore, pollution is a result of processes becoming out of balance, and the degree of pollution is a function of the degree of imbalance (for example, stimulation of planktonic growth or bacterially induced deoxygenation). Furthermore, concepts such as desired and designated beneficial uses have evolved to include other considerations such as human-health–related issues, consumptive uses, recreational uses, aesthetic values, and other water resource considerations.

STUDIES OF NONPOINT SOURCE POLLUTION AND REGULATORY BACKGROUND

The study of urban nonpoint source runoff in the U.S. has evolved from initial research into chemical constituents in dustfall and rainout conducted by the U.S. Geological Survey in the 1960s (Carter, 1961, and Leopold, 1968). The discovery that significant quantities of nutrients, pesticides, herbicides, and heavy metals were contained in urban runoff caused the U.S. Environmental Protection Agency (U.S. EPA) to require that regional urban planning agencies in the U.S. conduct planning studies regarding ways to reduce pollution from urbanized areas under Section 208 of the Clean Water Act. The studies, which came to be known as the "208 nonpoint source planning area studies," were conducted throughout significant metropolitan areas across the U.S. during the 1970s. The 208 studies were not successful because the profession had little experience in how to measure and quantify runoff quality or in the effectiveness of control measures in a dynamic system subject to the vagaries of urban hydrology. The unsuccessful 208 programs prompted U.S. EPA to fund the National Urban Runoff Program (NURP) of the early 1980s. While early studies aimed to define the magnitude of nonpoint source pollution relative to point sources and the significance of urban nonpoint sources (such as combined sewer overflows and separated storm drainage systems) relative to rural sources (such as agricultural land uses; wooded lands; and arid, sparsely vegetated lands), recent studies have focused on confirming the levels of pollution and effectiveness of pollution control efforts. A similar study path has been followed in Europe and Canada (Marsalek *et al.*, 1993), in which the focus on characterizing the relative importance of nonpoint sources has changed to the implementation of BMPs in agricultural and urban areas.

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Best management practice, which has the roots of its definition in agricultural practice, refers to management practices and "soft engineering" methods to control pollutants in runoff. Agricultural management practices include leaving stubble in harvested fields to reduce wind erosion, fertilizer management to reduce costs, and crop rotation to increase yields; soft engineering controls include contour plowing, establishment of buffer zones between working fields and receiving waters, and check dams in drainage ditches to reduce sediment production. In an urban setting, BMPs are of two types: source controls (sometimes called "nonstructural" controls) and treatment controls (sometimes called "structural controls"). Source controls, which are described in detail in Chapter 4, are practices that keep chemical constituents from entering the runoff. Examples are covering chemical storage areas and/or diverting runoff away from such areas, street sweeping, and household hazardous waste recycling programs. Treatment control BMPs refer to devices that remove pollutants from the runoff. Examples are vegetated swales and buffers strips, infiltration, detention, and retention. Chapter 5 addresses treatment controls in detail.

After two decades of emphasis by U.S. EPA on the treatment of point source pollution as part of the Federal Clean Water Act (CWA) of 1972, remaining pollution problems now stem predominantly from diffuse and minor point sources. According to U.S. EPA, nonpoint source pollution represents more than half of the remaining water quality problems in the U.S. Through more recent legislation, U.S. EPA has developed a multifaceted approach to controlling runoff quality from these sources. Largely implemented through state agencies, this approach consists of overlapping programs covering general state strategies for nonpoint sources, municipal and industrial runoff quality, national estuary protection, protection of the U.S. Great Lakes, coastal zone protection, total maximum daily loads, and combined sewers. Runoff quality requirements have also indirectly been established through other federal and local environmental programs, such as environmental impact statements, endangered species programs, and wetlands preservation programs.

The CWA, as amended in 1987, and subsequent U.S. EPA regulations governing National Pollution Discharge Elimination System (NPDES) permits for stormwater discharges are the principal vehicles for controlling stormwater pollutants at the federal level. The 1987 amendments to CWA added Section 402(p), which established a framework for regulating municipal and industrial stormwater discharges as part of the NPDES program. In addition, in November 1990, U.S. EPA published regulations that established application requirements for stormwater NPDES permits.

U.S. EPA's application requirements for municipal discharges consist of two parts. Part 1 requires the discharger to collect existing information regarding stormwater dischargers, receiving waters, management programs, fiscal resources, and associated elements. In Part 2, a municipality is expected to take this information and formulate a stormwater management program designed to reduce the discharge of pollutants to the "maximum extent practicable."

Other laws/programs that directly or indirectly affect the control of stormwater pollutants are discussed in Chapter 2.

HYDROLOGICAL CHARACTERISTICS OF URBAN STORMWATER RUNOFF

HYDROLOGICAL CHANGES IN AN URBAN CATCHMENT. In general, urbanization can change a hydrologic cycle by

- Reducing the degree of infiltration and increasing the volume of runoff because of development of surfaces (changing slope, form, or cover);
- Changing the amount of depression storage because of regrading;
- Changing evapotranspiration because of removal of vegetative cover; and
- Reducing the travel time to a receiving body of water because of the construction of efficient sewer systems.

In extreme cases, small streams may be completely replaced by pipes and open channels after urbanization, resulting in streams and open channels that are completely dry between storms.

Imperviousness and Runoff. The relationship between imperviousness and runoff is worth considering in some detail. Figure 1.1 provides a good representation of the way the site runoff coefficient typically relates to site imperviousness. The figure was developed from more than 40 runoff monitoring sites throughout the U.S. (Schueler, 1994). The runoff coefficient (event runoff volume divided by event rainfall volume) ranges from 0 to 1, representing no runoff at one extreme and no infiltration at the other.

The first significance of the figure is that the runoff coefficient is closely correlated with the percentage of impervious cover, except at very low imperviousness. At low levels, other factors (soils and slopes) become important and imperviousness is a less perfect predictor of runoff coefficient.

It is interesting to note that the total runoff volume for a 100% paved parking lot is approximately 20 times that produced by an undeveloped meadow. This is indicative of the degree to which runoff volume can increase as sensitive lands are developed. Peak discharge, velocity, and time of concentration of stormwater runoff would also increase to a large degree in such a situation (see Table 1.1).

Another example of this is the calculated effect on a catchment's hydrol-

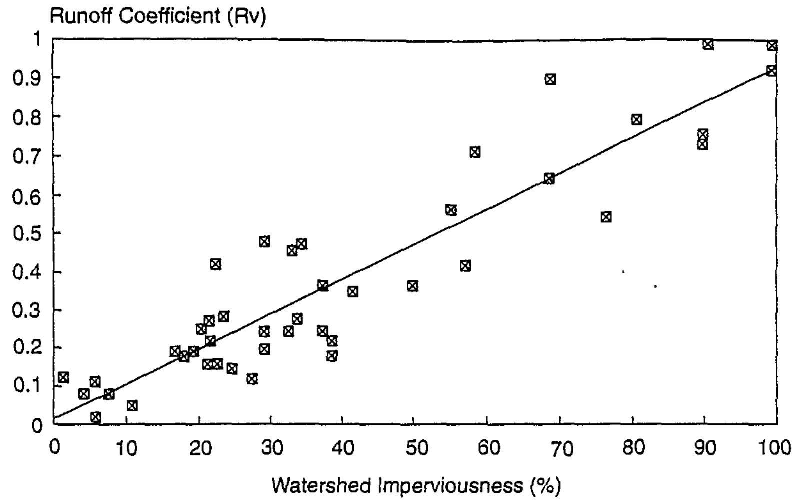

Figure 1.1 Watershed imperviousness and the storm runoff coefficient.

Table 1.1 Comparison of 1 ac (0.4 ha) of parking lot versus 1 ac (0.4 ha) of meadow in good condition (from Schueler, T.R. [1994] *Watershed Protection Techniques: a Quarterly Bulletin on Urban Watershed Restoration and Protection Tools.* Center for Watershed Protection, Silver Spring, Md., 1, 1, with permission).

Runoff or water quality parameter	Parking lot[a]	Meadow[b]
Curve number	98	58
Runoff coefficient	0.95	0.06
Time of concentration, minutes	4.8	14.4
Peak discharge rate, cfs,[c] 2/year, 24-hour storm	4.3	0.4
Peak discharge rate, cfs, 100-year storm	12.6	3.1
Runoff volume from 1-in. storm, cu ft[d]	3 450	218
Runoff velocity at 2-year storm, ft/sec[e]	8	1.8
Annual phosphorus load, lb/yr/ac[f]	2	0.50
Annual nitrogen load, lb/yr/ac	15.4	2.0
Annual zinc load, lb/yr/ac	0.30	—

[a] Parking lot is 100% impervious, with 3% slope; 200-ft (61-m) flow length; type 2 storm, 2-year, 24-hour storm = 3.1 in. (79 mm); 100-year storm = 8.9 in. (226 mm); hydraulic radius = 0.3; concrete channel; and suburban Washington "C" values.
[b] Meadow is 1% impervious, with 3% slopes, 200-ft (61-m) flow length, good vegetative condition, "B" soils, and earthen channel.
[c] cfs × 0.028 32 = m^3/s.
[d] cu ft × 0.028 32 = m^3.
[e] ft/sec × 0.304 8 = m/s.
[f] lb/yr/ac × 1.121 = kg/ha·a.

Table 1.2 **Effect of urbanization on distribution of May to November water budget for forested and urban areas.**[a]

Item	Forested areas		Urban areas with 40% impervious land			
			No infiltration		With infiltration	
	Depth, mm	Total depth, %	Depth, mm	Total depth, %	Depth, mm	Total depth, %
May to November rainfall	515	100	515	100	515	100
Interception storage and depression storage on impervious areas	342	66.5	235	45	235	45
Infiltration	155	30	100	20	200	40
Runoff	18	3.5	180	35	80	15

[a] Sandy soils assumed.

ogy because of a change in land use from a forested area to a typical single-family residential area. The results show a decrease in infiltration, depression storage, and interception storage (see Table 1.2). This results in a tenfold increase in the volume of runoff that reaches the receiving stream. Other observed changes in urban hydrology include the ratio of urbanized to nonurbanized peak flows. Data for three sites are provided in Table 1.3 (Urbanos and Roesner, 1992).

Table 1.3 **Ratio of peak runoff rates before and after development at three single-family residential sites.**

Return period, years	Post/preurbanization ratios of runoff peaks		
	New Jersey site[a]	Denver, Colorado, site[b]	Canberra, Australia, site[c]
2		57.0	9.0
10		3.10	4.7
15	3.0		
100		1.85	1.9

[a] 33-in. (840-mm) annual precipitation; based on modeling pre- and postdevelopment conditions using SCS TR-55 model and type II storm distribution.
[b] 15-in. (380-mm) annual precipitation; based on 8-year rainfall–runoff data record and 73-year simulation of pre- and postdevelopment conditions.
[c] 22-in. (550-mm) annual precipitation; based on statistical analysis of similar size adjacent developed and undeveloped tracts of land.

Effect of Imperviousness on Groundwater Recharge. As runoff volume increases with imperviousness, infiltration reduces. Groundwater recharge may be expected to reduce accordingly, which should, in turn, tend to cause lower dry weather stream flows. This is an effect that has been associated with urbanization; however, there are actual data that suggest this effect is not universal. An analysis of 16 North Carolina (U.S.) watershed areas could not find any statistical difference in low stream flow between urban and rural watersheds (Schueler, 1994). Nevertheless, other studies support the conclusion that the phenomenon exists. For example, dry weather flows dropped 20 to 85% after development in several urban watersheds in Long Island, New York (U.S.) (Schueler, 1994). And, in contrast, by evaluating low-flow statistics for urban streams in Toronto, Ontario (Canada), Belore (1991) found that low-flow rates (over a 7-day moving average and 10-year return period) increased during a 30-year urbanization period. One explanation offered for this counterintuitive result is that the additional water discharged to storm sewers from sources such as lawn irrigation and sanitary sewer exfiltration was sufficient to affect mass balances.

The net result of these studies is a mixed picture concerning the effects of urbanization on groundwater infiltration as inferred from base flow in streams. Therefore, it may be useful to critically evaluate these and other new studies case by case, paying particular attention to infiltration estimates distinct from base flow trends.

IMPERVIOUSNESS AS AN INTEGRATING CONCEPT. It is difficult to provide a measure of effect that simultaneously reconciles the needs of various scientists, engineers, and other stakeholders who must deal with the effects of urbanization. Nevertheless, some such common measure is needed if results are to be consistent when these individuals make decisions regarding individual development sites or the watershed as a whole.

One suggested index of effect is the amount of imperviousness on a given site or watershed. Imperviousness is the percent, or decimal fraction, of the total catchment covered by the sum of roads, parking lots, sidewalks, rooftops, and other impermeable surfaces of an urban landscape. Operationally, for mature urban areas, watershed imperviousness can be defined as the fraction of watershed area that is unvegetated.

Another way to describe imperviousness is that it represents the imprint of land development on a landscape, which, in simplistic terms, consists of two primary components: rooftops under which humans live, work, or shop and a transportation system consisting of roads, driveways, and parking lots. Increasingly, the "transportation system" often exceeds the rooftop component in terms of total impervious area created. For example, transportation-related imperviousness composed 63 to 70% of total impervious cover in 11 residential, multifamily, and commercial areas in the city of Olympia, Washington (U.S.) (Schueler, 1994, and City of Olympia, 1994).

Because imperviousness is a useful indicator for measuring the varying effects of land development on receiving waters and their aquatic systems, it can be viewed as providing a unifying theme in urban watershed protection (Schueler, 1994). It should be recognized that this is a convenient approximation only, not necessarily a realistic measure.

CONSTITUENTS IN URBAN STORMWATER RUNOFF

Two general approaches have developed in the literature for estimating contribution to chemical constituents in stormwater runoff: approaches based on human activities (such as pesticide application) and those based on general land-use categories (such as suburban downtown). Presently, land-use category approaches dominate the field of urban stormwater management to predict constituent concentrations. Primary land-use contributors are streets, roads, and highways; residential areas; commercial areas; industrial areas; and sites under development.

Historical case studies have provided alternative ways of estimating constituent loadings from urban areas or helped in developing methods for predicting pollutant levels based on urban characteristics (such as street accumulation or curb length). Implications for monitoring these studies are provided later in this chapter.

RESULTS FROM THE NATIONAL URBAN RUNOFF PROGRAM. National Urban Runoff Program research (U.S. EPA, 1983), which includes data from 28 urban sites throughout the U.S., is a compilation and evaluation of urban runoff data. The NURP study was funded and guided by U.S. EPA from 1978 to 1983, and although conducted at 28 local sites, it was reviewed, coordinated, and managed centrally.

One objective of the study was to characterize the water quality of discharges from separated storm sewers that drain residential, commercial, and light areas. The majority of samples collected in the study (see Table 1.4) were analyzed for eight conventional parameter sets. However, the study did not rigorously address issues such as the significance of elevated constituents' concentrations in urban runoff as they relate to the designated beneficial uses of receiving waters. This issue and the assessment/measurement of effects have been primary focuses of research and monitoring in similar studies of the 1990s.

The NURP study found that geographic location, land-use category, runoff volume, and other factors appeared to be of little use in explaining overall site-to-site or event-to-event variability. The NURP study determined that the best general characterization to predict characteristics of urban runoff at unmonitored sites is obtained by pooling site data from all sites (other than the open/nonurban ones). Pooled data for water quality characteristics from the NURP study are given in Table 1.4. In the absence of better

Table 1.4 **Overall water quality characteristics of urban runoff (U.S. EPA, 1983).**

Constituent	Typical coefficient of variation	Site median EMC[a] For median urban site	Site median EMC[a] For 90th percentile urban site
TSS, mg/L	1–2	100	300
BOD, mg/L	0.5–1	9	15
COD, mg/L	0.5–1	65	140
Total P, mg/L	0.5–1	0.33	0.70
Soluble P, mg/L	0.5–1	0.12	0.21
TKN, mg/L	0.5–1	1.50	3.30
NO_{2+3}–N, mg/L	0.5–1	0.68	1.75
Total Cu, μg/L	0.5–1	34	93
Total Pb, μg/L	0.5–1	144	350
Total Zn, μg/L	0.5–1	160	500

[a] Event near concentration.

information, the NURP study recommended the values given in Table 1.4 for planning purposes as the best description of the expected quality of urban runoff.

The event mean concentration (EMC) and the site mean concentration (SMC) are approaches to reporting the concentration of constituents in urban stormwater runoff and are used in Table 1.4 and subsequent chapters. Event mean concentration is the total mass of the constituent in the runoff event divided by the total volume of runoff during that event. Site mean concentration is the mean (from an arithmetic probability distribution) or median (from a log-normal distribution) value of all EMC values measured for a particular monitoring site.

In addition to assessing water quality characteristics, a portion of the NURP study also involved monitoring 120 "priority pollutants" in stormwater discharges (Thon, 1992). The study detected 77 priority pollutants in samples of stormwater discharges from the study sites, including 14 inorganic and 63 organic substances. Representative detection frequencies included lead (94%), zinc (94%), copper (91%), chromium (58%), arsenic (52%), pesticides (in particular, endosulfan, chlordane, and lindane) (15 to 19%), pentachlorophenol (19%), phthalates (22%), and fluoranthene (16%).

CONCENTRATIONS ESTABLISHED IN RECENT DATA SETS. **Representative Concentrations from One Urban Area.** The NURP database includes a limited number of water quality parameters. Where resources permitted, more parameters were monitored and SMC estimates were developed to determine the concentrations of other constituents (see Tables 1.5

Table 1.5 Comparison of concentrations measured in Toronto waterfront studies with various water quality criteria (separated urban stormwater system discharge to Lake Ontario).

Parameter		Discharge to sanitary sewer by-law target concentration	Discharge to storm sewer by-law target concentration	PWQO aquatic life (drinking water)[a]	Observed concentration dry weather outfall	Observed concentration wet weather outfalls
BOD	mg/L	300	15	—	7–19	420
Fecal coliforms	CNT/dL	300	15	100[b]	38 000–301 000	10 000–16E6
SS	mg/L	350	15	—	17–37	87–188
TP	mg/L	10	—	0.03	0.2–0.5	0.3–0.7
TKN	mg/L	100	—		1.8–4	1.9–3
Phenolics	mg/L	1	—	0.001	4–6	0.014–0.019
NO_3	mg/L	—	—	(10)	3.1–7.9	1.1–2.1
Al	mg/L	50	—	—	0.25–0.35	1.2–2.5
Fe	mg/L	50	—	0.3	0.63–1.0	2.7–7.2

Cr	mg/L	5	0.2	0.1	0.008–0.13	0.009–0.025
Pb	mg/L	5	0.05	0.025	0.008–0.012	0.038–0.055
Mn	mg/L	5	—	—	0.11–0.17	−0.12–0.17
Se	mg/L	5	—	0.1	<0.001	<0.001
Ag	mg/L	5	—	0.000 1	<0.01	0.002–0.005
Cu	mg/L	3	0.01	0.005	0.040–0.071	0.045–0.46
Ni	mg/L	3	0.05	0.025	0.008–0.012	0.009–0.016
Zn	mg/L	3	0.05	0.030	0.42–0.065	0.14–0.26
Total cyanide	mg/L	2	—	0.005	—	0.005
As	mg/L	1	—	0.1	0.002–0.004	<0.001
Cd	mg/L	1	0.001	0.000 2	<0.002	0.001–0.024
Hg	mg/L	0.1	0.001	0.000 2	<0.000 01	0.000 04–0.000 06
PCBs	µg/L	0	0	0.001	<0.02	
Solvent extractable	—	—	—	—	5–11	—

[a] Guideline values in brackets are for drinking water.
[b] Guideline for swimming.

Table 1.6 Comparison of concentrations (μg/L) measured in Toronto waterfront studies with guidelines for organic parameters (separated urban stormwater system discharge to Lake Ontario).

Compound, μg/L	Guidelines	Observed concentration, dry weather outfalls	Observed concentration, wet weather outfalls
Phenols	2.0	8	17
Toluene	300	0.02	—
Benzene	300	0.02	—
α-BHC[a]	0.092	0.001	0.001
γ-BHC[a]	0.186	0.000 5	0.001
Total PCB[b]	0.001	<0.005	<0.25
Anthracene	—	<0.02	0.061
Fluoranthene	42	<0.02	0.782
Pyrene	—	<0.02	0.615
Benzo(A)anthracene	—	<0.04	0.249
Chrysene	—	<0.02	0.333
Hexachlorobutadiene	0.1	<0.000 4	0.000 24
Bis-2-ethyl hexyl phthalate	6	7.4	—
Dichlorobenze 1,2	2.5	<0.02	—
Dichlorobenze 1,3	—	<0.02	—
Dichlorobenze 1,4	4.0	<0.02	—
Trichlorobenzene 1,2,4	0.5	0.002	0.005
Trichlorobenzene 1,2,3	0.9	<0.000 1	0.002
Trichlorobenzene 1,3,5	0.65	<0.000 05	<0.000 4
Tetrachlorobenzene 1,2,3,4	0.1	<0.000 05	<0.000 4
Pentachlorobenzene	0.03	<0.000 05	0.000 8
Hexachlorobenzene	0.006 5	<0.000 05	0.000 3
Heptachlor epoxides and heptachlor	0.01	<0.000 01	<0.000 05

[a] Benzenehexachloride.
[b] Polychlorinated biphenyl.

and 1.6 and papers published in Torno *et al.* [Eds.], 1994, for recent data). These data sets provide several advantages. A data set from the same site improves the assessment of water quality because it is often difficult to find an internally consistent set of data that includes most parameters. New statistical techniques for detection-limit data now permit estimation of the SMC, even if 80% of the EMC data from a site are below analytical detection limits. Moreover, new analytical equipment and improved sampling and analytical methodologies have resulted in lower detection limits and more rigorous quality assurance/quality control.

Concentrations measured in separated urban storm sewers for dry weather and wet weather conditions are given in Tables 1.5 and 1.6 and are compared to various water quality targets. Catchments that are drained by these storm sewers serve low-density suburban areas (that is, drainage areas ranging from

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10 to 100 ha) of Metropolitan Toronto along the Toronto waterfront (D'Andrea *et al.*, 1993). For many conventional parameters and trace metals, observed concentrations (see Table 1.5) exceeded relevant receiving water standards and even targets established for discharges to storm drains. For a variety of other compounds (see Table 1.6), either urban source concentrations were below water quality targets or water quality targets were not established.

In general, these and similar literature data sets (Cooke *et al.*, 1995) can be used to define exclusionary criteria for parameter selection, provided that additional criteria, such as a knowledge of what constituents have the potential to be in the water, are used to define the parameters to be excluded.

GENERAL LITERATURE. The following is a list of references for individual sources of constituents in urban stormwater runoff:

- Atmospheric deposition, general levels (Halverson et al., 1982; Harrison and Johnston, 1985; Ng, 1987; and Novotny and Chesters, 1981).
- Atmospheric deposition by land-use type (Novotny and Kincaid, 1982; Pitt and Barron, 1989; and Randall *et al.*, 1982), geology (Pitt, 1979), wet fall–dry fall (Bannerman *et al.*, 1984), and dry deposition (Department of City Development, 1981).
- Street refuse deposition (see U.S. EPA, 1984, for particles greater than 60 μm).
- Vegetation (Halverson *et al.*, 1984, and Heaney and Huber, 1973).
- Traffic (Harrison and Johnston, 1985; Pitt, 1979; Sartor and Boyd, 1972; Shaheen, 1975; and Strecker *et al.*, 1987).
- Deicing chemicals, when applied (Field *et al.*, 1974; Lord, 1988; Oberts, 1986; and Zariello, 1990).
- Impervious and pervious surfaces:
  - Accumulation on impervious surfaces—buildup (Heaney and Huber, 1973; HEC, 1975; Huber, 1986; James and Boregowda, 1986; U.S. EPA, 1971; and Whipple *et al.*, 1978);
  - Retrainment from impervious surfaces (Cowherd *et al.*, 1977, and Pitt, 1979);
  - Winter accumulation (Bannerman *et al.*, 1984);
  - Washoff (Sartor and Boyd, 1972; Sartor *et al.*, 1974; and Zison, 1980); and
  - Losses with snow melt processes (Bengtsson, 1982; McComas *et al.*, 1976; Novotny, 1987 and 1988; Oberts, 1986 and 1990; and Westerström, 1990).
- Cross connections and illicit discharges (Pitt *et al.*, 1990a and 1990b, and Schmidt and Spencer, 1986).
- Grain size distribution (Sartor et al., 1974).

The following is a list of references for other substances in urban runoff (see Marsalek and Torno [Eds.], 1993; Torno *et al.* [Eds.], 1994; and historical references cited below):

- Microorganism (Glenne, 1984, and Olivieri *et al.*, 1977 and 1989);
- Pesticides and herbicides (U.S. EPA, 1984);
- Plasticizers (U.S. EPA, 1984);
- Polychlorinated biphenyls (Marsalek, 1986);
- Petroleum hydrocarbons (Hoffman, 1985, and Hoffman *et al.*, 1984);
- Polyaromatic hydrocarbons (Fam *et al.*, 1987; Forster, 1990; Hoffman *et al.*, 1984; and Marsalek, 1990);
- Toxicity (Pitt and Barron, 1989); and
- Atmospheric acidity and its influences (Forster, 1990, and Novotny and Kincaid, 1982).

Measurement of Other Chemicals. There are more than 60 000 chemicals used in the U.S. In relative terms, only a few are analyzed in a typical extended suite of analysis (approximately 100 to 150) or are regulated in terms of having receiving water standards. More recent studies (Waller *et al.*, 1995) have identified pesticides such as diazinon, which is a toxicant that is not typically tested for in water quality monitoring programs, in runoff in the southern U.S. Therefore, a designer should be encouraged to consider potential unknown factors about chemicals used in watersheds to establish a water quality management or monitoring program.

CONCENTRATIONS IN RUNOFF FROM OTHER STORMWATER SOURCES. Combined Sewer Overflows. Representative constituent levels for combined sewer overflows (CSOs) based on late 1970s monitoring have been established by U.S. EPA (1978). Although CSOs have been scrutinized by researchers and U.S. EPA and a large number of data sets on their use have been compiled, a statistical analysis comparable to NURP studies is only now evolving. Therefore, only ranges and mathematical averages have historically been reported. Some analysis has emphasized EMCs for CSOs (Driscoll and James, 1987).

The significance of CSOs, relative to secondary wastewater treatment plant (WWTP) discharges to surface waterways, was demonstrated in a U.S. EPA nationwide assessment conducted in 1978. For example, for the same land area, loadings from CSOs relative to loadings from secondary WWTPs had the following relationships: biochemical oxygen demand (BOD), equal; lead and suspended solids (SS), CSOs were 15 times larger; and total nitrogen and phosphorus, CSOs were one-quarter to one-seventh. The relative significance of CSOs and separated storm sewers in a watershed is site specific. For initial screening for planning purposes on a watershed basis, consideration of the relative volumes of runoff from different types of land areas (for example, separated storm drains, highways, or CSOs) and EMCs for these land areas is an appropriate approach. Where data for CSOs are not available, an EMC can be estimated from the relative volume of stormwater flow and sanitary sewer flow in the "overflow event" and the stormwater EMC and sanitary wastewater concentration (estimated as the dry weather flow concentration or the average wet weather concentration in the WWTP inflow).

Industrial Sources. Data for concentrations in runoff from industrial sources are evolving under the NPDES program. A designer is encouraged to contact local agencies and trade associations for relevant data.

Highway Sources. The U.S. Federal Highway Administration (FHWA) maintains a national database for highways similar to the NURP database. In the FHWA database, sites were sampled during the same time period (early 1980s) as the NURP database and were summarized by Driscoll *et al.* (1990) using similar statistical techniques (such as EMCs and reduction to approximately log-normal distributions).

The FHWA database contains concentration data (see Watershed Planning section) for 10 water quality parameters. The database has been summarized for urban areas and rural areas for two highway traffic densities: greater than and less than 30 000 average daily traffic (ADT). (Traffic density is the total number of vehicles that drive past a specific point in both directions in all lanes expressed on a daily basis.) Investigators such as Strecker *et al.* (1990) have provided probabilistic representations of the data (see Watershed Planning section). Recent synthesis documents (for example, Young *et al.*, 1996) stress that the categories of "urban/rural" and "less than/greater than" continue to be the accepted approach for estimating pollutant concentrations in highway runoff. However, some question still exists about the use of the database—most of the urban sites had an ADT of greater than 30 000, whereas most of the rural sites had an ADT of less than 30 000. This led Young *et al.* (1996) to summarize the data for two categories, urban areas (ADT > 30 000) and rural areas (ADT < 30 000), and to not provide data for the opposite categories of urban areas (ADT < 30 000) and rural areas (ADT > 30 000). Other studies that focus on data from only one site (such as Kerri *et al.*, 1985; Barrett *et al.*, 1995; and Thomson *et al.*, 1995 and 1997) have found additional predictive factors for constituent concentrations, such as ADT during the storm and interevent periods.

In the absence of site-specific data, these values are useful for planning and other purposes.

LESSONS LEARNED FROM PREVIOUS WATER QUALITY MONITORING

STATISTICAL CONCEPTS FOR URBAN RUNOFF WATER QUALITY EVALUATION. The NURP studies focused on evaluating EMCs. In most cases in these studies, the total load from the runoff event was more important than the individual concentrations within the event because the nature of the effect (for example, loadings to a receiving water) on the receiving water did not occur instantaneously but, rather, during an extended period of time.

Evaluation of the NURP database (U.S. EPA, 1983) and European data (Harremöes, 1988) revealed that the probability distribution of EMCs followed a probability distribution reasonably represented as log-normal. Additional studies (Driscoll and James, 1987) have also demonstrated that concentration data for other sources, such as CSOs, WWTP influent and effluent streams, and agricultural runoff, can be taken to have log-normal distributions.

The representation of the fundamental probability distribution of EMCs as log normal has a number of benefits (U.S. EPA, 1983, and Marsalek, 1991), including the following:

- Concise summaries of highly variable data can be developed;
- Comparisons of results from different sites and events are convenient and are more easily understood;
- Conclusions can readily be made concerning frequency of occurrence (one can express how often values exceed various magnitudes of interest);
- A more useful method of reporting data than the use of ranges is provided (one that is less subject to misinterpretations);
- A framework is provided for examining "transferability" of data in a quantitative manner;
- Data below the detection limit can be extrapolated; and
- Loadings can be obtained by multiplying the EMC by the total volume of runoff.

Another important statistical concept is the analysis of detection-limit data from knowledge of the probability distribution function. For many parameters, 20 to 80% of the sample values from a sample set are below detection limits. This can pose a problem in determining the true population mean and variance. An effective approach is to use a probability distribution estimation technique for this left-censored data set.

The variance structure of the term "loadings" also influences the method for reporting water quality data. To allow comparison of data between sites, investigations of the 1960s and 1970s reported data using units of unit loads (loadings per unit area of catchment). This is in contrast to recent data, which emphasize concentrations. Because unit loads include variance (because of both hydrological and concentration components), the concentration approach is emphasized in this manual.

PREDICTIVE RELATIONSHIPS OF URBAN RUNOFF QUALITY. Several potential predictors of constituent concentrations in runoff were evaluated in the NURP studies (U.S. EPA, 1983). The results are summarized in the following sections.

Land-Use Effects. The nationwide analysis in the NURP studies did not detect a significant statistical correlation of EMCs to the geographical locations of the sites studied throughout the U.S. In addition, three typical land uses, "residential, mixed, and commercial," were not found to be statistically different. Only open land uses and nonurban land uses were found to be significantly different (using statistical criteria) from these three land uses.

Runoff Volume Effects. A total of 67 sites from 20 of the NURP projects were examined for possible correlation between volume and EMC for nine constituents. The NURP study concluded that there is no significant linear correlation between EMCs and runoff volume.

Other Watershed Factor Effects. Factors such as slope, soil types, and rainfall characteristics are all potentially important. However, in a statistical sense, these factors did not have any consistent significance in explaining observed similarities or differences among individual sites.

IMPLICATIONS FOR MONITORING PROGRAMS. Monitoring programs for characterizing the quality of stormwater runoff, defining the effectiveness of BMPs, and developing relationships between runoff quality and various factors require increasingly onerous amounts of data and numbers of monitoring locations. Therefore, results from existing monitoring programs can be used to provide reasonably clear direction for typical stormwater quality monitoring issues in the 1990s. These issues include

- Defining differences in the concentration of stormwater chemical constituents over time at a site (for example, lead concentrations have declined because of their removal from gasoline);
- Defining a structured approach to measuring site-specific environmental effects and the implications of stormwater toxicity measurements (Herricks *et al.*, 1994);
- Applying scale-dependent factors (such as time and space) to a monitoring program design (for example, in a watershed in which BMPs have been completely implemented); and
- Defining the amount and type of monitoring data required to show significant differences between inflow and outfall loadings from a BMP facility (for example, one might establish 20% differences with an 80% level of confidence [a minimal statistical test] in a monitoring program).

Moreover, the issue of monitoring data to show differences between inflow and outfall of a BMP can be further addressed by analyzing NURP data, data from specific sites (see Torno *et al.* [Ed.] [1994] for examples of urban sites, and Thomson *et al.* [1995] for an example of a highway site), and data collected from a study of 18 sites in Austin, Texas (U.S.) (Cheng *et al.*, 1994).

Stormwater quality monitoring is sufficiently well developed today that direction can be given to new monitoring programs. Monitoring the environmental effects of stormwater runoff is a combination of art and science and requires hypothesis testing, evaluation of what "effects" are measurable, and an adaptive approach to program design (Hollings [Ed.], 1978).

National Urban Runoff Program research (U.S. EPA, 1983) and the FHWA database (Driscoll *et al.*, 1990), which were gathered in the early 1980s, are still considered the definitive studies available to characterize the concentration of substances such as SS, nutrients, metals, and oxygen-demanding substances (for example, chemical oxygen demand and BOD).

Recent NPDES monitoring data typically are consistent with these constituent concentrations except for lead, which displays lower levels because of its removal from gasoline. However, more recent data should be used to characterize many parameters, such as synthetic organic chemicals and polynuclear aromatic hydrocarbons (PAHs), because of the use of lower detection limits and better quality assurance/quality control. In addition, because of different levels of detection limits for parameters such as PAHs, some of these programs have varying degrees of utility.

As shown in NURP data, concentration (EMC) and runoff volume are independent (such that there is no significant correlation). The influence of other factors, such as interevent period and event duration, may be influential at a particular site (Barrett *et al.*, 1995, and Thomson *et al.*, 1997).

Studies have suggested that a minimum of 15 to 20 (Thomson *et al.*, 1995) or 18 to 30 (Cheng *et al.*, 1994) samples per site are required to provide an unbiased estimate of an SMC. In earlier studies, such as one conducted in Austin, Texas, approximately 40 monitoring sites were thought to be needed to show differences between two types of land uses and three sizes of watersheds to obtain four to eight mean concentration values for each combination of land use and watershed scales (Cheng *et al.*, 1994).

Furthermore, a practical measurement program can be used to specify the minimum number of flow-proportioned samples necessary to obtain a reasonable estimate of SMC, where the minimum number is a compromise between the number of samples suggested by a thorough statistical analysis and economic and resource considerations. For example, for sites typical of the temperate climates of the northeastern U.S., a reasonable minimum number would be 8 to 10 events, while a larger number of events may be needed for extremely left-censored data. For such a minimum number, obtaining two to three samples per site to address site-specific questions is not useful. Aggregation of two to three samples per site and data from several sites in an urban area may provide useful data for establishing SMCs; however, the additional variance introduced by this process should be evaluated.

Additionally, although first-flush phenomena have been observed in relatively small catchments (see Thomson *et al.*, 1995, for a Minnesota highway example), the existence of first-flush phenomena in large catchments is less clear.

Finally, performance assessment data from existing BMP databases can be used to define the amount of data required to evaluate the performance of new BMPs. For example, for a wet detention pond BMP (see Chapter 5), the following performance (removal of constituents) might be observed: SS, 70%; lead, 70%; total phosphorus, 50%; and total zinc, 20%. Compilations of performance-monitoring data (Schueler *et al.*, 1992) are rapidly accumulating; one method for decreasing the range of observed performance (for example 30 to 90% for TSS) is the use of standardized BMP data reporting protocols (Urbonas, 1994).

Clear monitoring guidance cannot be given for several biological and ecological properties of stormwater. The database characterizing the toxicological properties of urban runoff is sparse, and the scale-up of event-type phenomena to receiving water effects is not well known (see Herricks *et al.*, 1994). The role of BMPs in minimizing or reducing the potential toxicity of stormwater runoff is an evolving science. However, significant advances are currently being made in developing an understanding of this issue, as discused at the conclusion of this chapter and in Chapter 3.

EFFECTS OF URBANIZATION ON RECEIVING ENVIRONMENTS

Urbanization affects all components of the environment, such as air quality, surface water, groundwater, soil quality, and the habitats for animals, including humans. The quality of the existing local environment, which may range from pristine to degraded, is influenced by the form and characteristics of the existing development within the watershed. New development, redevelopment, and retrofitting provide opportunities for changing the characteristics of the receiving environment. The form of new development, together with the existing quality of the local environment, determines whether these projects will cause further degradation or improve the local environment.

The alteration of the hydrological cycle in an urban watershed was described earlier in this chapter. This section describes the effects of these alterations on receiving environments. Effects from the alteration of the hydrological cycle are presented in an integrated way to assist designers in developing appropriate solutions for specific conditions. This section discusses effects on streams, wetlands, lakes, groundwater, and the biological habitats supported by these aquatic systems. Emphasis is given to streams because the relative distribution of surface waters affected by urban areas has been estimated by Herricks (1991) as follows:

- Receiving streams and rivers: 85%. More than 80% had an average annual flow less than 8 500 L/s (300 cfs), with many having a flow of less than 8.5 L/s (0.3 cfs).

- Receiving lakes: 5%.
- Small ponds, shallow backwater areas: less than 0.1%.
- Estuaries and oceans: 10%.

Not captured in this survey is the large number of headwater streams affected by urbanization.

EFFECTS OF STORMWATER RUNOFF ON STREAM ECOSYSTEMS. Effects in urban streams can be loosely grouped into four categories: changes to stream hydrology, stream form, water quality, and aquatic ecology (Schueler, 1992). The extent of an alteration is a function of the climatic regime (wet or dry) and change in land use.

The example presented in this section for streams is based on the urbanization of a forested headwater watershed in a relatively wet, temperate area on the eastern seaboard of the U.S. Therefore, a designer should consider the hydrologic characteristics of other climatic areas and an individual stream's morphological setting to assess the potential effect of hydrological alterations on particular receiving streams.

Changes in Stream Hydrology. The net effect of conventional development practices on an urban stream is a dramatic change in the hydrologic regime of the stream. Effects include

- An increase in the magnitude and frequency of runoff events of all sizes;
- Delivery of more of the stream's annual flow as surface storm runoff rather than base flow or interflow; and
- Increases in velocity of flow during storms.

Changes in Urban Stream Morphology. Stream channels in urban areas respond and adjust to the altered hydrologic regime that accompanies urbanization. The severity and extent of stream adjustment is a function of the degree of watershed imperviousness. Examples of stream adjustments and their consequences include

- Increased stream cross-sectional area to accommodate higher flows;
- Significant downcutting of the stream channel (unless the bottom is heavily armoured), where widening is prevented by road or pipeline crossings;
- Increased sediment loads in the stream because of increased stream bank erosion and upland construction site runoff;
- Modification of the streambed (typically, the grain size of channel sediments shifts from coarse-grained particles to a mixture of fine- and coarse-grained particles); and
- Modification of the stream through straightening and/or lining by humans to "improve" drainage and reduce flooding risks in intensively

urbanized areas (headwater streams tend to suffer disproportionately from enclosure).

Additionally, stream crossings by roads and pipelines change such stream plan-form characteristics as location and meander pattern. These structures may be heavily armored to withstand the downcutting power of stormwater.

A critical issue is the level of development at which stream morphology begins to change significantly. Research models developed in the Pacific Northwest (U.S.) suggest that a threshold for urban stream stability exists at approximately 10% imperviousness of a watershed (see Figure 1.2) (Booth, 1991, and Booth and Reinelt, 1993). Watershed development beyond this threshold consistently results in unstable and eroding channels. The rate and severity of channel instability appears to be a function of subbankful floods, the frequency of which can increase by a factor of 10 even at relatively low levels of imperviousness (Hollis, 1975; Macrae and Marsalek, 1992; and Schueler, 1994).

Changes in Stream Water Quality. Changes in stream water quality are associated with two phases of urbanization. During the initial phase of development, an urban stream can receive a significant pulse of sediment eroded from upland construction sites, even if erosion and sediment controls are

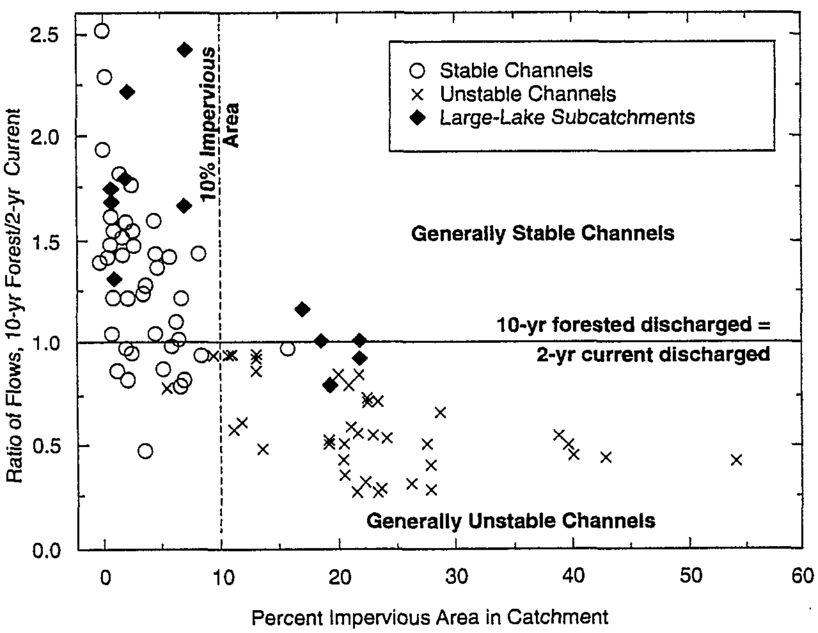

Figure 1.2 **Channel stability as a function of imperviousness (Booth and Reinelt, 1993).**

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used. Sediment contributions from the land surface typically decline to less than predevelopment contributions after upland development stabilizes and is replaced by increased stream-bank erosion. In the second phase of urbanization, the dominant source is the washing off of accumulated deposits from impervious areas during storms (Schueler, 1992).

In general, constituent concentrations in urban streams are one to two orders of magnitude greater than those reported in forested watersheds (see earlier section, Constituents in Urban Stormwater Runoff). Their degree of loading has been shown to be a direct function of the percentage of watershed imperviousness (Schueler, 1987). In urban streams, higher loadings can cause water quality problems such as turbid water, nutrient enrichment, bacterial contamination, organic matter loads, toxic compounds, temperature increases, and increased instances of trash or debris.

Changes in Stream Habitat and Ecology. The ecology of urban streams is shaped and molded by extreme shifts in hydrology, geomorphology, and water quality that accompany the development process. Stresses on the aquatic community of urban streams are often manifested as

- A shift from external (leaf matter) to internal (algal organic matter) stream production;
- A reduction in diversity in the stream community; and
- A destruction of freshwater wetlands, riparian buffers, and springs.

Structure of These Changes. Stream hydrology, stream form, water quality, and stream habitat and ecology, in order of importance, provide a structure for a designer to develop an integrated picture of the effects of hydrologic alteration on receiving environments (Snodgrass *et al.,* 1996). This structure can also be used to assist in defining environmental and BMP monitoring (Chapter 3) and stream protection (Schueler, 1992) strategies.

EFFECTS OF URBANIZATION ON OTHER RECEIVING ENVIRONMENTS. Effects of Urbanization on Wetland Systems. Neglecting direct intrusion, sound, and other effects outside the sphere of urban hydrology, the effects of urbanization on wetlands can be broadly categorized into physical/geochemical and biological effects. Primary physical/geochemical effects include

- Changes in hydrology and hydrogeology;
- Increased nutrient and other contaminant loads;
- Changes in atmospheric inputs (through increased air emissions to the urban airshed); and
- Compaction and destruction of wetland soil.

Primary biological effects associated with urban stormwater discharges are

- Changes in wetland vegetation;
- Changes in or loss of habitat;
- Changes in the community of organisms (diversity, kind, density);
- Loss of particular biota; and
- Permanent loss of wetlands.

In addition, socioeconomic changes may result, such as decreased passive recreational use. However, through the proper application of BMPs, much of this effect can be mitigated and a healthy ecosystem can be promoted.

Effects of Stormwater Runoff on Lakes. Compared to streams, lakes have at least three inherent differences that cause different reactions to stormwater runoff. These differences are as follows:

- Lakes, because of their volume, respond primarily to the mass of constituents and volume of flow rather than constituent concentration and peak flow rate. The response time is on the order of days or weeks, whereas a stream responds within hours or days.
- After visible refuse and damage, nutrient enrichment and the resulting increase in primary productivity is the most visible sign of urbanization.
- Lakes do not flush as quickly as streams and are net-depositional environments. As such, they act as sinks for sedimented materials and take longer to recover from contamination than do streams.

Heavy metals that adsorb onto sediment particles in urban runoff may not pose an immediate threat to lake ecosystems if the bottom is aerobic. But, if the bottom eventually becomes anaerobic, or is seasonally anaerobic, metals may solubilize in sufficient quantity to be toxic to benthos or pelagic species that swim through the area.

A common effect of urban runoff on lake ecosystems is that the sediment load in the inflowing stream(s) drops out near the inlet and impacts the biota living on the bottom. Depending on the areal extent of the deposition, a sufficient percentage of the natural benthos might be destroyed to alter the food chain, hence the lake organism assemblage.

Another common effect on lakes is that floatables carried into the lake by the runoff stream are blown onto the shore or into small pocket embayments, impairing the aesthetic value of the water body.

A third common effect is increased algae production by the lake if a formerly forested watershed is urbanized. Eventually, summer populations get sufficiently high to create blooms that are aesthetically displeasing. At this point, a lake's value as a drinking water source is also compromised. Blooms may deplete lake oxygen supplies sufficiently to cause fish kills, but ecologically the most significant effect is that the increased primary productivity results in an aquatic environment with decreased diversity and increased "trash" fish populations. Once this occurs, a simple stopping of the source of nutrients will have a limited short-term effect on biota—a polluted lake may take decades to recover naturally.

The broader effects of urbanization on lakes include inputs from storm sewers, CSOs (where they exist), and wastewater treatment plants. Perceptions about increased algal production after urbanization are caused more often by WWTP discharges than by storm sewer discharges. Well-developed loading estimates from the different sources on a watershed basis are needed to adequately distinguish the relative importance of the different influences of urbanization.

Effects of Urbanization on Groundwater. Urbanization affects both groundwater flow and groundwater quality, although, as noted previously, the effects on flow do not always follow expected norms. The primary effects of urbanization on groundwater quality are caused by leaking or leaching of toxic or hazardous substances from significant industrial operations (such as landfills or specific manufacturing sites), gasoline stations, and leaching of previously contaminated soils by infiltrating rainwater. These sources are often the main focuses for soil quality and groundwater quality management in urban areas but are beyond the scope of this manual.

A principal focus of this manual is the way groundwater quality is affected by infiltrating stormwater runoff and BMP facility water. The effects of these sources can be subdivided into perceptions and documented data. The perception of many individuals working in urban stormwater management is that the constituent concentration levels in stormwater runoff (see Tables 1.4 and 1.5) should affect groundwater by increasing the concentration of constituents such as heavy metals, pesticides, and herbicides. Limited data for heavy metals (such as copper, iron, and zinc) suggest that they are sorbed by soils in the bottom of BMP facilities, provided the sediments remain aerobic and have high redox potential (Yousef *et al.*, 1985) and, therefore, do not migrate in a significant way. Hydrophobic organic compounds, such as polychlorinated biphenyls and PAHs, typically do not migrate because of their highly sorptive properties.

However, highly soluble substances such as chlorides and nitrates will move with infiltrating water and not be sorbed. Some evidence is evolving to suggest that groundwater below cities such as Toronto, which uses deicing chemicals, may attain chloride levels between 500 and 800 mg/L (Howard *et al.*, 1991).

Effects of Stormwater Runoff on Estuaries. Because of the relative size of receiving environments, attributing effects to stormwater is more likely in cases of discharges to creeks (rivers) than in discharges to estuaries. To date, few studies have focused solely on the effects of urban runoff to estuaries (Odum and Hawley, 1986, and Jones, 1986). One reason for this is that, in large estuaries, urban runoff effects are inexorably and synergistically associated with the effects of dredging, chemical spills, point source contaminants, and other serious alterations. Therefore, separating the effect of urban runoff is difficult and perhaps artificial.

The effect of urban runoff is also discontinuous. Because episodes of heavy runoff with high pollutant levels are interspersed with long periods of little or no runoff, erosion of near-shore sediments during runoff events is followed by tranquil periods when biological communities can reestablish themselves. In addition, tidal processes spread discharges in multiple directions.

However, there are some definable and measurable effects of urbanization on estuaries. These include

- Sedimentation in estuarial streams;
- Changed hydroperiod of saltwater wetlands, which results from larger, more frequent pulses of fresh water and longer exposure to saline waters because of reductions in base flow; and
- Short-term salinity swings in small estuaries caused by the increased volume of runoff; this affects the local ecosystem, which may be a "delicate" or key reproduction area.

Research studies, hypothesis of effect (Hunsaker and Carpenter [Eds.], 1990), and careful segregation of scale may provide the database necessary for systematically documenting effects. Alternatively, generalized land-use relationships between the lands of urban areas and adjoining estuaries in specific ecozones may be the scale at which effects are documentable. At such a scale, the cumulative effects of urban land development, including stormwater discharges, are related to receiving water characteristics, although the specific effects of stormwater discharges are not measured.

EVOLVING ISSUES

ECOSYSTEMS AND WATERSHED BASIS FOR MANAGEMENT. Water quality management has historically focused on the control of specific pollutants. Control of BOD discharged to streams and estuaries to maintain satisfactory oxygen levels has been evaluated using assimilative capacity models (Streeter and Phelps, 1925). Discharges of phosphorus to lakes are managed to maintain a specific trophic status for lakes (Reckhow and Chapra, 1983). However, some constituents discharged to a receiving water cannot be assimilated and are exported to adjacent ecosystems through cycles of water and elements.

Ecological limits posed by the biosphere and the pollution of specific aquatic systems are leading to attempts to use ecological targets (endpoints) as approaches for defining objectives for urban stormwater quality management. In simple terms, the biosphere is the life-supporting system on the surface of the earth that provides energy, fresh air, potable water, uncontaminated food, and the recycling of wastes. Water and chemical elements cycle through various biological niches and hydrological and geological reservoirs in the biosphere. However, urbanized human populations exert severe stress on specific local biota and natural resources. In addition, the elemental and hydrological cycles cause stress to be exported to adjacent lakes, streams, estuaries, and ecosystems.

Therefore, the ecosystem has become the focus for management of the environment. This requires an understanding of what is meant by the term "ecosystem" and an approach for using the ecosystem as the basis for urban stormwater quality management.

These broad concepts are applied to urban stormwater management issues in the following sections, which consider the overall effects of urbanization on the environment, watersheds, application of ecosystem principles to BMP planning, and impact assessment.

EVOLVING APPROACHES TO STORMWATER QUALITY MANAGEMENT. Urban stormwater quality management is subject to analysis through several different approaches, namely, environmental resource protection planning, comprehensive urban runoff quality management, and comprehensive stormwater management. As it applies in this manual, the term "urban" includes developed and urbanizing areas. In broader terms, evolving approaches to stormwater quality management in North America include

- Water-quality-based mandates for stormwater releases (that is, stormwater effluent quality levels developed by an impact assessment methodology or for a design storm by the stipulation of a defined concentration target for stormwater releases);
- Best management practice plans for stormwater runoff from a specific facility or subwatershed;
- A comprehensive stormwater quality protection strategy that includes BMP plans;
- A comprehensive receiving water protection strategy; and
- Watershed-based approaches.

The comprehensive stormwater quality protection strategy includes pollution prevention (also called source control), pollution control, land-use planning, and regulatory control.

Pollution control, in the form of treatment-type BMPs, has been a primary focus of recent efforts. Because most BMPs are passive in nature, protection strategies have expanded to include pollution prevention and regulatory control approaches. However, the effectiveness of pollution prevention efforts are often not known quantitatively. With the development of data that link percent imperviousness thresholds to stream degradation in headwater areas (see Figures 1.2 and 1.3), the potential for using land-use planning as a tool has commonly been proposed.

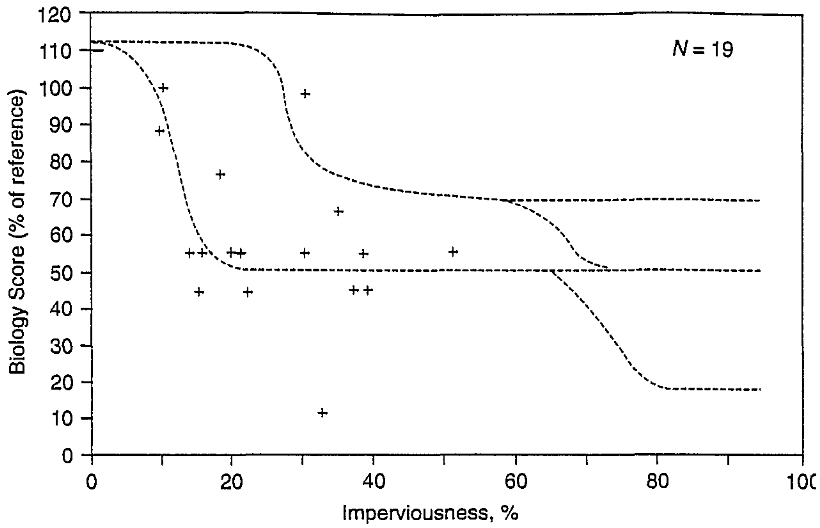

Figure 1.3 Effect of watershed imperviousness on biologic integrity within the Northern Piedmont ecoregion of Delaware, 1993.

Both pollution prevention and pollution control are cornerstone approaches for stormwater quality management. They are addressed in this manual in Chapters 4 and 5, respectively. Watershed approaches historically have been used for flood control and erosion control. Future direction will come from ecosystem analysis on a watershed basis and attempts to integrate these concepts with flood control, erosion control, and water quality management.

THE WATERSHED AS NATURAL BIOPHYSICAL BOUNDARY. An ecosystem approach to planning requires that boundaries for examining relationships between the natural environment and human activities be based on biophysical rather than political issues. To this end, watersheds and subwatersheds provide a biophysical basis for planning and management.

A watershed uses the hydrologic cycle as the pathway that integrates the physical, chemical, and biological processes of the basin ecosystem. It provides a fundamental unit with real boundaries of ecological significance. This unit provides a quantitative reference frame to make inferences on ecological stress, instream flow, and the cumulative effects of land-use development. A watershed basis has been the natural approach for water-quantity-related issues (such as flood control or erosion control) and, more recently, for water quality issues (for example, dissolved oxygen control in streams and phosphorus loadings to streams).

The ecosystem approach assists in balancing economic, social, and environmental needs. The approach purposefully links aquatic, terrestrial, and human life within the watershed as a healthy self-sustaining ecosystem. The benefits of this are numerous and long term. Watershed planning becomes an integral part of an ecosystem and land-use planning process, set within the context of environmental sustainability.

WATERSHED PLANNING. Watershed planning (U.S. EPA, 1993), described further in Chapter 2, involves at least the following three phases:

- Background review and definition of management goals;
- Analysis and development of a plan (strategies including an impact assessment); and
- Implementation of a plan.

Watershed planning is an essential element for environmental resource protection because it identifies ecological components requiring protection, systematically analyzes relationships between urban land uses and these ecological components, and develops a plan that is ecosystem based. The pertinent steps for watershed planning are outlined in Table 1.7; methods for developing an overall watershed approach are described in Chapter 2.

Representative products (or deliverables) expected from a watershed study, a subwatershed study, and a BMP facilities study are given in Table 1.8. An ecosystem approach requires that a master environmental plan be developed in addition to "and integrated with" a master drainage plan. A fundamental problem, however, is how to implement an ecosystem approach to planning on a watershed basis. An ecosystem approach forces a designer to look not only at air, water, land, and living things but also at the interrelationships of these components. Furthermore, the study of these interrelationships includes both "quality" and "quantity" aspects.

Traditionally, science has taken a reductionist approach by studying the individual components of a system. In the context of a watershed, this would mean studying streams, groundwater, aquatic communities, and other environmental components of interest. It also includes studying municipal WWTP discharge, industrial waste sources, CSOs, sanitary sewer overflows, and stormwater discharges. However, ecological planning requires an understanding of how these components interact. This study of interrelationships and the whole is known as "integration."

USE OF AN ECOSYSTEM APPROACH FOR PLANNING. Best management practice planning occurs on both a watershed scale and a site scale (see Table 1.9). Watershed-level plans are more suited to incorporating ecosystem-based geographic boundaries, multiple project influences and effects, and the setting of ecosystem health objectives with the assistance of public input.

However, application of an ecosystem approach for individual development projects and BMP facilities is more difficult because it is harder to understand the relationship of a specific project to the surrounding ecosystem

Table 1.7 Steps in watershed planning.

Phase I background information
Define study goals
Inventory watershed and establish VECs/human uses
Design/initiate necessary field work
Public participation
Define present land uses and pollution sources
Define present state of the environment
Define future causes of environmental degradation (land-use changes, population growth, emission sources)
Define management goals for aquatic systems/human uses
Phase II analysis and development of plan
Define ecosystem framework
Define impact hypothesis (modes of impact, exposure pathways, environmental changes)
Define ecological/environmental endpoints and targets (evaluation criteria)
Define by screening studies, magnitude of impact
Define potential ecosystem protection/mitigating measures (such as BMPs, conservation practices)
Prioritize analysis
Define and apply prediction techniques
Establish alternative management strategies
Review effectiveness, uncertainties, cost, benefits, risks, implementation
Assess whether management goals/environmental targets can be met
Public and institutional review
Select and develop recommended watershed plan
Define uncertainties
Financing
Phase III implementation plan
Define implementation strategy
Define uncertainties and necessary research
Define lead agency for implementing different components of plan
Define funding sources
Define approval mechanisms
Define direction for subwatershed and BMP plans
Define schedule and phasing
Establish implementation committee/task force and terms of reference
Define long-term monitoring program

Table 1.8 Outline of deliverables expected from watershed planning.

Deliverables expected from watershed study
Inventory of resources and establishment of management objectives
Statement of environment endpoints and quality targets
List of BMPs and mitigating measures and location in watershed
List of impact statements and uncertainties to be addressed in future monitoring programs.
Deliverables expected from subwatershed study
Detailed evaluation of watershed information
More detailed analysis of environmental quality targets (defined in watershed study) and land-use densities and mitigating measures required to achieve the targets
Detailed hydrology and hydraulic modeling (as required) to define sizes of BMP facilities required for hydrological aspects
BMP selection
Deliverables expected from BMP facilities study
Confirmation of critical hydrological/hydraulic assumptions used previously
Selection of ecosystem features at BMP facility
Conceptual followed by detailed layout of BMP/BMPs for upstream, site, and downstream aspects
Detailed design

and it is difficult to assess the cumulative effects that are involved. Therefore, for individual projects in which watershed plans have not been developed, an ecosystem approach should include

- Establishing ecological objectives based on desired beneficial uses;
- Considering effects beyond the vicinity of the facility site but within the watershed (another definition is to "look upstream," "downstream," and "at the point of release" of the stormwater);

Table 1.9 Proposed hierarchy based on geographic/geomorphic scaling considerations.

System level	Linear spatial scale, m	Aerial spatial scale, m^2	Time scale of continuous potential persistence, years	Time scale of persistence under human disturbance patterns, years
Watershed	10^5	10^{10}	10^6–10^5	10^4–10^3
Subwatershed	10^4	10^8	10^4–10^3	10^2–10^1
Reach	10^2–10^1	10^5	10^2–10^1	10^1–10^0
Site	10^1–10^0	10^2	10^0	10^0–10^{-1}
Habitat element	10^0–10^{-1}	10^1	10^0–10^{-1}	10^{-1}–10^{-2}

- Establishing the boundaries of the study to include off-site areas with functional linkages on site, sometimes by facilitating cooperation among landowners to include stream corridors, wildlife management areas, and local groundwater aquifers;
- Increasing collaboration among the team members dealing with biology, surface water, and hydrogeology;
- Illustrating ecosystem functions and linkages in "pathway diagrams" for project effects such as air, noise, litter, and water quality and using these to scope the assessments;
- Systematically considering interactions among components of the environment (for example, the effects of surface water and groundwater on biology);
- Describing existing and past conditions, including both the functions of the ecosystem components and their interactions with one another (for example, past construction of a storm sewer has dried up a wetland or the construction of barriers has reduced stream flow); and
- Systematically considering environmental effects of other existing and future facilities or projects in assessing the net effects of the undertaking.

The first four points are often considered in watershed evaluations; the other points represent the evolving practice toward an "ecosystem" approach.

ENVIRONMENTAL MONITORING AND IMPACT ASSESSMENT

Methods for conducting an impact assessment include evolving methodologies such as a stress-response framework (Hunsaker and Carpenter [Eds.], 1990), risk assessment approaches (Suter, 1993, and Warren-Hicks *et al.*, 1988), environmental effects monitoring (Hollings [Ed.], 1978, and Hunsaker and Carpenter [Eds.], 1990) and other methodologies detailed in Chapter 3.

Furthermore, watershed studies, research studies, and experience now permit desired environmental quality goals to be stated in physical, biological, and chemical terms. However, cause–effect methodologies for relating BMP performance to biotic changes are only now evolving. Therefore, impact assessment methodologies presented in Chapter 3 are stated in terms of hydrological performance (using hydrological models); loadings of constituents to receiving environments; and bioassessment, biocriteria, and inferences that can be gathered from field data rather than from deterministic cause–effect relationships.

EVOLVING APPROACHES TO BIOLOGICAL IMPACT ASSESSMENT. Environmental Endpoints. The term "environmental endpoint" has evolved from the field of ecological risk assessment (U.S. EPA, 1992, and Warren-Hicks *et al.*, 1988) to include both "ecological entities" and human uses/concerns (such as human health and safety and property protection). An environmental endpoint can be defined as

- A component of the environment (for example, air or soil quality) that is valued by the public and represents a significant attribute of the environment;
- A part of the environment that can be measured (often using various biological, chemical, or physical parameters) or calculated/modeled;
- An entity that is affected by urbanization or a specific proposed project; or
- An intermediate or final compartment along a series of environmental pathways that are affected by the project.

The following environmental endpoints and methods are presently being applied in the field of impact assessment:

- *In situ* properties of receiving environments:
  - Hydrological characteristics (such as flow and velocity);
  - Physical and chemical constituents of surface water;
  - Physical and chemical characteristics of sediments (Livingston *et al.*, 1995);
  - Water column communities (such as algae, zooplankton, and fish);
  - Benthic communities;
  - Human health characteristics (such as fecal coliforms and viruses);
  - Other biological and toxicity characteristics (for example, BOD); and
  - Morphometric properties (particularly in streams).
- Laboratory-based measurements:
  - Aquatic toxicity,
  - Genotoxicity,
  - Sediment toxicity, and
  - Chemical concentrations of field samples.
- *In situ* probes and biomonitors:
  - Algal organisms to measure bioaccumulation or *in situ* toxicity,
  - Attached algae that sorb particular contaminants, and
  - Young-of-year fish that migrate limited distances in stream.
- Stormwater and BMP discharge:
  - Chemical constituents, and
  - Biological properties (BOD, fecal coliforms, toxicity).

The category "*in situ* probes" involves putting organisms in place for brief periods of time to measure phenomena not measured by typical chemical procedures or using special *in situ* organisms to detect effects.

Biologically Based Effects Monitoring. These types of environmental endpoints represent a shift away from a chemical concentration approach for measuring environmental quality and toward a biologically based effects approach (for example, bioassessment or biocriteria). This change is occurring because biological measurements provide more meaningful data for characterizing environmental quality. However, data obtained are often difficult to interpret. Moreover, while water quality standards for many parameters provide a reference by which to compare water characteristics, water quality objectives for many biomonitors are not known. By installing biomonitors above and below stormwater discharges in an urban area, an increase in body burden for a particular chemical parameter can be measured, although its environmental meaning is unclear.

An environmental effects monitoring program can be thought of as having the following structure in its biological and chemical components:

- Concentrations of constituents and whole water toxicity of the BMP-discharged water;
- Sediment accumulation and toxicity;
- Bioaccumulation (for example, contaminant burden in organism tissue or human consumptive concerns); and
- Trophic-level effects (such as subcellular, cellular, community level, and population level).

The development of monitoring systems during the next decade may be aimed at formulating a balance between chemical- and biological-monitoring approaches in this evolving science. A set of principles and approaches for monitoring the effectiveness of stormwater quality BMP and receiving water effects is provided in Chapter 3.

Focus in This Manual. In the evolving field of environmental monitoring, the following physical and chemical factors are particularly relevant monitoring components (Urbonas, 1994) as they apply to information presented in this manual:

- Hydrological alterations/mitigations to stormwater runoff from an urban catchment provided by the BMP;
- The treatment efficiency provided by the BMP for SS and attached contaminants;
- Nutrient removal provided by the facility; and
- Temperature properties of discharged waters.

These monitoring components are presently carried out at many sites and are discussed in detail in Chapter 3 in relation to monitoring BMPs and their receiving waters.

In addition to physical and chemical factors, important environmental monitoring factors for biological components include

- Toxicological properties of runoff water (as a laboratory procedure) and scale-up to receiving water consequences;
- Bioaccumulation of contaminants in the food chain; and
- Alteration of the benthic community because of the physical stress of runoff water.

A key technical issue of monitoring is to determine the relative importance of flow alterations (physical, morphological changes that degrade the benthic community) and chemical effects (through toxicity and bioaccumulation) on determining the primary cause of effects on receiving water ecosystems. Presently, emphasis is placed on the structure and abundance of water column and benthic communities in receiving environments rather than on cause–effect relationships. If either the physical or chemical effects of urban stormwater runoff were clearly shown to be the primary causes of degradation of urban receiving water ecosystems, improvement in the rationale for stormwater BMP design could be achieved.

ISSUES OF SCALE. This section examines the influence of scale on the response time of streams to urbanization and the receiving water scale on which monitoring can be expected to detect changes because of the installation of one BMP facility or a set of facilities within a watershed.

Physical and Temporal Response of Streams. The geomorphological alteration of streams caused by altered urban hydrology has one of the longest response times of all receiving water attributes. In terms of the scale of a stream reach, at least a decade may be required for a stream ecosystem to respond to altered hydrology.

Scale for Monitoring the Response of Streams. Research has suggested that a threshold effect is observed in the relationship between imperviousness of a watershed and a stream's morphology and ecosystem. The relationship between imperviousness and benthic organism density, presented in Figure 1.3, shows a significant change in watersheds having 10 to 20% imperviousness. Shaver *et al.* (1995) hypothesized that installations of BMPs might protect the stream and change the threshold to 30 to 50% (see Figure 1.3).

Because the streams shown in Figure 1.3 are largely unprotected with BMPs, validation of this hypothesis should be sought by comparing subwatersheds fully protected by BMPs to equivalent watersheds without BMPs.

In developing such a monitoring program, additional points should be considered. Benthic organisms, if used as the response variables, integrate the effects of hydrologic control and water quality protection provided by BMPs. As discussed above, a monitoring program that seeks to separate the effects of water quality improvement from those of hydrologic control requires a special design. Secondly, many of the streams represented in research drain small watersheds (typically containing first- and second-order streams). Therefore, different threshold effects may be measured in larger streams.

TOTAL EFFECTS METHODOLOGIES. Broader based planning methodologies and environmental assessment are evolving to account for the total impacts of urbanization on the environment. Best management practice impact assessment methodologies may need to consider such new issues especially in multifaceted watershed studies.

Other Ecosystem Boundaries. The watershed boundary is an appropriate ecological boundary for managing stormwater runoff from catchments discharged to receiving environments (surface waters and their contained ecosystems, and groundwater). But, other boundaries may need to be considered.

The watershed boundary is not the only boundary used in ecosystem analysis and planning. In fact, there is no single, all-inclusive ecosystem approach to analysis and planning. Rather, there are several approaches in existence, such as landform based (such as the Appalachian mountains), ecological land classification based (ecoregions and ecozones) (see Livingston *et al.*, 1995), landscape and natural heritage, groundwatersheds, and airsheds. Human concerns include urban regions and commutersheds. An important points is that we are the ones identifying the boundaries of ecosystems as a geographical basis for management. However, ecosystems function regardless of our efforts to compartmentalize and spatially define them. The ecosystems that we map are simply "constructs" to facilitate our understanding and management. The chosen boundaries are seldom "absolute," but, rather, should be regarded as "diffuse" and as an approximation of what is appropriate for a given concern, theme, and chosen scale.

Total Impacts of Urbanization. This chapter has concentrated on the environmental impacts of urbanization caused by stormwater runoff and the mitigation provided by urban BMPs. However, stormwater runoff does not account for all the environmental impacts of urbanization. This section outlines the broader issues to assist the designer in understanding other evolving issues that may influence their decisions related to stormwater management. The broader issues include direct spatial effects involving loss of lands; indirect impacts through pathways, especially hydrological and ecological alterations; and cumulative effects.

DIRECT SPATIAL EFFECTS. Loss of lands and direct alteration of stream channels (direct spatial effects) have historically been among the largest effects of urbanization on surface waters and their contained ecosystems. In fact, a permanent feature of urban development is the loss of natural features, valued land forms, groundwater recharge/discharge areas, and wildlife habitats if development occurs on lands occupied by these land uses. In some literature, these effects are called "form effects" or "spatial impacts," in the geographical information system sense of "spatial analysis."

Spatial impacts resulting from urbanization include reconstruction, encroachment, and intrusion by humans. For receiving environments such as stream corridors and valleys, direct effects have historically been caused by enclosing streams in pipes or open channels, channel realignments, and stream crossings by infrastructure. Stormwater impacts are not easily addressed under this topic because they are an indirect effect.

PATHWAYS. Pathway-based methodologies are used in fields such as ecological and human health risk assessment. Pathways involve the movement of water or contaminants from industrial, residential, commercial, or agricultural areas through atmospheric, surface water, or groundwater routes (indirect impacts through pathways) to affect biota in the various ecosystems where they live, breed, and raise their offspring. These ecosystems units are called habitats. The pathways may be physical or biological in nature. Pathways relevant to urbanization issues include hydrological pathways, biological pathways, and air pathways.

Stormwater runoff is one pathway used to analyze the impacts of urbanization and is considered in this manual. As summarized above, the main effects of urbanization on hydrological pathways include increases in surface water flow, reduction in infiltration to groundwater, increased risk of water quality degradation, increases in flooding and erosion potential, and habitat degradation and even destruction.

The main effects of biological pathways include the bioaccumulation of toxic elements through the food chain. The main effects on air pathways include increased emissions of various contaminants to air from fuel consumption for heating residences, industrial and commerical buildings, transportation, and industrial operations. These latter pathways are generally not considered in this manual.

CUMULATIVE EFFECTS. Cumulative effects assessment is an additional factor required in recent planning and monitoring studies. The current system for reviewing planning applications, particularly in rural areas within the urbanizing fringe, is primarily oriented to site-specific analysis and, therefore, does not anticipate the broader, longer term environmental implications of permitting many individual sites to be developed. In some planning circles, these are known as cumulative environmental effects (for additional discussion, see Constant and Wiggins, 1991).

Watershed studies and ecosystem-based planning are examples of cumulative effects analyses. They allow one to examine the effect of all development on loadings of contaminants to surface waters and groundwater; changes in groundwater and surface water flow; changes in an instream or lacustrine fishery habitat caused by changes in surface water flow or water quality; and changes in other ecosystems or their habitat because of the introduction of contaminants through air or water pathways.

However, few studies have been carried out to date to measure (monitor) the cumulative effects of implementing urban BMPs throughout a watershed, a deficiency that needs to be addressed in future research.

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Chapter 2
Developing Municipal Stormwater Management Programs

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Historically, municipal management of stormwater has focused on runoff quantity—primarily through the control of peak runoff rates during land development to limit susceptibility to flood-related damage. However, considerable emphasis has also been placed on municipal management of stormwater quality—pollutant removal from stormwater before discharge to receiving waters. This emphasis primarily is because of

- Regulations prepared by the U.S. Environmental Protection Agency (U.S. EPA) that control the quality of stormwater discharges under the National Pollutant Discharge Elimination System (NPDES) permitting program;
- Water quality regulatory programs at local and state levels; and
- Specific cases in which there is a clear mandate to treat stormwater before discharge, regardless of whether there is a regulatory need to do so.

Although there is legitimate debate on many aspects of stormwater quality management, there is a general consensus that urban stormwater quality needs to be managed. This section presents a six-step decisionmaking process for developing a stormwater management program, as follows:

- Step 1—define objectives,
- Step 2—assess existing conditions,

- Step 3—establish program framework,
- Step 4—select near-term best management practices,
- Step 5—implement near-term program, and
- Step 6—evaluate effectiveness.

The first three steps establish a long-range strategy for the stormwater management program. These steps are described below:

- Establish stormwater management objectives—convene a committee of "stakeholders" in the program to define what the program aims to achieve and the critical factors that will determine its success.
- Assess pollutant sources and existing controls—use readily available information to perform an initial assessment of factors affecting stormwater quality management (for example, development patterns, known pollutant sources, and observations of illicit discharges). Implement a long-term assessment plan to provide decisionmakers with a better understanding of water quality issues, pollutant sources, and best management practice (BMP) effectiveness.
- Establish a management program framework—a long-term strategy should include a management program framework outlining the scope of the program and a list of priorities appropriate to the objectives and current conditions.

Steps 4 and 5 involve selection and implementation of a complementary and integrated set of BMPs. Chapters 4 and 5 of this publication describe BMPs.

The last step in this decision process, assessing the effectiveness of implemented BMPs, may involve monitoring, modeling, and BMP performance auditing. This step is introduced in this chapter, with evaluation techniques defined in Chapter 3.

ESTABLISHING STORMWATER MANAGEMENT OBJECTIVES

An effective management program should focus on desired beneficial uses of receiving waters and must relate to significant pollutant sources within the entire watershed of that receiving water. Often, the cause–effect relationships of pollution control and beneficial use protection are uncertain. Therefore, near-term goals should focus on obvious, localized problems and should establish an appropriate scientific and administrative structure for addressing long-term beneficial use protection in a cost-effective manner.

PROTECTING BENEFICIAL USES. A stormwater quality control program should protect beneficial uses of receiving waters. These beneficial uses typically include aesthetic resources, aquatic habitat, water supply, and recreation. While state regulatory agencies have designated beneficial uses for most major receiving waters, beneficial uses of many urban streams and lakes may not be currently designated. In addition, beneficial uses of urban streams and lakes should reflect their municipal drainage functions and consider any previous or required future alterations for flood or stream bank erosion control.

After being designated, the stormwater management program should implement only those stormwater management measures necessary to mitigate urban runoff effects on beneficial uses. While this conclusion is obvious, there are significant gaps in our understanding of these effects, their causes, the relative effects of other pollutant sources, and the effectiveness of available management measures. The municipal stormwater management program should participate in confirming or designating beneficial uses of waters receiving urban runoff. Each receiving water "user" will have definite views on what these beneficial uses should be (for example, swimming, surfing, fishing, boating, aquatic life habitats, or aesthetics) and the local areas of concern. Certain waters will be seen as more valuable than others.

The attainment of seemingly obvious beneficial uses may carry significant cost burdens. If the attainment of goal 4 in Table 2.1 were selected as the goal of the stormwater management program, enormous costs would be incurred and current technology might be insufficient to meet existing standards for several constituents. Therefore, it is imperative to understand the implications of various goals and the costs associated with obtaining these goals. Technical studies are necessary to determine whether beneficial use attainment is achievable at a reasonable cost and to quantify long-term pollution control goals necessary to attain designated uses. Detailed discussion of appropriate study techniques is found in Chapter 3.

DEVELOPING A WATERSHEDWIDE APPROACH. The need to use a watershedwide approach to managing stormwater is obvious—stormwater flows and constituent loads at any location are generated to some degree by all points tributary to that location. However, every watershed is composed

Table 2.1 Beneficial use attainment guide.

	Performance standards	
Attainment goals	**Loadings**	**Water quality**
1. No significant degradation	Reduce increase	Reduce deterioration
2. No degradation	No increase	No deterioration
3. Improved water quality	Lower than existing	Better than existing
4. Meet numeric water quality standards during storm events	Significantly lower than existing	Better than existing

of many smaller watersheds, and each watershed is a portion of a larger watershed. Therefore, focus management programs on the watersheds of receiving waters with observable beneficial use impairment or valuable beneficial uses warranting protection.

Next, establish watershed management responsibilities. Smaller watersheds may be entirely urban with no significant sources of pollution other than stormwater. Typically, these watersheds can be managed exclusively by the urban stormwater management agency. However, other watersheds may span several jurisdictions or contain a wide variety of pollutant sources. Watershed management in these larger watersheds requires intergovernmental coordination and cooperation to establish

- Objectives that will benefit the watershed,
- Measurable criteria to demonstrate that the implemented practices are effective, and
- Clear lines of responsibility for watershed management among all jurisdictions in the watershed.

Finally, establish watershed management objectives. At a minimum, objectives for a small urban watershed should address the needs of its local receiving water. In addition, a small watershed's objectives should reflect its relative contribution to beneficial use impairment to receiving waters of the larger watersheds. The larger watershed may have different pollution control objectives than its smaller component watersheds, objectives that may be difficult to define in the near term because of size and complexity. Therefore, near-term stormwater management programs typically should focus on managing the watersheds of small urban streams because their needs are easier to define and solve. Near-term stormwater management programs should also address impairment to larger receiving waters only where the source is obvious, the cost is low, or the program establishes the foundation for long-term control (for example, public education).

INVOLVING STAKEHOLDERS. A stormwater management program should be developed with the involvement of one or more qualified committees of interested and affected organizations, agencies, elected officials, or citizens within the watershed. The purpose of these committees is to address technical, monetary, and policy issues associated with a regional stormwater management program. It is important to establish these committees early in the planning process. Perhaps more importantly, the committee will develop a sense of the commitment on the part of the participating agencies.

Participating committee members must include any agencies that will be affected by the stormwater management program. The composition of a typical committee is shown in Figure 2.1. Key members of the committee include representatives from regulatory agencies and environmental groups to address health and safety aspects of specific stormwater management early in

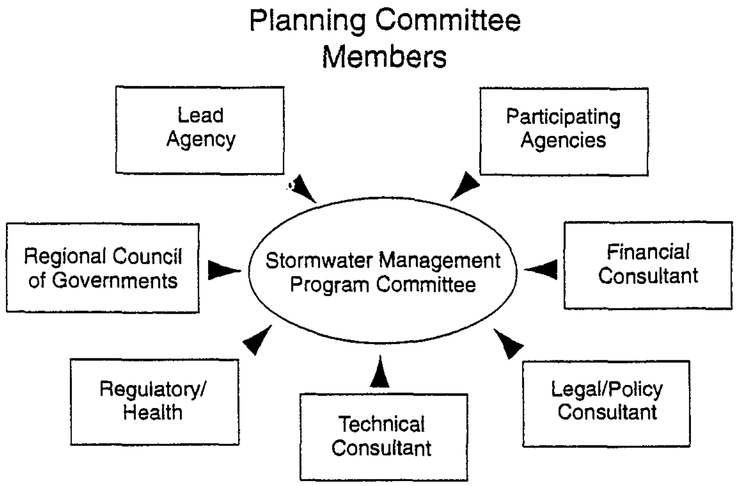

Figure 2.1 Stormwater management program.

the planning process. The committee also must include experienced individuals in the areas of aquatic chemistry, aquatic ecology, and urban hydrology.

The stormwater planning committees must ensure that watershed planning is conducted in the spirit of cooperation and good faith. The priorities of each participating agency need to be fully disclosed and discussed. Even a hint of a "hidden agenda" can prolong any real progress of a project.

MEETING REGULATIONS. In the final analysis, the stormwater management program pollution reduction goals are set by the regulatory requirements. This section describes types of regulatory programs concerned with urban runoff pollution.

Federal. *NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMITTING.* Section 402(p) of the Clean Water Act established NPDES permitting requirements for municipal stormwater systems and two goals for these permits:

- Eliminate nonstormwater discharges from storm drains. Nonstormwater discharges typically are intermittent, unpredictable, widely dispersed, and difficult to detect. They may be physically connected to storm drains or may result from dry weather water use that entrains constituents as it runs off.
- Reduce stormwater pollution to the maximum extent practicable. According to U.S. EPA NPDES permitting regulations in the Code of Federal Regulations, the local entities and regulatory agency should define the maximum extent practicable (MEP) through a comprehensive planning process. The process should consider the magnitude of

the problem, constraints on its resolution, the effectiveness and track record of available BMPs, and costs. Recent practice is to define MEP using a combination of source control BMPs and treatment control BMPs. The MEP is not a fixed target but should be reexamined and, if necessary, revised to incorporate current knowledge about sources of pollution and the demonstrated effectiveness of BMPs.

COASTAL NONPOINT POLLUTION CONTROL PROGRAM. The Coastal Zone Act Reauthorization Amendments of 1990 require states with approved coastal zone management programs to develop a Coastal Nonpoint Pollution Control Program for approval by U.S. EPA and the National Oceanographic and Atmospheric Administration. The purpose of the program is to work closely with other state and local authorities to develop and implement management measures for nonpoint source pollution (including urban runoff) that restore and protect coastal waters. Coastal stormwater control programs are not intended to supplant existing coastal zone management programs. Rather, they are to serve as an update and expansion of existing nonpoint source management programs and are to be coordinated closely with the existing nonpoint source management programs (U.S. EPA, 1991).

NATIONAL ESTUARY PROGRAM. U.S. EPA administers the National Estuary Program under Section 320 of the Clean Water Act. This program focuses on all pollutant sources in geographically targeted, high-priority estuarine waters. Through this program, U.S. EPA assists state, regional, and local governments in the development of comprehensive management plans that recommend priority corrective actions to restore estuarine water quality, fish populations, and other designated uses of the water (U.S. EPA, 1991).

State. States have evolved a variety of statewide stormwater pollution control strategies. A few states initiated controls in response to the perceived needs of their states. Many more developed strategies in response to U.S. EPA requirements that have sometimes lapsed into oblivion, lacking any obvious immediate necessity or federal sanction. The general objective of controlling stormwater pollution is accepted as important not only by environmental interests but by water resource analysts as well. Development of stormwater pollution control programs is proceeding but is moving slowly.

CASE STUDY—STATE OF MARYLAND. Maryland has a well-developed program for the control of stormwater pollution, with particular interest in the restoration and protection of the Chesapeake Bay and its tributaries. Eutrophication of the Chesapeake Bay causes serious declines in water quality and fishery productivity. A water quality model of the Chesapeake Bay demonstrated the relationship between nutrient input, eutrophication, and deoxygenation. Accordingly, a target was set in 1987 to reduce the total input of nitrogen and phosphorus by 40% by the year 2000. A current reevaluation will examine the progress made toward the 40% goal and recommend adjustments to the program.

Maryland enacted legislation from 1984 to 1986 to establish a 305-m (1 000-ft) critical area around the edge of the bay and create the Chesapeake Bay Critical Area Commission to establish criteria for development in the critical area. Within intensely developed areas of the critical area, storm runoff pollution loads for new development must be reduced at least 10% below predevelopment levels or offsets must be provided. In limited development areas, no more than 20% of woodland or forest may be developed, and the impervious area created in any development site is limited to a maximum of 15% of the total site. In resource conservation areas, additional residential development can only be allowed at a density not exceeding one house per 8 ha (20 ac). State grants have been available to support the necessary local planning.

More than 5 000 stormwater management facilities have been installed on new developments in Maryland between 1985 and 1989. The general goal of Maryland's stormwater management program is that both the quantity and quality of runoff from developed land will be as close as possible to the runoff characteristics of the predeveloped condition. Implementation of management stormwater controls for existing urban areas is carried out with local jurisdictions through the Stormwater Pollution Control Program. This state program provides grants of up to 75% of the project's cost to counties and towns. Although more than 50 projects have been constructed, progress statewide has been slow.

Interstate. Many watersheds encompass areas within more than one state. For example, the Delaware Estuary Management Plan, sponsored by U.S. EPA and the states of Delaware, New Jersey, and Pennsylvania, is part of the National Estuaries Program. The Delaware Estuary, as a whole, is still relatively unpolluted. Thus, the plan focuses primarily on land use management programs in each state designed to prevent the major increases of stormwater pollution that otherwise would accompany future development and the protection of sensitive habitat (for example, a primary national flyway).

The plan establishes a "primary zone of influence" where controls would be mandated based on time of travel (that is, the time for runoff to reach the estuary). A time of travel of 40 hours at mean flow conditions was used to establish the tentative boundary for the primary zone of influence.

The estuary program is bringing attention to some striking differences in handling stormwater pollution control in the three states. Delaware has a recently developed program requiring water quality control of storm runoff from new developments statewide. New Jersey has well-developed, but nonmandatory, standards of water quality control in stormwater management in which application is left to municipal discretion. Pennsylvania has no such standards except for streams draining into lakes and for the control of nutrients in the Susquehanna River Basin related to the Chesapeake Bay estuary study. Clearly, interstate programs present numerous implementation issues.

Regional. Several states have adopted regional approaches to managing stormwater runoff. In Florida, rapid growth during the late 1970s and throughout the 1980s placed numerous demands, both in water quantity and quality, on the state's vulnerable and limited water resources. To reduce degradation from the rapid growth and extensive land-use changes, a wide variety of laws and regulations have been implemented by the state and local governments.

California's Porter-Cologne Act requires the development of basin plans for the various watersheds. The basin plans are implemented through the NPDES permitting program, which is administered by the nine regional water quality control boards under supervision of the State Water Resources Control Board. Areawide municipal stormwater NPDES permits have been granted to 12 urban counties and all cities within these counties. In the San Francisco Bay watershed, the Bay Area Stormwater Management Agencies provide watershedwide coordination of the NPDES-permitted stormwater management programs, other nonpermitted municipal stormwater management programs, and San Francisco's combined sewer overflow program. Additionally, statewide Stormwater Quality Management Task Force meetings of municipalities, industries, regulatory agencies, and consultants help coordinate stormwater management programs throughout the state.

ASSESSING EXISTING CONDITIONS

A common question asked while developing a stormwater management program is "What is the stormwater quality problem?" While this is a logical question, a firm scientific answer is sometimes difficult and costly to give. To move the program forward, municipalities should conduct a quick assessment of obvious local receiving water problems, significant pollutant sources, and existing control programs based on visual observations and readily available data. This assessment should apply monitoring, modeling, and performance auditing methods discussed in Chapter 3 for watershedwide evaluations of pollutants and their effects. Local staff members with pragmatic knowledge of the "lay of the land" are an asset when assessing existing conditions. The four primary areas that should be explored when assessing existing conditions are receiving water characterization, watershed characteristics, pollutant sources, and existing programs.

RECEIVING WATER CHARACTERIZATION. The main receiving water effects associated with stormwater are

- Receiving water hydromodification because of increased runoff from urban areas;
- Water quality degradation from changes in the chemical/bacteriological constituents in runoff; and
- Losses in the assimilative capacity of the urban drainage system.

Schueler (1993) classifies urban runoff effects as changes in stream hydrology, morphology, water quality, habitat, and ecology. An effective stormwater management program needs to consider receiving water characteristics and effects of urban runoff on the receiving water. However, significant gaps remain in our understanding of and ability to define these characteristics and effects. Therefore, the near-term stormwater management program should begin to define receiving water characteristics and effects to establish near-term stormwater pollution control targets.

Typically, the beneficial use effects of stormwater on specific receiving waters have not been examined in detail. The traditional method of defining beneficial use effects are based on numerical and narrative water quality standards and effluent limits for chemical constituents. This traditional method must be supplemented by other approaches (for example, hydrologic modeling, bioassessment, and habitat assessment) to address the full range of urban runoff effects and develop appropriate control strategies. Chapter 3 discusses these traditional and alternative approaches to characterizing receiving waters and the effects of urban runoff.

POLLUTANT SOURCES. The stormwater management program should direct control measures at pollutants that impair the beneficial uses of the receiving water. For example, pollution control in the watershed of a eutrophic receiving water should be directed at significant sources of the limiting nutrient (such as phosphorus or nitrogen). Concentrated sources of pollutants can be effective early targets for the stormwater program because their cleanup is both observable and measurable. These sources might include old commercial and industrial areas and old core urban areas where polluting non-stormwater connections to the storm drain system are most likely to be found. Also, stormwater pollution controls are often easier to implement if directed at related problems recognizable to the community. For example, a business or resident using "bad housekeeping practices" outdoors is often considered to be an eyesore to neighbors (if not in violation of local regulations).

Visual observation is the best way to begin targeting pollutant sources in the near term. After the most concentrated sources are addressed, long-term monitoring programs may begin providing insight to more widely dispersed pollutant sources. Computer models then can be used to project existing and future pollutant loads based on the land uses of the watershed and characteristic concentrations of runoff from each land use (see Chapter 3 for details). Research into the composition of materials may also help reveal the source of critical pollutants.

Pollutant load estimates define the relative loading of pollutants from different parts of the watershed. Knowledge of pollutant characteristics helps reveal proper pollution control strategies. For example, can nonstructural controls, especially for currently existing development, significantly address water quality needs before structural controls are even considered? What will be gained if structural controls are retrofit in an area, and can the cost be justified?

WATERSHED CHARACTERISTICS. The basic objectives of this step include becoming familiar with the watershed, focusing on those factors that will influence the nature of stormwater management, and collecting all information necessary to select BMPs. Characteristics should include the following:

- Land use: What is the existing land use and impervious area of the watershed? What will land use/imperviousness be at buildout? What is the proximity of intensive land uses to sensitive receiving waters?
- Physiology: Are slopes steep, moderate, or flat? Are soils erosive? Are they permeable? What is the depth to bedrock? To groundwater?
- Climate: What is the rainfall intensity/duration/frequency for small storms?
- Habitat: What habitat thrive in this area? How has urbanization irrevocably altered this habitat?
- Drainage system: What impervious surfaces are connected to the drainage system? What is the extent of the closed storm drain system? Where do curb and gutter systems exist? Are open storm drains improved or natural?
- Community profile: What are the makeup and activities of the residents and businesses in the watershed (for example, demographics, community organizations, and business climate)?

EXISTING PROGRAMS. An effective stormwater management program consists of a number of specific components, each targeted at specific types of pollutant sources. However, not all components need to be new components focused exclusively on stormwater management. Every municipality conducts a wide variety of programs that can be integrated to a community-wide stormwater management program. This section presents examples of existing municipal programs that have objectives similar to those of stormwater management.

Existing Regulatory Programs. Table 2.2 lists a number of regulatory programs that have a bearing on the selection of BMPs or implementation of a stormwater management program. The prudent selection of BMPs will serve to comply with the objectives of both the stormwater program and other regulatory programs. The following paragraphs describe various federal, state, and local programs as they relate to stormwater control.

Table 2.2 **Existing regulations for stormwater pollution control.**

Regulation	Activity	Potential
Federal Clean Water Act 401 and 404 permits	Permits dredging and filling in "waters of the United States"	Erosion control, sediment control, long-term sediment balance, and reduce pollutants Vegetative controls to preserve riparian areas
Federal 1601 and 1603 Stream Bed	Alterations to creek and stream beds	Pollutant controls and prevent loss of habitat
State General Plan Act	Municipal development objectives Adoption of ordinances	Stormwater management controls, for example, pollutants control, watershed protection
State Environmental Quality Act	Environmental review of projects	Mitigation measures for reduction of pollutants
State Subdivision Map Act	Adoption of ordinances	Standard/regulations for grading, erosion protection, detention/retention design, and dust control
State air quality management plans	Emission	Sediment and dust controls
Local flood plain management and drainage ordinances	Control of velocity Detention/retention Bank stabilization and outlet controls	Control of erosion Control of sediment, pollutants, and quantity Erosion and sediment controls
Local zoning ordinances	Cluster development Hillside development Landscape/open space	Reduce runoff and impervious areas Slope and erosion restriction; may include revegetation or stabilization Vegetative best management practice perimeter controls reduction of runoff
Local sewer use ordinance	Control of illicit connections	Pollutant controls
Local uniform building code	Chapter 70—excavating and grading	Reduce erosion and sedimentation Standards for stable cut and fill slopes
Local uniform plumbing code	Prevention of illicit connection Various chapters on materials and application/use	Pollutant controls Pollutant controls
Local fire code	Storage of materials	Pollutant controls

PESTICIDE PROGRAM. U.S. EPA administers the pesticide program under the Federal Insecticide, Fungicide, and Rodenticide Act. Among other things, this program authorizes U.S. EPA to control pesticides (sometimes found in stormwater) that may threaten groundwater and surface water (U.S. EPA, 1991). Potential actions carried out in this program include national requirements on labels, training, development of state management plans, and national prohibition of certain domestic uses of designated chemicals.

HAZARDOUS MATERIAL/WASTE CONTROL PROGRAMS. There are numerous laws (primarily the Resource Conservation and Recovery Act and the Emergency Planning and Community Right-to-Know Act) and regulations regarding the control of hazardous material and waste. Hazardous materials storage and emergency response programs regulate hazardous materials storage and emergency response planning. A company's annual business plan must include a hazardous material inventory, estimates of hazardous waste amounts, and emergency response planning. Under workers' right-to know programs, the employee is advised, through the use of material safety data sheets, material labeling, and employee training, of the potential for contact with hazardous substances. Also, under hazardous waste source reduction and management review programs, hazardous waste generators must look at source reduction as the preferred method for managing waste. The industry must prepare a source reduction evaluation review and plan that identifies all hazardous waste streams and potentially viable source reduction approaches.

AIR QUALITY PROGRAMS. Source control of atmospheric contributions of stormwater pollution (such as automobile and industrial emissions) should be coordinated with state and local air quality programs. As an example, some states require counties with a metropolitan population greater than 100 000 to form a Congestion Management Agency (CMA). This agency, which typically is a joint power authority, coordinates the development of a Congestion Management Program. This program addresses the effects of land-use decisions on regional transportation systems, trip reduction ordinances, and public transit services. Consequently, close cooperation between the CMA and the municipality would benefit each entity's efforts to reduce pollutants in the environment.

SPILL PREVENTION AND CLEANUP PLANS. Federal regulations require on-shore facilities engaged in operations that could reasonably be expected to discharge oil in harmful quantities to prepare Spill Prevention Control and Countermeasure (SPCC) Plans. National Pollutant Discharge Elimination System regulations for some industrial activities also require SPCC plans as part of the facility's BMP program.

Existing Municipal Programs. An effective stormwater management program should instill stormwater management concepts to the activities of other municipal programs. Several examples of integrating stormwater management to existing programs follow:

- Integrated pollution prevention programs–in many cases, a single pollutant prevention measure can meet more than one environmental regulation (for example, household hazardous waste collection, waste minimization, landfill management, or pesticide use).

- Integrated water resource management–extending flood control policies to address more frequent storms, prevent streambank erosion, and promote percolation of runoff to control the peak and volume of runoff will also control pollutants in runoff.
- Growth management policies–how and where land is developed may significantly change the effect of stormwater pollution on receiving waters. Directing intensive land uses away from sensitive receiving waters has been proven to be an effective source control BMP for new development projects.
- Multiuse open spaces–many communities incorporate treatment control BMPs to parks and recreation areas through proper planning, design, and landscaping. These types of "multiuse" facilities provide a cost-effective way of meeting stormwater management plan goals.

ESTABLISHING A MANAGEMENT PROGRAM FRAMEWORK

STRUCTURING THE PROGRAM. A stormwater management program must address a wide variety of individuals, businesses, organizations, and agencies that contribute to the stormwater pollution problem and its solution. Such a program should be planned carefully to have the following important characteristics:

- Comprehensive—the program should have adequate resources to address all aspects of stormwater quantity and quality in the watershed that affect beneficial uses of receiving waters.
- Integrated—maximum effectiveness is achieved by an integrated program of regulation, education, and municipal action.
- Balanced—each responsible party must be defined, and specific direction must be given to each party. Direction for each party should be commensurate with its share of the problem and equitable to its share of the solution.
- Continuous and dynamic—meaningful stormwater control, particularly in developed areas, will take a long time, certainly longer than a single 5-year NPDES permit term. Therefore, stormwater management programs should be implemented in a manner that addresses the dynamics of an evolving, long-term program.

The program's organizational framework should capture the full breadth of the problem and its solution. It is not appropriate for this publication to recommend an ideal stormwater management program structure. Each program must do this based on the assessment of the existing conditions described in the previous section. Typically, however, each program should address the three broad areas listed below:

- Land development is one of the most typically regulated aspects of stormwater management in North America and, thus, is the area where the most experience lies. This aspect of the program typically addresses land-use planning considerations, incorporating treatment controls to development projects, and controlling construction-related effects.
- Municipal drainage system management typically involves cleaning channels, detention basins, pipes, inlets, catch basins, streets, and impervious areas connected to the drainage system. In some cases, it may be feasible to retrofit treatment controls to the drainage system to improve the ability to capture stormwater pollutants or ease their removal.
- Residents and businesses also contribute stormwater pollution, largely by conducting outdoor activities in a manner that allows pollutants to enter the drainage system. Municipalities can use a combination of education and regulation to address this aspect of stormwater pollution.

SETTING PRIORITIES. The next step in developing and implementing the stormwater management program is to set priorities and establish phases for meeting the established objectives. Priorities and phasing should be soundly based on the existing condition assessment. Priorities should be established by the committees that have defined the program objectives. Many decision-making techniques exist for establishing priorities. It is not the intent of this publication to discuss these techniques. At a minimum, priorities should reflect common sense, using questions like those listed below:

- How much can we afford?
- Do we think it will work?
- What are we already doing?
- Can we show that it works?
- Where are the worst problems?
- Can we learn something new?
- What are the easiest solutions?
- Is this the right direction?
- What has been successful for others?
- Will beneficial use impairment decrease?

SELECTING MANAGEMENT PRACTICES

The basic objective of stormwater management is watershedwide improvement in water quality and enhanced beneficial use of the receiving water bodies. The current practice is to presume that a cost-effective, practicable set of BMPs (that is, restrictions, techniques, or treatment facilities that are required under given conditions) will provide some progress in protecting water quality. For example, individuals can conclude that used motor oil should be recycled rather than discarded without site-by-site analysis or sampling. This approach typically will be used, at least in the near term, because the cause–effect relationships between pollutants in the watershed and beneficial use impairment in the receiving water are not always understood, the urban stormwater management agency often does not have complete jurisdiction over a complete watershed, or regulatory requirements can be met through BMPs.

MULTILEVEL STORMWATER QUALITY MANAGEMENT STRATEGY. A municipality's stormwater management strategy must cost-effectively address program objectives using existing information to address priority needs within the context of an overall program framework. An effective strategy uses multiple BMPs, including source controls (see Chapter 4) and treatment controls (see Chapter 5). A single BMP typically cannot provide significant reductions in stormwater pollutant loads because these pollutants come from many sources within the municipality. However, multiple BMPs can provide complementary water quality enhancement to achieve desired results. A multilevel BMP approach, schematically depicted in Figure 2.2, deals with the many pollutant and runoff sources throughout the watershed and shows that, whenever feasible, combining most effective BMPs in a series can be an effective strategy to reduce pollutant loads being transported to the receiving waters by stormwater (UDFCD, 1992).

SELECTING STANDARD AND SPECIAL BEST MANAGEMENT PRACTICES. There are hundreds of different BMPs appropriate for the different sources of pollution and the varieties of receiving waters to be protected. In practice, a large degree of simplification will be necessary, especially in starting a program. Typically, there should be a set of standard BMPs appropriate for general application to a particular geographical or political area, supplemented by special BMPs for application where a greater degree of pollution control may be desirable. These would be further refined by establishing standard and special BMPs for the protection of groundwater and surface water, respectively. For example, control of nitrates and volatile organics is more important for groundwater than for rivers unless they drain into a reservoir, lake, or estuary. Therefore, special BMPs for those substances might be applicable for percolation to groundwater but not for drainage to rivers. In addition to specifying either standard or special degrees of protection, additional measures may be added as particular circumstances require, and, of course, there are some cases where no control of stormwater pollution is necessary.

It is apparent that the selection of BMPs must consider the potential harmfulness of the land use, the sensitivity of the receiving waters, and the prox-

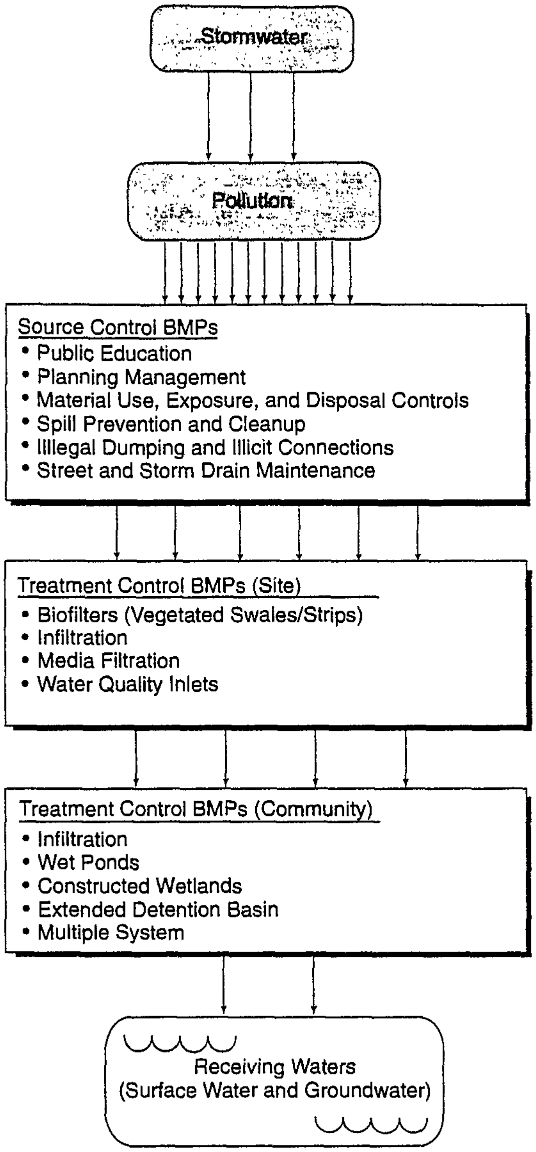

Figure 2.2 Multilevel strategy for stormwater management program (UDFCD, 1992).

imity of the land use to the sensitive portion of the receiving water. One BMP selection method uses numerical indices of harmfulness and sensitivity (see Figure 2.3). These indices can be evaluated with a matrix approach to show whether special or standard BMPs will be required for a given situation or whether, through land-use controls, that kind of development should be prohibited in the location proposed. However, best results can be obtained if the approach described previously provides for the level of BMP control

Areal Priorities: Designate areas GW where extra protection is warranted for groundwater and SW for surface waters warranting extra protection:

Class 1 Any officially designated highest priority protection areas, such as habitat of threatened or endangered species, exceptional resource wetlands. Also, delineated well head protection areas (GW).

Class 2 Aquifers usable for water supply, including important recharge areas (GW). Delineated buffer zones around water supply reservoirs. The area immediately adjacent to the reservoir should be protected against either groundwater or surface water pollution, the balance of the buffer against surface pollution only (SW).

Class 3 The remainder of the watershed to be protected.

Class 4 Any area that does not warrant protection against water pollution from stormwater (typically GW).

Harmfulness Index of Stormwater: Unless otherwise demonstrated in specific situations, the following classifications are in descending order of pollutant loading, the most intense being first:

Class 1 From industrial and waste management sources.

Class 2 From multiple-family housing, commercial facilities such as gas stations and shopping centers, highways, urban areas, and single-family housing with lot sizes smaller than one-third acre per housing unit.

Class 3 From single-family housing developments, with lot size one-third acre or larger per housing unit, and from lesser roads.

Class 4 Undeveloped land or unfertilized vegetation.

In addition, there are other categories of stormwater pollution that are highly variable in their pollutant loading. These include agriculture and road salts, which must be appropriately classified depending on the circumstances.

Stormwater Best Management Practices: If a proposed land use is rated Class 1 harmfulness index (as indicated above), it should not be located in a Class 1 area. If located in a Class 2 or 3 area, special provisions for quality control of runoff are appropriate. If the proposed development is Class 2 harmfulness index, special BMPs are appropriate if the development is located in a priority 1 area. (Class 1 developments may not be allowed in such areas.) If the proposed Class 2 development is not located in a priority 1 area, but its runoff drains into it, it may still require special BMPs for runoff control. A decision is required as to how far upstream such controls should extend. Otherwise, standard BMPs are appropriate for Class 2 harmfulness, except for priority 4 areas.

Figure 2.3 Best management practice numerical selection guide (ac $\times$ 4 047 = m^2).

Infiltration Best Management Practices:

a. In Class 1 protected areas, such as well heads, buffer areas adjacent to protected habitat, and habitat of endangered species, facilities involving infiltration may not be allowed at all. If they are allowed, infiltration of Class 1 runoff will be acceptable only with special water quality provisions for processing the runoff. Infiltration of processed Class 2 runoff will be acceptable if processing of runoff follows standard BMPs.

b. In Class 2 areas, including aquifers, Class 1 runoff that has been processed through standard water quality systems such as water quality detention basins or filter strips may be approved for infiltration to aquifers. Infiltration of Class 3 runoff should be encouraged, after processing with standard water quality provisions, unless special circumstances indicate existence of potential contamination.

Conditions for Infiltration

Areal Priority	Harmfulness Class 1	Harmfulness Class 2
1	No infiltration except after special water quality process	No infiltration except after standard water quality processing
2	No infiltration except with a positive showing of no adverse effect or after standard water quality processing	Infiltration encouraged unless potential harm indicated
3	Allowed	Allowed
4	Allowed	Allowed

Figure 2.3 Best management practice numerical selection guide ($ac \times 4\,047 = m^2$) (continued).

needed for an entire watershed and addresses BMPs that can be applied throughout the watershed. A detailed watershed-planning process should be used where the type and level of BMPs at each site may differ because of technical, financial, or jurisdictional issues.

SELECTING BEST MANAGEMENT PRACTICES FOR LAND DEVELOPMENT. Land development changes both the hydrologic regime of a watershed and the chemical constituents in the runoff. These changes are best controlled at the point of origin by land-use planning. Next best are source controls because land-use controls are often difficult to implement. To the extent that land-use controls and source controls are not sufficiently effective to prevent pollution, treatment controls should be used to address the problem. These controls may include detention and retention facilities, other measures classified as treatment, or, occasionally, diversion of runoff to a less sensitive environment. Both source controls and treatment controls may be included as conditions of a permit, as indicated further below.

Land-Use Controls. Land-use controls involve adoption of a comprehensive and integrated set of environmental restrictions to govern the development process. The greatest level of beneficial use protection is afforded when a single development ordinance is adopted by a community and administered by a single planning authority. In short, the ordinance mandates a minimum level of environmental site planning during development and can include, but is not limited to, the following items:

- Stream buffer requirement—development is not allowed within a variable width buffer strip on each side of ephemeral and perennial stream channels. As an example, in Baltimore, Maryland, the minimum width of the buffer strip is 15 m (50 ft) for low-order headwater streams but expands to as much as 60 m (200 ft) in larger streams (Baltimore County, 1989). The stream buffer further expands to include floodplains, steep slopes, wetlands, and open space areas to form a contiguous system, according to prescribed rules.
- Floodplain restrictions—development is restricted within the boundaries of the postdevelopment, 100-year floodplain.
- Steep slope restriction—no clearing and grading are permitted on steep slopes, for example in excess of 25%.
- Nontidal wetland protection—no development is permitted within nontidal wetland areas and a perimeter buffer area.
- Protection of environmentally sensitive areas—development is not allowed within unique habitat areas/plant communities or protective perimeter buffers identified through watershed master planning.
- Upland and riparian tree cover requirements—an allotted percentage of upland predevelopment tree cover must be maintained after site development. In addition, the riparian tree cover (which should be entirely contained within the stream buffer system) must also be retained or reforested if no tree cover currently exists.
- Waterway disturbance permits—forms of development such as roads and utilities must, by their very nature, cross through the stream buffer system. Linear developments must be scrutinized to locate them in the narrowest portions of the buffer system and ensure they do not form barriers to either fish migration or riparian wildlife migration.
- Community open space requirements—after the stream buffer system has been delineated, consider preserving additional open space at the site to accommodate the residents' future requirements for parks, playgrounds, ball fields, and other community needs.
- Cluster development—the objective here is to reduce the impervious surfaces at the site and cluster development into centralized areas where stormwater can be effectively treated. The best tools include

transferable development rights, cluster zoning, site "fingerprinting," planned unit development, and flexible site and road width layout (Yaro *et al.*, 1988).

Selecting Source Controls. A source control program for a land development project should

- Identify possible postconstruction outdoor activities that may use or generate concentrated or high-risk pollutants at the site;
- Prohibit these outdoor activities where practical;
- Designate specific areas for those activities that must be conducted outdoors;
- Install structural source controls (for example, covers, enclosures, containment systems, or connections to sanitary sewers) in these designated areas; and
- Place conditions on the development project for maintaining these areas.

Outdoor activities may include material storage, waste handling, material loading or unloading, vehicle and equipment maintenance, and myriad specific work tasks typically conducted outdoors. Source controls are selected as described in Chapter 4 of this publication.

Selecting Treatment Controls. An effective system of treatment controls addresses dispersed sources of pollutants throughout the watershed that affect beneficial uses but cannot be effectively controlled at the source (for example, automobiles and air deposition). When coupled with proper land-use controls, they can be integrated to the landscaping, drainage and flood control system, and other open spaces of development projects. When properly designed, they become amenities rather than interferences to development projects. When preceded by effective source controls, they do not cause other environmental problems (such as groundwater pollution or hazardous sediments). For example,

- A grass-lined channel can be designed to effectively convey flood waters and, by incorporating certain design techniques, reduce pollutant loads.
- Ponds can be designed to attenuate peak discharges to desired levels and reduce pollutant load before discharge. Pollutants are reduced by detaining "first-flush" runoff from large storms and all runoff from small storms long enough for sediments to settle and biological processes to act on degradable materials.
- Many well-designed treatment controls integrate with recreational facilities, provide wildlife habitat and groundwater recharge, preserve open space in urban settings, and increase the value of adjoining land.

Integrating treatment controls to multiuse facilities of this type promotes cost effectiveness and other benefits by reducing capital costs (by reducing the number of facilities needed in the first place); saving land; reducing operation, maintenance, and replacement costs; reducing planning and design time; and stimulating integrated, comprehensive planning. Chapter 5 presents an integrated approach to selecting and designing treatment controls that achieves desired water quality and quantity objectives in an effective and efficient manner.

SELECTING BEST MANAGEMENT PRACTICES FOR EXISTING MUNICIPAL DRAINAGE SYSTEMS. In most cases, the urban drainage system includes street gutters, inlets, catch basins, storm drain pipes, constructed ditches, channels, and urban streams. These streams often are severely altered, either by humans or by the changed hydrologic regime. Two categories of BMPs are appropriate for urban drainage systems:

- Various techniques for cleaning drainage system components or preventing nonstormwater discharges to the drainage system in the first place (source controls); and
- Various devices that can be retrofit to the drainage system to slow the rate of runoff or remove and assimilate pollutants (treatment controls).

Typically, all available source controls for municipal drainage systems should be used to some degree. Selection of BMPs for existing municipal drainage systems involves establishing an appropriate cleaning frequency for each component and an inspection frequency for nonstormwater investigations. Chapter 4 describes the source controls for municipal drainage systems and presents guidelines for determining cleaning/inspection schedules.

Feasible retrofit strategies typically involve an urban stream restoration program and feasible retrofitting of existing flood control basins. The primary purpose of stream restoration is to enhance the aquatic habitat and ecological functions of urban streams that have been lost or degraded during the urbanization process. Stream restoration also "builds back" the assimilative capacity of these urban streams, allowing them to better remove pollutants before discharging to larger downstream receiving waters. A comprehensive stream restoration program incorporates several of the following steps, where geomorphological/land-use opportunities permit:

- Watershed assessment of restoration opportunities—stream restoration opportunities are best assessed though systematic biological surveys throughout the stream system and its upland watershed. These surveys should determine the dominant effects that have degraded the aquatic community and identify feasible opportunities for restoring stream habitat or water quality.

- Retrofitting of flood control basins—the best restoration opportunities often involve the improvement of existing flood control basins. For example, in the Washington, D.C., metropolitan area, retrofitting typically has involved converting older, dry stormwater ponds to extended wet pond–marsh systems (Herson, 1989).
- Construction of additional urban best management practices—retrofit of new urban BMPs in the urban landscape is not an easy task, given the typically limited amount of space available. Innovative retrofit techniques include the peat–sand filter (Galli, 1989), oil–grit separator inlets, and extended detention lake/wetland systems (Schueler and Helfrich, 1988).
- Reforestation programs—the buffer zone along urban streams and upland areas can be reforested gradually within a matter of years at a relatively low cost through cooperative community tree planting programs according to a long-term watershed plan. These volunteer programs are most effective when local governments arrange the logistics, assemble the sites, and secure the plant stock.
- Instream fish habitat improvement—the degradation of stream habitat structure (most notably the loss of pools, riffles, and clean spawning areas) can be reversed by adapting habitat improvement techniques such as boulder and log deflectors, log drop structures, brush bundles, willow wattles, boulder placement, and imbricated riprap.
- Urban wetland creation/restoration—active creation, restoration, and management of urban wetlands partially substitute for the lost ecological functions of the destroyed or degraded wetland system in many urban areas.
- Identification and removal of fish barriers—possible barriers to fish migration can be detected through systematic upstream/downstream fish collections at suspected structures during spring runs (Cummins, 1988) or, in some cases, by visual surveys. In many cases, urban fish barriers are created by structures in the stream that can be rather easily modified to allow migration.
- Stream stewardship—citizens often take an active and personal interest in maintaining urban stream quality. Local governments can encourage them to adopt a stream; remove debris; and report oil spills, sediment control violations, pollution problems, and sewer overflows.
- Natural urban parks—urban parks, centered about the stream valley and riparian vegetation zone, provide a tool for managing land use and human access while protecting key vegetative communities in core stream areas.

SELECTING BEST MANAGEMENT PRACTICES FOR RESIDENCES AND BUSINESSES. Most of the urban landscape consists of private property containing residences and businesses. An effective municipal stormwater management program must include BMPs for these residences and businesses. Typically, the near-term program will focus on source control in these areas, achieved through a combination of public education and municipal regulation. Chapter 4 of this publication describes feasible source control strategies for existing residences and businesses.

It is unlikely that treatment controls will be retrofit to existing development on private property in the near future unless the runoff is significantly polluted, the property discharges to a highly sensitive receiving water, source controls are ineffective, or the property is subject to an industrial NPDES stormwater permit. Retrofitting other treatment controls on private property will be expensive and controversial without additional proof of direct water quality effects for each property's runoff.

IMPLEMENTING THE PROGRAM

IMPLEMENTATION STRATEGIES. Three options exist for implementing the stormwater management program: incorporating stormwater management concepts into an existing program, starting a new program, and conducting further planning and study. The following sections describe each of these strategies.

Incorporate Stormwater Concepts to an Existing Program. Programs that partially achieve stormwater pollution control are already in place for many areas. These may be municipal programs, programs sponsored by overlapping jurisdictions, or private initiatives. Typical existing programs include household hazardous waste collection, hazardous spill response units, hazardous material storage rules, Resource Conservation and Recovery Act and landfill management and closure regulations, litter control programs, and erosion and sedimentation control requirements. For many existing programs, all that may be required is better documentation and effective communication about their conduct and effectiveness at achieving stormwater pollution control. Other existing programs may be compatible with stormwater pollution control but require some redirection. In this category, the objective should be to incorporate effective stormwater management concepts to the program. Water quality management plans that have been developed by local governments to satisfy the requirements of Section 208 of the Clear Water Act typically refer to nonpoint source effects and controls. These need to be reviewed and, in most cases, redirected to focus on stormwater quality aspects rather than on point sources only. Existing programs that may be redirected include detention/retention requirements for new development, construction site and building permit inspection programs, drainage system maintenance activities, and transportation and land-use planning programs.

Start a New Program. There are two instances where new programs are favored in the near future:

- The program will directly and measurably benefit the beneficial uses of the receiving water (for example, an illicit discharge control program).
- The program will begin educating the community at large about how stormwater systems operate, how their actions can pollute receiving waters through storm drains, and how the community can be involved in stormwater pollution control.

Conduct Further Planning and Study. Some activities warrant additional study in the short term to achieve cost-effective BMP selection:

- Watershedwide master plans are often used to select BMPs for land development activities and new, enlarged flood control facilities as described previously in this chapter.
- Pilot studies are an interim step aimed at gaining practical knowledge on which to base long-term implementation decisions. They should be directed toward a representative microcosm of the watershed and should be considered where watershedwide implementation is expected to be cost prohibitive in the near term. Possible pilot studies may include street sweeping programs, school curriculum on stormwater pollution control, stormwater pollution control initiatives directed at small businesses, innovative treatment technologies, and illicit connection detection programs.

Pilot studies are most appropriate for source control BMPs where a high level of community involvement may be required, implementation may be labor intensive, effectiveness is largely unmeasured, or effective implementation may be site specific. While a large body of research and practical field experience already exist for treatment control BMPs, pilot studies of these BMPs may still be necessary to account for local climatic, physical, and institutional conditions.

TREATMENT CONTROL OPERATION AND MAINTENANCE. Regular inspection and maintenance of treatment BMPs is an absolute necessity if these controls are to perform consistently to expectations. Sediment removal and removal of debris from BMP inlets and outlets are important requirements to maintain consistent performance. Access to detention ponds is necessary for excavating equipment, trucks, mowers, and personnel for routine maintenance and erosion repair and for the removal of sediment and trash accumulation. Where access is particularly difficult or impractical, ponds should be overdesigned to allow for additional sediment accumulation.

Chapter 5 of this publication presents an overview of maintenance requirements. Further information is also contained in *Design and Construction of Urban Stormwater Management Systems* (ASCE and WEF, 1992). Each municipal stormwater management program should determine specific maintenance practices for treatment controls implemented in their community, clearly define what the municipality will maintain, and develop enforceable agreements with private parties responsible for facilities the municipality does not maintain.

FINANCING STORMWATER MANAGEMENT PROGRAMS. Revenue Alternatives. The stormwater management program needs a reliable source of revenue for general administration, operation, maintenance, and capital improvements. This section reviews revenue alternatives for the funding and financing of the stormwater management program. Funding refers to sources of revenues used to pay for annual operating expenditures, including maintenance and administrative costs; to pay for improvements directly out of current revenues; and to repay debt issued to finance capital improvements. Financing is defined as the initial source of funds to pay for planned capital improvements or equipment.

Five funding alternatives and nine financing alternatives are reviewed in this section. Several important characteristics are discussed to provide a general background for comparing alternatives. Legal provisions for the selection and use of the revenue alternatives presented may vary from state to state, depending on state statutes or regulations.

Funding Options. Annual funding requirements of a local stormwater management program may include administration, permitting, design, planning, operation, system maintenance, meeting the system's annual debt service obligations, and other financial requirements.

GENERAL GOVERNMENT TAX RECEIPTS. Stormwater management operation and maintenance costs can be funded by general government tax receipts. With this option, the funds required could be generated by any revenue source accrued in the general fund. Revenue from the general fund primarily is derived from *ad valorem*-based levies on taxable property. A significant advantage to consumers is that these costs are tax deductible. The primary disadvantage is that the general fund is not a dedicated source, and stormwater management needs would have to compete for limited funding with other programs. As a result, this funding mechanism is subject to fluctuations and typically is unreliable for implementing a long-term capital improvement program. In addition, *ad valorem* funding is less equitable because tax-exempt property does not pay and charges are based on property values rather than the effects associated with stormwater runoff or services provided.

BENEFIT AREA OR SPECIAL ASSESSMENTS. Property owners within a stormwater benefit area typically are assessed a levy or charge to fund stormwater systems within the benefitted area. In addition, if different land uses within the benefit area receive substantially different levels of stormwater benefits, the assessment of levies from subarea to subarea should vary in proportion to the benefits received.

The following criteria typically are applied when a benefit area or special assessment is developed:

- Assessment levies should not exceed the amount of the benefit received by any particular property;
- The assessment should be properly allocated to the benefitted properties; and
- Property owners typically are allowed by law to have an opportunity to comment on how the assessments are allocated to their properties.

The goal is to show that assessed levies are used to cover costs of facilities or services benefitting each property and that the benefits to each property are at least equal in value to the assessment levy. Constitutional standards typically require that property owner benefits funded by such assessments be special benefits that typically are not shared by the community as a whole.

STORMWATER MANAGEMENT UTILITY. A dedicated funding source that has gained recent acceptance is the establishment of a stormwater management utility (SMU). The premise of this method is that developed property can be charged a user fee in proportion to the contribution to the need for stormwater facilities or services. Utility customers are the properties that add runoff to the stormwater system, and individual charges can be calculated using an appropriate billing unit formula. The charge per billing unit can be set to generate the level of annual funding desired by the community.

The careful development of a rate structure has been found to be critical to the successful implementation and operation of an SMU. Also, feasible procedures for preparing billing records and database management requirements should be defined early.

The basis for determining the fee a customer pays for stormwater management services typically is the amount of runoff generated by property improvements. The runoff potential is a function of many variables and is often best determined by measuring the area of impervious surfaces. Because all improved property, including tax-exempt property, can be charged in proportion to its effect on or need for the stormwater management system, SMU fees have been proven to be an equitable and fair method of paying for stormwater management services.

INSPECTION FEES. The costs of evaluating permit applications and inspecting ensuing construction activities can be recovered through fees assessed to the developers or applicants who create the need for this service. These fees can be used with other funding options to recover the costs of providing user-specific stormwater management services.

OTHER FUNDING. Funding mechanisms could include other taxes such as fuel or utility taxes. The availability of other options will depend on state and local statutes that must be evaluated on a case-by-case basis.

Financing Options. This section reviews options available for initial financing of stormwater system capital improvements or equipment purchases. Several of the options discussed involve the issuance of bonds, which is one approach to obtaining lump sums of revenue to pay for significant capital improvement or equipment expenditures. A bond is an instrument by which an agency borrows money and guarantees repayment of the loan principal and interest with revenues generated from a specified source.

PAY AS YOU GO. This approach seeks to establish a revenue flow that is accumulated in a sinking fund. Planned facilities would be constructed or equipment would be purchased after the sinking fund contains enough revenue to pay for the purchases. Revenue deposited in the sinking fund can be derived from a number of sources, including tax revenues, user charges, in-lieu-of charges, or system development charges (impact fees).

GENERAL OBLIGATION BONDS. A general obligation bond is a loan that is secured by the full faith and credit of a local government. This means that the local government pledges its general fund revenues, primarily property taxes, as the source of revenue for loan repayment. This type of bond is easy to administer and widely used to finance various types of capital improvements. Because of the high level of security associated with the pledge of tax revenues for these bonds, the interest rates can be lower.

Both the amount of general obligation debt that a local government may issue and the total property taxes that may be assessed are limited. Because general obligation bonds are repaid through property taxes, the distribution of costs typically is not considered equitable. Costs are distributed to property owners in proportion to the value of their property, rather than to the amount of stormwater runoff generated by their land use. Tax-exempt properties do not pay for these improvements.

REVENUE BONDS. A utility enterprise typically can fund capital improvement projects or purchases by issuing bonds that will be repaid by the revenues from an enterprise operation. With revenue bonds, the utility obtains the funds needed to start and complete significant improvements and repays them over the long term with revenue collected from those who benefit from the improvements, such as the utility's users or rate payers. Provided the utility has a rate structure designed to equitably recover costs, this form of financing is better suited for use on stormwater projects than general obligation bonds. Interest rates, thereby the interest expenses, typically are somewhat higher for revenue bonds than for general obligation bonds.

SPECIAL ASSESSMENT BONDS. Special assessment bonds may be issued if the planned stormwater construction project will benefit a specific area or watershed. These bonds are secured by non-*ad valorem* tax assessments to the landowners in that area. The initial cost of implementing this option typically is high because the local government must establish stormwater benefit areas or tax assessment districts for each individual project. This bond is then relatively easy to administer because the debt service is recovered through non-*ad valorem* assessments to the properties in the district.

User acceptance and equity can be good for a properly designed program because a clearly identified area directly benefits from the stormwater improvements. User equity also can be high because tax assessments must be distributed in direct proportion to the benefits received.

DEVELOPER-CONSTRUCTED IMPROVEMENTS. As a condition of approving a proposed new development, the local government could require a developer to construct improvements to control stormwater runoff. Typically, these are on-site improvements; however, the local government occasionally may require some off-site improvements. The ease of administering this option may be difficult because developers may object to or oppose the required construction. Equity typically is considered to be good because the new development likely to generate the runoff will incur the cost of controlling or alleviating the problems arising from that runoff.

IN-LIEU-OF CHARGES TO DEVELOPERS. An alternative to requiring developers to construct on-site stormwater management facilities is to require them to pay a front-end charge for off-site capital improvements needed to serve their development. Payment would be a condition of development approval and would recover the cost of the off-site improvements to manage the development's runoff or its proportionate share of the cost of a regional facility serving a larger area.

This technique frequently is used where a small-scale facility is not necessarily advisable (that is, assumption of responsibility for the operation and maintenance costs for the planned improvements), and the local government wants developer participation in a larger facility designed to control drainage on a regional basis.

Conceptually, this option can be equitable because it can be designed to recover the cost of the improvements in proportion to the runoff generated by the users of the system. However, equity may be difficult to implement if the costs paid by each developer are negotiated separately. Therefore, in-lieu-of charges should not change over time or reflect factors other than user runoff contribution.

Developers may resist these assessments if they can identify improvements that are less expensive than their proportionate share of the planned regional facilities. Administrative costs for this option may also be high.

SYSTEM DEVELOPMENT CHARGES. System development charges (or impact fees) are fees or charges collected from new developments to recover the cost of increasing the capacity of a stormwater or other system to meet the needs of new customer growth. These fees frequently are used to repay debt service on capital improvements and thus could be considered an annual funding option. System development charges are discussed as a financing option because their primary purpose is to generate funds for capital improvements that provide the capacity to serve new development.

Stormwater impact fees are designed to reflect the stormwater contribution of new development and the costs incurred to provide enough additional control facilities in the system to meet those needs. These charges are set in a fee schedule uniformly applied to all new development and are often based on impervious area. In this way, all new development contributes on a consistent basis to the costs of the regional stormwater system rather than to specific regional facilities to serve the individual development. This provides an equitable way, from a regional viewpoint, to recover these costs.

System development charges shift the burden of payment to new residents for facilities sized to serve future growth, rather than imposing these costs on existing customers. These revenues may be used to reimburse existing customers for costs they have incurred to provide capacity for future users. Revenues from these fees may be used to retire a debt issued to finance regional facilities or as part of a pay-as-you-go financing plan. Revenues will fluctuate with the amount of new construction.

COMMUNITY DEVELOPMENT BLOCK GRANTS. This is a federal grant program to aid local governments in constructing various types of public improvements that cannot be financed by any other available source. This program is intended to benefit low-income groups or communities. These grants may be difficult to administer because they originate and are supervised by a federal agency—the Department of Housing and Urban Development. Funds available are also limited.

INTERNAL BORROWING. Another source of revenue for financing the construction or purchase of capital improvements involves borrowing money from other local departments or utilities. The borrowed money must be repaid with interest.

Implementation Process. The evaluation and selection of appropriate revenue alternatives available to implement a stormwater management master plan typically can be accomplished by the following steps:

- Define level of service goals. Categories of problems should be identified and specific performance criteria defined to address the problems.
- Identify program components. Watershed evaluations should be performed to identify and prioritize specific problem areas, including the development of program facility components or activities to comply with the level of service goals.
- Establish program costs. Based on the program components, a schedule of funding and financing requirements can be prepared.
- Identify revenue alternatives. Available revenue alternatives, as discussed in this section, should be reviewed to identify existing and potential sources.
- Develop funding and financing plans. Combine results of the program cost and revenue alternative evaluations to develop specific funding and financing plans.

The process to accomplish these tasks can require several iterations to match level-of-service goals with achievable funding and financing plans.

EVALUATING EFFECTIVENESS

Chapter 3 of this publication provides detailed guidance on assessment, monitoring, and modeling approaches to evaluating program effectiveness. Assessing the program effectiveness means demonstrating that the BMPs adequately protect beneficial uses of the receiving waters. Doing this correctly can be complex, and specific procedures need to be defined for assessment. The assessment typically consists of the following three methods:

- Ecological monitoring evaluates the habitat in the receiving water, determines stresses on the habitat, and defines habitat that reasonably can be supported in the receiving water.
- Water quality monitoring can take place in either the receiving water where the stormwater discharges or in the stormwater discharges before the receiving water.
- Nonconventional monitoring is the enumeration of some quantity other than direct water quality data to infer pollution reduction or water quality improvement. There are many different kinds of indirect measures that can be devised to estimate the success of a particular BMP program. For example, public surveys may show increases in environ-

mental awareness. Another example would be monitoring the amount of used oil collected.

In either case, it is important to establish the specific objective of the monitoring program. There are primarily three distinctly different objectives to consider:

- Characterize the stormwater discharge. Here, the monitoring program basically is set up to provide water quality data for comparison with other databases (for example, to determine if a pollutant warrants special attention in the stormwater management plan).
- Characterize the receiving water during and after stormwater discharges. A monitoring program carried out under this objective could include "biological surveys" and water quality sampling.
- Assess the effectiveness of the stormwater management plan in reducing pollutants. To accomplish this objective, a carefully laid out program is required. Because of the wide variability in stormwater quality, this monitoring program should be complemented with a targeted BMP. Pilot studies provide an excellent opportunity for evaluating targeted BMPs in a well-defined area or watershed.

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Chapter 3
Monitoring, Modeling, and Performance Auditing

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The management of urban stormwater quality requires accurate and detailed information about sources and possible effects of stormwater-related pollution. Monitoring, modeling, and performance auditing activities typically are part of a program that is structured to address specific issues, such as permit compliance, pollutant source identification and removal efficiency, or impact assessment. Therefore, a stormwater management program requires coordinated and detailed monitoring procedures, which include planning, data collection, data analysis, and result interpretation and use. Modeling can supplement and, in some cases, replace monitoring efforts with simulations that allow prediction of both discharge and receiving water quality. Auditing performance is a specific application of monitoring (and, in some cases, modeling) that demands standardization of the physical, chemical, climatic, geological, biological, and meteorological parameters reported as part of the audit. This chapter reviews methods for data collection, analysis, and interpretation in monitoring programs; the selection and use of models; and information on parameters that are essential in assessing the performance of best management practices (BMPs).

MONITORING

Monitoring has been an essential element of management programs. Since the adoption of Public Law 92-500 in 1972, holders of National Pollutant Discharge Elimination System (NPDES) permits have been responsible for self-monitoring. Self-monitoring must meet specific frequency and quality criteria, and contain information about discharge quality, toxicity, and receiving water conditions. In 1991, the U.S. Environmental Protection Agency (U.S. EPA) adopted an NPDES permitting program for urban runoff, and in late 1992, U.S. EPA published a draft policy statement on combined sewer overflows. Stormwater NPDES permit monitoring requirements have included the development of sampling programs and the assessment of both discharges receiving water conditions. Further, U.S. EPA has placed a high priority on controlling nonpoint source pollution through clarification of the requirements of Section 303(d) of the Clean Water Act. Dischargers are now faced with total maximum daily load analyses within a water-quality-based toxics control program (U.S. EPA, 1991).

The result of these developments in regulatory programs is an increasing emphasis on monitoring physical, chemical, and biological conditions of receiving water. Holders of NPDES permits, environmental quality managers, consultants, and others must now deal with a regulatory environment that requires monitoring beyond the analysis of chemical water quality parameters in effluents. Different data collection procedures and integrated monitoring efforts are now required to meet the typical objectives of management programs.

This section of the publication has been developed to provide the reader with a summary of the steps that lead to effective and efficient monitoring programs. The design process starts with developing a clear statement of objectives, followed by identifying data needs, data collection procedures, and methods of data analysis. Further, to develop a context for monitoring stormwater, it is necessary to connect storm events with stormwater runoff and recognize that the complex interaction of physics and chemistry on the land as well as in the channel will have an equally complex effect on receiving waters. In short, a watershed approach is essential in stormwater monitoring.

FUNDAMENTAL DESIGN ISSUES. Study Design Assurance. Monitoring efforts in stormwater management programs typically are initiated based on a general need to identify sources, quantities, and effects of pollutants. Unfortunately, this need is often expressed as a general direction for studies, not sufficiently detailed objective statements that will direct monitoring efforts. For example, a general statement might specify "assess water quality." That assessment could include water quality sampling and analysis, toxicity testing, or biosurveys. The toxicity testing might include laboratory or *in situ* testing. The biosurvey could sample algae, macroinvertebrates, or fish, including single samples or long-term assessments. Any of these efforts will require different personnel and have different costs. Further, water quality analyses, toxicity testing, or biosurveys may answer different questions about receiving waters and support management decision making in a different way. The first step in a monitoring program will be the careful development of a statement of objectives, which will direct specific data collection efforts.

A monitoring design approach proposed by Schaeffer *et al.* (1984) and Herricks and Schaeffer (1987), termed study design assurance (SDA), provides a workable process to ensure that the monitoring conducted fully meets an agreed objective. The SDA process recognizes that the first step in monitoring program implementation is the review of stated study objectives. If an objective is general (such as the determination of environmental impact), then specific monitoring program objectives (such as the determination of the effects of fish, macroinvertebrates, and water supplies) must be developed to guide data collection. An effective, specific objective is clear and testable, similar to hypotheses that are used to test a general theory in many scientific experiments. This development of specific objectives is an iterative process where the initial objective is used to specify the data needed to meet the objective. Then, the data needs are evaluated and a "hypothetical" database is developed. At this stage, it is possible to determine if sufficient resources (both fiscal and scientific/technical) are available to collect the data needed to meet the stated objective. If resources are limited, the initial general objective is then modified. This modification will produce a more specific objective that reflects the limits in available resources while still addressing the stated objective. A hypothetical database is again identified and evaluated against available resources. At this time, it may be apparent to both the managers and the scientists and technicians that initial management expectations are unrealistic, and management expectations are then modified with the stated objective. The process of objective development, evaluation, and more specific objective development may require many iterations.

Critical to the SDA process is the effective communication of monitoring "realities" to managers and the corresponding resource "limits" to monitoring specialists. Therefore, in the SDA process, managers come to recognize that monitoring realities may constrain initial expectations, leading to a more realistic understanding of how monitoring data can be used in their decision making. The scientific and technical staff benefit from the SDA process because they clearly identify how the data can be used before costly data collection efforts are initiated. Matching expectations to what actually can be achieved with a specific data collection program avoids a typical problem where data limitations fail to meet management needs, and potentially useful information from a monitoring effort is discredited.

The organization of the SDA process calls for iterative analysis at all stages in the management process, formalizing data collection to meet specific decision requirements. Adoption of SDA procedures can ensure that a rigor similar to that imposed by the scientific method in experimentation is applied to monitoring.

Monitoring Program Implementation. Implementation of a monitoring program can be considered a five-step process that includes identification and acquisition of existing data, design of the assessment program, collection of the data, analysis of the data, and presentation of the data/information developed.

IDENTIFY AND ACQUIRE EXISTING DATA. The first step of any monitoring design is to identify and review available data. Obtaining access to existing data will have a number of benefits. First, it is relatively inexpensive; when involved in the development of a monitoring program, fiscal issues will often be the most significant constraint. It may even be possible to use existing data to meet management objectives, and scarce resources can be applied to other needs in the management program. Second, existing data will guide the monitoring design by providing critical information on existing conditions. It will be possible to evaluate "watershed" or other influences on the monitoring site, identify problem areas or areas of significant interest, and, as part of the SDA process, use existing data to better define specific objectives and expectations for monitoring data use. Finally, existing data provide a basis for early comparison of results, supporting mid-course corrections typical in any data collection effort.

PREPARE THE MONITORING DESIGN. Monitoring programs must emphasize information development, not simply data acquisition. Further, the SDA process has, at its foundation, the analysis of cost versus information. Thus, the monitoring program design must clearly identify sampling locations, sampling variables, and frequency of sampling to identify not only the information to be acquired but also the cost of that information. The typical sampling design will identify a reference location, a site in the area of maximum effect, and a location where effects have moderated and the receiving waters have recovered. Sampling variables should include sufficient water quality data to characterize water quality and assist in the interpretation of the results of biological sampling. Biological variables should be selected on the basis of expected effect—benthic macroinvertebrates are often used because they are not mobile, while fish may provide information connected directly to public interests and existing (fisheries) management programs. Sampling frequency will vary, but most bioassessment programs will require seasonal sampling. Finally, added to these design elements are the quality assurance/quality control (QA/QC) program requirements, which include both field and laboratory elements.

COLLECT THE DATA. Although data collection is often identified as one of the primary functions of monitoring design, if the existing data are identified and acquired, needed data may be acquired from existing sources rather than requiring new data collection efforts. The final sampling program design should recognize that any data collection effort in natural systems must deal with conditions that are constantly changing. The data collection program should be flexible enough to allow modifications as these receiving system changes occur. A common problem in many data collections programs should be avoided. In many programs, data collection is often assigned the most junior, lowest-cost, and least-experienced member of the team. Because any analysis will only be as sound as the data on which it is based, good analysis will depend not only on a good QA/QC program, but also on competent staff. Elements of a good data collection program are

- Assignment of competent staff,
- Maintenance of design flexibility,
- Rapid processing of data so that results can be used for continuous improvement in design, and
- Maintenance of a QA/QC program.

ANALYZE THE DATA. Data analysis is a process that requires both specific skills and the benefit of experience. Identifying small anomalies in a data set, developing connections between disparate types of data, and extracting the maximum amount of information from a data set are skills that grow with practice but may develop into standard analysis procedures for longer term monitoring efforts. As mentioned in the discussion of data collection, the analysis of data will often depend on and be constrained by the quality of the collection effort. The process of data analysis includes

- Evaluation of the QA/QC program and its results;
- Analysis of independent factors (parameter-specific trends and identified problems with the data set);
- Analysis of the relationships among independent factors (this analysis typically will involve arrangement of data sets, such as ranking and correlation—it is extremely important to maintain flexibility in this analysis step and not get locked into a limited set of analysis procedures that may not be appropriate for the data collected);
- Comparison of new data with historical data or other data collected as a part of the current monitoring program;
- Creation of an archive; and
- Maintenance of the established QA/QC program.

PRESENT THE DATA. The actual presentation of the data is possibly the most important step in monitoring program implementation because design, collection, and analysis quality are all represented in this program step. In the presentation, one should

- Present the facts simply and in an understandable format;
- Meet the objectives and goals initially set for the monitoring program;
- Translate monitoring complexity (including elements of analysis) without losing meaning; and
- Provide a basis for future use, specifically relating the presentation to the data archive.

Quality Assurance and Quality Control. In the monitoring program implementation steps presented, one of the consistent elements of monitoring activities is the development and implementation of the QA/QC program. The QA/QC program is initiated with the application of the study design process and followed by specific quality control activities suited to data collection, analysis, or interpretation. Quality control procedures can be applied to any data collection effort or monitoring program, but it must be recognized that studies with different objectives involve different approaches to data collection and will have different quality control elements. What should be sought is an internal statistical quality control and an external quality control, proficiency testing, or laboratory evaluation. Both product quality and production processes must be evaluated.

In programs designed to assess receiving system effects of urban stormwater, it will be necessary to consider QA/QC elements specific for biological monitoring. Biological monitoring can be separated into two types of analysis: toxicity testing and biosurveys, or bioassessments. Toxicity tests are laboratory-based analyses that incorporate rigorous experimental protocols operating under strict environmental control to expose selected organisms to toxicants for a defined time period. Guidance for QA/QC programs is provided in *Standard Methods for the Examination of Water and Wastewater* (APHA *et al.*, 1995) and ASTM publications. Bioassessments are field-based analyses that lack strict experimental controls and may range from the description of organisms present in a community or ecosystem to the measurement of a range of ecosystem properties and processes. Bioassessments may include the use of experimental manipulation of contaminants, habitat, and ecological relationships in ecosystems, but bioassessments depend on uncontrolled reference areas to assess the consequence of the manipulation. The QA/QC procedures for biosurveys and bioassessments begin with adherence to quality assurance procedures for field and laboratory analyses of chemical and biological data (U.S. EPA, 1973a, and USGS, 1993). Quality assurance procedures for database development and management, including entry error checking, range checking, and statistical/graphical detection of outliers, should follow current practices for research databases (Gurtz, 1986).

Physical, Chemical, and Biological/Ecological Measurements

Because the actual selection of measurements needed in a monitoring program is objective and often site specific, a full discussion of measurements useful in the assessment of urban runoff effects is not possible in this publication. Nonetheless, it is possible to reference a number of government publications that provide detailed information on measurements typically made in monitoring programs. Publications listed in the Reference and Suggested Readings sections provide specific guidance on measurement and assist in setting the context for analysis and interpretation.

PHYSICAL PARAMETER SELECTION. Changes in physical conditions because of urban runoff include both change in hydrology and modification of channels in the receiving systems. Typical hydrological data measured in monitoring programs include analysis of discharge volume and distribution. From these data, it is possible to develop information about storm runoff peaks, runoff volumes, or storms and base flow. General hydrologic parameters that should be measured or calculated from discharge information include

- Runoff volume parameters during the monitoring season:

  V_R = volume of the average runoff event in the watershed, mm (in.);
  V_{50} = volume of the 50th percentile runoff event in the watershed, mm (in.);
  CV_{VR} = coefficient of variation in the volumes of runoff events ($V_{SD\text{-}R}/V_R$), in which $V_{SD\text{-}R}$ = standard deviation of runoff volumes;
  V_B = volume of the seasonal dry weather base flow in the watershed, mm (in.);
  Q_P = average runoff peak rate, m^3/s (cu ft/sec); and
  CV_{QP} = coefficient of variation of flow peaks.

- Time-variable parameters of storms during the monitoring season.
- Storm runoff interevent (separation) time:

  T_S = average separation period between the end of a storm runoff hydrograph and the beginning of the next one, hours;
  T_{S50} = the 50th percentile of storm runoff event separation periods, hours; and
  CV_{TS} = coefficient of variation in storm runoff event separation periods ($T_{SD\text{-}S}/T_S$), in which $T_{SD\text{-}S}$ = standard deviation of storm runoff event separation periods.

- Storm runoff duration:

  T_D = average duration of storm runoff, hours;
  T_{D50} = the 50th percentile value of storm runoff duration, hours; and
  CV_{TD} = coefficient of variation in storm runoff duration ($T_{SD\text{-}D}/T_D$), in which $T_{SD\text{-}D}$ = standard deviation of storm runoff duration.

The modification of channels should focus on analysis of

- Stream channel widening and downcutting;
- Changes in stream bank erosion;
- Changes in channel features, including bar location and sediment size composition;
- Changes in pool/riffle characteristics; and
- Stream relocation/enclosure or channelization.

Unlike hydrology, where a long history of practice has produced well-defined measurement and analysis methods, the process of monitoring changes in channel morphology is evolving. Accordingly, rather than make definitive statements in this publication, two types of data collection are recommended—indicators of change and establishment of data on stream channel stability (Rhoads, 1995).

Key parameters for change in channel morphology include

- Meander geometry,
- Width:depth ratio, and
- Frequency of full-bank flow.

Systems for classifying the morphology of streams are less well defined. One system, the Rosgen system, is receiving wide application. Other approaches are energy based (unit stream power) or ecosystem based (habitat suitability index modeling). The basic data needed for classification include

- Watershed position (stream order),
- Riparian zone condition (for example vegetation or encroachment),
- Watershed and local geology and land use,
- Channel morphology,
- Channel profile, and
- Substrate and sediment characteristics.

WATER QUALITY PARAMETER SELECTION. In urban runoff, two aspects of water quality are often the focus of monitoring programs. The first is the concentration of contaminants in the runoff, particularly the changes in concentration that occur through time. The second is the eventual loading to the receiving system, which integrates concentration and discharge flow. The parameters selected for monitoring include general parameters such as temperature, alkalinity, hardness, conductivity, and pH and site-specific parameters that will include analyses for conservative and nonconservative pollutants. The actual selection of parameters should be based on expected sources of contamination or should be guided by water quality standards, which are the foundation for any water quality regulation. Of particular importance are contaminants that may bioaccumulate.

Because the presence and concentration of contaminants change rapidly in urban runoff, a critical element of water quality analyses is sampling. For selected general parameters (temperature, dissolved oxygen, pH, and conductivity), continuous monitoring using multiparameter "sonde" units is recommended. Measurement frequency of these general background parameters should be selected based on expected storm hydrograph characteristics, and the duration of the monitoring should reflect pre- and poststorm conditions. Sampling for specific parameters should be accomplished by grab sampling. Automatic samplers are available that can collect sequential grab samples during an event; mix sequential grab samples to provide an event composite sample; or provide flow-weighted or time-weighted single, or multiple, sample composites. Flow-weighted composite sampling is essential for contaminant-loading determinations.

Analysis of water quality parameters should follow standard methods, and QA/QC programs should be in place for both sample collection and sample analysis. Two interpretation issues typically associated with urban runoff analysis are detection limits and outliers. Analyses below detection limits should not be reported as zero values. General guidance suggests that water quality data should not be censored by detection limits; whenever possible, report actual concentration (positive or negative) regardless of whether it is below detection limits (Gilbert, 1987). Care must also be exercised in dealing with outliers. Although excursions well beyond other analytical results are often attributed to analytical error, the nature of urban runoff sampling suggests that these outliers may be "real" measures of short-term events and should be preserved in reported data.

BIOLOGICAL MONITORING. Although guidance for biological monitoring is provided in numerous published sources, the most typically applied procedures are rapid bioassessment protocols (RBPs), which are directed to macroinvertebrate and fisheries sampling. The following discussion of RBP procedures provides guidance for biological monitoring of urban runoff.

RAPID BIOASSESSMENT PROTOCOLS. In 1989, U.S. EPA published a set of protocols for bioassessments in *Rapid Bioassessment Protocols for Use in Streams and Rivers—Benthic Macroinvertebrates and Fish* (U.S. EPA, 1989). The implementation framework first describes the development of an empirical relationship between habitat quality and biological condition. As additional information is obtained from systematic monitoring, a relationship between habitat and biological potential is developed and the effect of water quality alteration can be objectively determined from either habitat change or measures of biological integrity.

Five rapid bioassessment protocols have been developed, three for benthic invertebrates and two for fish. The appropriate bioassessment approach depends on the study objectives. Rapid bioassessment protocols I and IV are screening tools to help determine if biological impairment exists. Benthic RBP I and fish RBP V are more rigorous and provide more objective and reproducible evaluations than RBPs I and IV. Rapid bioassessment protocols II, III, and V are semiquantitative and use an integrated analysis technique to provide continuity in evaluation impairment among sites and seasons. Each of the RBPs is summarized briefly.

- Rapid bioassessment protocol I—benthic macroinvertebrates, and rapid bioassessment protocol IV—fish. These RBPs provide a screening mechanism to identify biological impairment. They are neither intended to quantify the degree of impairment nor provide definitive data to establish cause-and-effect relationships. They allow a cursory assessment, using cost and time efficiencies to evaluate a large number of sites, identify major water quality problems, and help plan and develop management strategies.

- Rapid bioassessment protocol II—benthic macroinvertebrates. This RBP provides information to rank sites as severely or moderately impaired so that additional study or regulatory/management action can be planned. Like RBP I, this protocol can be used as a screening tool and allows agencies to evaluate a large number of sites with relatively little time and effort. The more documented procedures and integrated metrics of RBP II promote better consistency and allow better comparison among sites.
- Rapid bioassessment protocol III—benthic macroinvertebrates, and rapid bioassessment protocol V—fish. These two RBPs provide a consistent, well-documented biological assessment. Like RBP II, they provide information for ranking site impairment and a way to compare repeatable results over time (trend monitoring). These RBPs include taxonomic identifications to the lowest practical level, thereby providing information on population as well as community-level effects. They include an integrated assessment of metrics and can be used to develop biocriteria.

AN INTEGRATED ASSESSMENT APPROACH. An integrated assessment of urban runoff effects should include a watershed-based analysis that connects physical, chemical, and biological/ecological analysis activities in an effective, well-focused monitoring program. An integrated effort initially may focus on water quality, toxicity, physical dynamics, or general system health as program elements, but these analyses eventually must be brought together in a watershed context. Because spatial relationships are critical in an integrated approach to understanding and management of water resource problems caused by urban runoff and nonpoint sources, integrated management requires careful consideration of the spatial framework for the monitoring program. Traditionally, we have relied on spatial frameworks based on political boundaries, watersheds, hydrologic units, or physiographic regions. However, these areas do not correspond to patterns in vegetation, soils, land surface form, land use, climate, rainfall, or other characteristics that control or reflect spatial variations in surface water quality or aquatic organisms. An alternate approach is based on ecoregions. Omernik (1987) proposed using spatial frameworks based on ecological regions (ecoregions) to assess the health of aquatic systems. Ecoregions reflect similarities in the type, quality, and quantity of water resources and the factors affecting them. Therefore, regional patterns of environmental factors reflect regional patterns in surface water quality.

MODELING

URBAN MODELING OBJECTIVES AND CONSIDERATIONS. Studies and projects involving urban stormwater runoff quality can relate to many problems. In the broadest sense, water quality studies may be performed to protect the environment under various state and federal legislation. In a narrower sense, a study may address a particular water quality issue in a particular receiving water, such as the bacterial contamination of a beach or the release of oxygen-demanding material to a stream or river. Many of these studies can be supported or completed through modeling. By no means should it be assumed that every water quality problem requires a water quality modeling effort. Some problems may be mostly hydraulic in nature, for example, problems with basement flooding. That is, the solution may often reside primarily in a hydrologic or hydraulic analysis in which the concentration or load of pollutants is irrelevant. In some instances, local or state regulations may prescribe a nominal "solution" without recourse to water quality analysis. For example, stormwater runoff in the state of Florida is considered "controlled" through retention or detention with filtration of the runoff from the first inch of rainfall for areas of 40 ha (100 ac) or less. Other problems may be resolved through the use of measured data without the need to model. In other words, many problems do not require water quality modeling at all.

If a problem does require modeling, some objectives are better met through modeling than others. Models may be used for objectives such as the following:

- Characterize the urban runoff as to temporal and spatial detail, and concentration/load ranges;
- Provide input to a receiving water quality analysis (for example, drive a receiving water quality model);
- Determine effects, magnitudes, locations, and combinations of control options;
- Perform frequency analysis on quality parameters (to determine return periods of concentrations/loads); and
- Provide input to cost–benefit analyses.

The first two objectives characterize the magnitude of the problem and the last four objectives are related to the analysis and solution of the problem. Computer models allow some types of analysis, such as frequency analysis, to be performed that could rarely be performed because the history of water quality measurements in urban areas is often poor. It should always be recognized, however, that the use of measured data is typically preferable to the use of simulated data, particularly for the first two objectives, in which accurate concentration values are needed. Typically, models are not good substitutes for good field-sampling programs. On the other hand, models can sometimes be used to extend and extrapolate measured data and enhance field-sampling results.

Careful consideration should be given to providing input to a receiving water quality analysis. The model output needed to drive a receiving water quality model is related to the objective of the analysis program. Modeling can also follow a modified SDA process. If the focus in a monitoring effort is toxicity, the model should produce concentration versus time predictions for short intervals (5 to 15 minutes). In fact, the first urban runoff quality model incorporated the concept of simulation of detailed intrastorm quality variations, for example, the production of a "pollutograph" (concentration versus time) at 5- or 10-minute intervals during a storm for input to a receiving water quality model. If the objective of the receiving water quality modeling effort is to assess general effect, the modeling effort should be supported by a bioassessment program and the model need not predict short-term variations in concentration. The total storm load will be sufficient to determine the receiving water response.

Differences in detail require differences in model complexity, as seen in Table 3.1. The most complex models are needed to predict concentration versus time at high frequencies. If only the total storm loads are needed, this presents a much easier modeling task.

In any modeling effort, data requirements are critical. Such requirements may be as simple as a constant concentration, or they may include detailed time-related changes in concentration or flow. Data may be obtained from existing studies or require extensive field monitoring. For some model objectives, it may not be possible to actually measure fundamental input parameters, which are obtained through model calibration. Acquisition of the high-quality data needed to support modeling efforts, either through literature reviews or field surveys, will affect the level of effort and costs associated with the management program. Details on data requirements for model appli-

Table 3.1 Required temporal detail for receiving water analysis.

Type of receiving water	Key constituents	Frequency
Lakes, bays	Nutrients and toxics	Weeks, seasonal, years
Estuaries	Nutrients, oxygen demand, bacteria, toxics	Tidal cycle, days, weeks
Large rivers	Oxygen demand, nitrogen, toxics	Minutes, days (event based)
Streams	Oxygen demand, nitrogen, bacteria, toxics	Minutes, hours, days (event based)
Ponds	Oxygen demand, nutrients, toxics	Hours, weeks
Beaches	Bacteria	Hours (event based)

cation in urban areas will be deferred until modeling techniques are described.

OVERVIEW OF AVAILABLE MODELING OPTIONS. Several quality modeling options exist for the simulation of quality in urban storm and combined sewer systems. These have been reviewed by Huber (1985 and 1986) and range from simple to involved, although some "simple" methods (such as U.S. EPA statistical methods) can incorporate quite sophisticated concepts. The principal methods available to the contemporary engineer are outlined generically below, in a rough order of complexity. Their data requirements are summarized again in a following section.

- Constant concentration or unit loads,
- Spreadsheet,
- Statistical,
- Rating curve or regression, and
- Buildup/washoff.

Constant Concentration or Unit Loads. As its name implies, constant concentration means that all runoff is assumed to have the same constant concentration at all times for a given pollutant. At its simplest, an annual runoff volume can be multiplied by a concentration to produce an annual runoff load. However, this option may be coupled with a hydrologic model, wherein loads (product of concentration and flow) will vary if the model produces variable flows. This option may be useful because it may be used with any hydrologic or hydraulic model to produce loads simply by multiplying by the constant concentration. In many instances, it may be most important to get the volume and timing of such overflows and diversions correctly and simply estimate loads by multiplying by a concentration.

An obvious question is which constant concentration to use. Early (pre-1977) concentration and other data are summarized in publications such as Lager *et al.* (1977) and Manning *et al.* (1977). U.S. EPA Nationwide Urban Runoff Program (NURP) studies (U.S. EPA, 1983) have produced a large and invaluable database from which to select numbers, but the 30-city coverage of NURP will most often not include a site representative of the area under study. Nonetheless, a large database does exist from which to review concentrations. Another option is to use measured values from the study area. This might be done from a limited sampling program.

Unit loads are perhaps an even simpler concept. These consist of values of mass per area per time (typically pounds per acre per year or kilograms per hectare per year) for various pollutants, although other normalizations such as pound/curb-mile are sometimes encountered. Annual (or other time unit) loads are thus produced by multiplying mass per time by the contributing area. Such loadings are site specific and depend on both demographic and hydrologic factors. A unit load must be based on an average or "typical" runoff volume and cannot vary from year to year, but loading can be subject to reduction by BMPs if the BMP effect is known. Although early U.S. EPA references provide some information for various land uses (McElroy *et al.*, 1976; U.S. EPA, 1973b; and U.S. EPA, 1976a), unit loading rates are variable and difficult to transpose from one area to another. Constant concentrations can sometimes be used for this purpose because mg/L $\times$ 0.226 5 = lb/ac per inch of runoff. Thus, if a concentration estimate is available, the annual loading rate may be calculated by multiplying by the inches per year of runoff.

The universal soil loss equation (Heaney *et al.*, 1975, and Wischmeier and Smith, 1958) was developed to estimate tons per acre (kilograms per square metre) per year of sediment loss from land surfaces. If a pollutant may be considered as a fraction ("potency factor") of suspended solids concentration or load, this offers another option for the prediction of annual loads. Lager *et al.* (1977), Manning *et al.* (1977), and Zison (1980) provide summaries of such values.

Spreadsheets. Microcomputer spreadsheet software is now ubiquitous in engineering practice. Extensive and sophisticated engineering analysis is routinely implemented on spreadsheets, and water quality simulation is no exception. The spreadsheet may be used to automate and extend the constant concentration or unit load determinations. In the typical application of the spreadsheet approach, runoff volumes are calculated simply, typically by multiplying runoff coefficient times rainfall depth. The coefficient may vary according to land use, but the hydrology is inherently simplistic in the spreadsheet predictions. The runoff volume is then multiplied by a constant concentration to predict runoff loads. Alternatively, unit loads are input directly and then multiplied by corresponding land-use areas. The spreadsheet approach is best suited to estimation of long-term loads, such as annual or seasonal, because simple prediction methods typically perform better over a long averaging time and poorly at the level of a single storm event.

The advantage of the spreadsheet is that a mixture of land uses (with varying concentrations or loads) may easily be simulated, and an overall load and flow-weighted concentration can be estimated for the study area (Walker *et al.*, 1989). A study area may range from a single catchment to an entire urban area, and delivery ratios can be added to simulate loss of pollutants along drainage pathways between the simulated land use and receiving waters. The relative contributions of different land uses may be easily identified, and handy spreadsheet graphics tools may be used for displaying the results.

As an enhancement, control options may be simulated by application of a constant removal fraction for an assumed BMP. Although spreadsheet computations can be complex, BMP simulation is rarely more complicated than a simple removal fraction because anything further would require simulation of the dynamics of the removal device (for example, a wet detention pond), which typically is beyond the scope of the hydrologic component of the spreadsheet model. Nonetheless, the spreadsheet can be used to estimate the effectiveness of control options. Loads with and without controls can be estimated, and problem areas can be determined by separate analysis of contributing basin and land-use characteristics. Because most engineers are familiar with spreadsheets, such models can be developed in house.

Again, the question arises of what concentrations or unit loads to use, this time potentially for multiple land uses and subareas. Again, the NURP database will typically be the first one to turn to, with the possibility of local monitoring to augment it.

Statistical Method. The so-called "U.S. EPA Statistical Method" is somewhat generic and until recently was not implemented in any off-the-shelf model or implemented well in any single report (Hydroscience, 1979, and U.S. EPA, 1983). A FHWA study (Driscoll *et al.*, 1989) partially remedies this situation. The concept is straightforward, namely that of a derived frequency distribution for estimated mean concentration (EMC). This idea has been used extensively for urban runoff quantity (Howard, 1976; Loganathan and Delleur, 1984; and Zukovs *et al.*, 1986) but not as much for quality predictions.

The U.S. EPA statistical method uses the fact that EMCs are not constant but tend to exhibit a log-normal frequency distribution. When coupled with an assumed distribution of runoff volumes (also log-normal), the distribution of runoff loads may be derived. When coupled again to the distribution of stream flow, an approximate (log-normal) probability distribution of instream concentrations may be derived (Di Toro, 1984)—a useful result, although assumptions and limitations of the method have been pointed out by Novotny (1985) and Roesner and Dendrou (1985). Further analytical methods have been developed to account for storage and treatment (Di Toro and Small, 1979, and Small and Di Toro, 1979). The method was used as the primary screening tool in U.S. EPA NURP studies (U.S. EPA, 1983) and has also been adapted to combined sewer overflows (Driscoll, 1981) and highway-related runoff (Driscoll *et al.*, 1989). This latter publication offers a concise explanation of the procedure and assumptions and includes spreadsheet software for easy implementation of the method.

A primary assumption is that EMCs are distributed log-normally at a site and across a selection of sites. The concentrations may thus be characterized by their median value and by their coefficient of variation (*CV*—standard deviation divided by the mean). There is little doubt that the log-normality assumption is good (Driscoll, 1986), but similar to the spreadsheet approach, the method typically is then combined with weak hydrologic assumptions (for example, the prediction of runoff using a runoff coefficient). (The accuracy of a runoff coefficient increases as urbanization and imperviousness increase.) However, because many streams of concern in an urban area consist primarily of stormwater runoff during wet weather, the ability to predict the distribution of EMCs is useful for the assessment of levels of exceedance of water quality standards. The effect of BMPs can again be estimated crudely through constant removal fractions that lower the EMC median, but it is harder to determine the effect on the coefficient of variation. Overall, the method has been successfully applied as a screening tool.

Inputs to the method discussed by Driscoll *et al.* (1989) include statistical properties of rainfall (mean and coefficient of variation of storm event depth, duration, intensity, and interevent time), area, and runoff coefficient for the hydrologic component, plus EMC, median, and coefficient of variation for the pollutant. Generalized rainfall statistics have been calculated for many locations in the U.S. Otherwise, the U.S. EPA SYNOP model (Hydroscience, 1979; U.S. EPA, 1976b; U.S. EPA, 1983; and Woodward-Clyde Consultants, 1989) must be run on long-term hourly rainfall records. If receiving water effects are to be evaluated, the mean and *CV* of the streamflow are required plus the upstream concentration. A lake impact analysis is also possible based on phosphorus loadings.

As with the first two methods discussed, the choice of median concentration may be difficult, and the statistical method requires a coefficient of variation as well. Fortunately, from NURP and highway studies, *CV* values for most urban runoff pollutants are fairly consistent, and a value of 0.75 is typical. If local and/or NURP data are not available or inappropriate, local monitoring may be required.

Regression—Rating Curve Approaches. With the completion of the NURP studies in 1983, there are measurements of rainfall, runoff, and water quality at more than 100 sites in more than 30 cities. Some regression analysis has been performed to try to relate loads and EMCs to catchment, demographic, and hydrologic characteristics (Brown, 1984; McElroy *et al.*, 1976; and Miller *et al.*, 1978), the best of which are results of the U.S. Geological Survey (USGS) (Driver and Tasker, 1988, and Tasker and Driver, 1988) and are described briefly in this section. Regression approaches have also been used, with limited success, to estimate dry-weather pollutant deposition in combined sewers (Pisano and Queiroz, 1977). What are termed "rating curves" in this discussion are a special form of regression analysis in which concentration or loads are related to flow rates or volumes.

A rating curve approach is most often applied using total storm event load and runoff volume, although intrastorm variations can sometimes also be simulated (for example, Huber and Dickinson, 1988). It is typically observed (Driscoll *et al.*, 1989; Huber, 1980; and U.S. EPA, 1983) that concentration (EMC) is poorly correlated or not correlated with runoff flow or volume, implying that a constant concentration assumption is adequate. Because the load is the product of concentration and flow, load typically is well correlated with flow regardless of whether concentration correlates well. This instance of spurious correlation (Bensen, 1965) is often ignored in urban runoff studies. If load is proportional to flow to the first power (that is, linear), then the constant concentration assumption holds; if not, some relationship of concentration with flow is implied. Rating curve results can be used by themselves for load and EMC estimates and can be incorporated to some models.

Rainfall, runoff, and quality data were assembled for 98 urban stations in 30 cities (NURP and others) in the U.S. for multiple regression analysis by USGS (Driver and Tasker, 1988, and Tasker and Driver, 1988). Thirty-four multiple-regression models (mostly log-linear) of storm runoff constituent loads and storm runoff volumes were developed, and 31 models of storm runoff EMCs were developed. Regional and seasonal effects were also considered. The two most significant explanatory variables were total storm rainfall and total contributing drainage area. Impervious area, land use, and mean annual climatic characteristics also were significant explanatory variables in some of the models. Models for estimating loads of dissolved solids, total nitrogen, and total ammonia plus organic nitrogen (total Kjeldahl nitrogen) typically were the most accurate, whereas models for suspended solids were the least accurate. The most accurate models were those for the more arid Western U.S., and the least accurate models were those for areas that had large mean annual rainfall.

These USGS equations represent some of the best generalized regression equations available for urban runoff quality prediction. Note that these equations do not require preliminary estimates of EMCs or local quality monitoring data. except of verification of the regression predictions. Regression equations only predict the mean and do not provide the frequency distribution of a predicted variable, a disadvantage compared to the statistical approach. (The USGS documentation describes procedures for calculation of statistical error bounds, however.) Finally, regression approaches, including rating curves, are difficult to apply beyond the original data set from which the relationships were derived. That is, they are subject to potential errors when used to extrapolate to different conditions. Thus, the usual caveats about use of regression relationships continue to hold when applied to prediction of urban runoff quality.

Buildup and Washoff. In the late 1960s, a Chicago study by the American Public Works Association (1969) demonstrated the (assumed linear) buildup of "dust and dirt" and associated pollutants on urban street surfaces. During a similar time frame, Sartor and Boyd (1972) demonstrated buildup mechanisms on the surface and an exponential washoff of pollutants during rainfall events. These concepts were incorporated to an early hydraulic model (Metcalf and Eddy, Inc., *et al.*, 1971) as well as to the other models to a greater or lesser degree (Huber, 1985). "Buildup" is a term that represents all of the complex spectrum of dry-weather processes that occur between storms, including deposition, wind erosion, and street cleaning. The idea is that all such processes lead to an accumulation of solids and other pollutants that are then "washed off" during storm events.

Although ostensibly empirically based, models that include buildup and washoff mechanisms use conceptual algorithms because the fundamental physical foundations are related to principles of sediment transport and erosion that are sometimes poorly understood. Furthermore, the inherent heterogeneity of urban surfaces leads to the use of average buildup and washoff parameters that may vary significantly from conditions in isolated locations such as a street gutter. Thus, except in rare instances where actual measurements of accumulations of surface solids are available, the use of buildup and washoff formulations involve a calibration exercise against measured end-of-pipe quality data. In the absence of accumulation measurements, inaccurate predictions can be expected.

Different models offer different options for conceptual buildup and washoff mechanisms. In fact, with calibration, good agreement can be produced between predicted and measured concentrations and loads with such models, including intrastorm variations that cannot be duplicated with most of the methods discussed earlier. (When a rating curve is used instead of buildup and washoff, it is also possible to simulate intrastorm variations in concentration and load.) A survey of linear buildup rates for many pollutants by Manning *et al.* (1977) is a source of generalized buildup data, and some information is available in the literature to aid in selection of washoff coefficients (Huber, 1985, and Huber and Dickinson, 1988). However, such first estimates may not even get the user in the ballpark (that is, quality—not quantity—predictions may be off by more than an order of magnitude); the only way to be sure is to use local monitoring data for calibration and verification. Thus, as for most of the other quality prediction options discussed in this section, the buildup–washoff model may provide adequate comparisons of control measures or ranking of loads, but it cannot be used for prediction of absolute values of concentrations and loads (for example, to drive a receiving water quality model without adequate calibration and verification data).

It is relatively easy to simulate potential control measures, such as street cleaning and surface infiltration, using this modeling approach. When intrastorm variations in concentration and load must be simulated (as opposed to total storm event EMC or load), buildup and washoff offers the most flexibility. This is sometimes important for the design of storage facilities in which first-flush mechanisms may be influential.

The data for buildup and washoff modeling are sparse (Manning *et al.*, 1977), and the needed measurements are seldom made as part of a routine monitoring program. For buildup, normalized loadings, such as mass/day per area, mass/day per curb-length, or just mass/day, are required, along with an assumed functional form for buildup versus time, such as linear or exponential. For washoff, the relationship of washoff rate (mass/time) runoff rate must be assumed, typically in the form of a power equation. When end-of-pipe concentration and load data are all that are available, all buildup and washoff coefficients end up being calibration parameters.

Related Mechanisms. In the discussion above, washoff rate is assumed proportional to the runoff rate, as for sediment transport, but erosion from pervious areas may be proportional to the rainfall rate. One model includes this mechanism in its algorithms for erosion of sediment from pervious areas. Another includes a weaker algorithm based on the Universal Soil Loss Equation (Heaney *et al.*, 1975, and Wischmeier and Smith, 1958).

Many pollutants, particularly metals and organics, are adsorbed to solid particles and are transported in particulate form. The ability of a model to include "potency factors" or "pollutant fractions" enhances the ability to estimate the concentration or load of one constituent as a fraction of that of another, such as solids (Zison, 1980).

Groundwater contribution to flow in urban areas can be important in areas with unlined and open-channel drainage. The precipitation load may be input to some models, typically as a constant concentration. Point source and dry-weather flow (base flow) loads and concentrations can also be input to some models to simulate background conditions. Other quality sources of potential importance include catch basins and snowmelt.

Scour and deposition within the sewer system can be important in combined sewer systems and some separate storm sewer systems. The state of the art in simulation of such processes is poor (Huber, 1985).

SUMMARY OF DATA NEEDS. In the application of most models, there are two fundamental types of data requirements. First, there are data needed simply to make the model function, that is, input parameters for the model. These typically include rainfall information, area, imperviousness, runoff coefficient, and other quantity prediction parameters, plus quality prediction parameters such as constant concentration, constituent median and *CV*, regression relationships, and buildup and washoff parameters. In other words, each model will have a fundamental list of required input data.

The second type of information is required for calibration and verification of more complex models, namely, sets of measured rainfall, runoff, and quality samples with which to test the model. Such data exist (for example, Driver *et al.*, 1985; Huber *et al.*, 1982; and Noel *et al.*, 1987) but seldom for the site of interest. If the project objectives absolutely require such data (for example, if a model must be calibrated to drive a receiving water quality model), then monitoring may be necessary to produce needed data.

SELECTING URBAN RUNOFF QUALITY MODELS. This summary will relate primarily to quality prediction and will not represent a comprehensive statement of data needs for quantity prediction. However, because rainfall and runoff are required for virtually every study, certain quantity-related parameters are also necessary.

Modeling Fundamentals. Modeling caveats and an introduction to modeling are presented by several authors, including Huber (1985 and 1986), James and Burges (1982), and Kibler (Ed.) (1982), and summarized in *Combined Sewer Overflow Pollution Abatement* (WPCF, 1989). Space does not permit a full presentation here; a few items are highlighted in the following bullets.

- Have a clear statement of project objectives. Verify the need for quality modeling. (Perhaps the objectives can be satisfied without quality modeling.)
- Use the simplest model that will satisfy the project objectives. Often, a screening model, such as regression or statistical, can determine whether more complex simulation models are needed.
- To the extent possible, use a quality prediction method consistent with available data. This would often rule against buildup–washoff formulations, although these might still be useful for detailed simulation, especially if calibration data exist.
- Only predict the quality parameters of interest and only over a suitable time scale. That is, storm event loads and EMCs typically will represent the most detailed prediction requirement, and seasonal or annual loads will sometimes be all that are required. Do not attempt to simulate intrastorm variations in quality unless necessary.
- Perform a sensitivity analysis on the selected model and familiarize yourself with the model characteristics.
- If possible, calibrate and verify the model results. Use one set of data for calibration and another independent set for verification. If no such data exist for the application site, perhaps they exist for a similar catchment nearby.

Operational Models. Implementation of an off-the-shelf model or method will be easiest if the model can be characterized as "operational" in the sense of the following:

- Documentation—this should include a user's manual, explanation of theory and numerical procedures, data needs, and data input format. Documentation most often separates the many computerized procedures found in the literature from a model that can be accessed and easily used by others.
- Support—this is sometimes provided by the model developer but often by a federal agency such as U.S. EPA.
- Experience—every model must be used a "first time," but it is best to rely on a model with a proven track record.

Models described below are operational in this sense. New methods and models are constantly under development and should not be neglected simply because they lack one of these characteristics, but the user should be aware of potential difficulties if any characteristic is lacking.

Surveys of Operational Urban Runoff Models. Several publications, though somewhat out of date, provide reviews of available models. Some models have persisted for many years and are included in both older and newer reviews, while other models are more recent. Reviews that consider surface runoff quality models include Barnwell (1984 and 1987), Bedient and Huber (1988), Huber (1985 and 1986), Huber and Heaney (1982), Kibler (Ed.) (1982), Viessman *et al.* (1989), WPCF (1989), and Whipple *et al.* (1983).

URBAN RUNOFF QUALITY SIMULATION MODELS AND METHODS. Several models are often considered the best choices for full-scale simulation for urban areas. Other models have been adapted and given modified names. Still other models have been used for water quality simulation for a specific project (Noel and Terstriep, 1982), but such modifications and quality procedures remain undocumented, and the quality model cannot be considered operational. A number of models have been developed in Europe and applied extensively in a number of situations. One of these models includes modules for generation of runoff from rainfall using either a time–area method or a nonlinear reservoir model. The model handles six pollutants, and the emphasis is production of statistics for both extreme and annual loads. Finally, there are many models well known in the hydrologic literature that are useful in the hydrologic modeling in water quality studies but do not simulate water quality directly.

BIOLOGICAL AND ECOLOGICAL MODELING. In many respects, biological and ecological modeling have lagged far behind physical, chemical, and hydrologic modeling, and there are few examples of general application of biological and ecological models in urban runoff. It is possible to connect other modeling efforts with a prediction of biological and ecological receiving system effects through a general application of concentration and time of exposure analysis, which allows assessment of toxicity and supports general predictions of effect.

RECEIVING WATER MODELS

To assess the effects of runoff loads on receiving water quality, it is often necessary to use computer models. Measurements of receiving water quality parameters are preferable for impact assessment, but such data typically are sparse. Also it is difficult and costly to obtain sufficient data for model calibration, let alone for evaluation of effects. And if alternative pollution control options are to be evaluated, models are the only option with which to assess "what if" management strategies, at least as far as effects on *in situ* concentrations are concerned. It sometimes may be possible to evaluate water quality control strategies on the basis of hydraulic or surface runoff quality criteria alone, without receiving water quality modeling—an advantage.

Do not model if it is not necessary. However, if comparison with water quality standards is a requirement, modeling typically is the only option.

Receiving water quality models are available for streams, lakes (and reservoirs), estuaries, and bays. Groundwater models will not be discussed here, although several models are available. Segments of coastal ocean areas can also be modeled with more difficulty (because of the necessity of two- and three-dimensional formulations). Such models are driven by transient or steady-state point and nonpoint source loadings, typically entering the water body at multiple locations. Nonpoint source loads are often generated by surface runoff loading models discussed previously. Thus, there typically is a coupling of surface runoff models with receiving water models for determination of nonpoint source effects. The output from such models typically is a transient or steady-state prediction of water quality constituent concentrations at multiple locations throughout the receiving water, although some methods (such as simple eutrophication models) provide only an average concentration in space and time.

Most receiving water quality models require information about flows, velocities, volumes, and stages—that is, a description of quantity (hydrodynamic) processes. Some models compute flows and quality concentrations, whereas other models require a separate model or data for input of such information. Data input for the former is correspondingly more demanding. This discussion will focus only on quality modeling because of the vast complexity of two- and three-dimensional quantity modeling. Simulation of quantity processes will thus be mentioned only incidentally if it is included as an option for a particular model.

Most of the caveats and general modeling fundamentals provided previously while discussing surface runoff models also apply to receiving water quality modeling, for example clear objectives, desirability of simplicity, and the need for data. Receiving water quality models should be calibrated and verified similar to surface runoff models because of the many influential processes at work in natural waters. A similar statement can be made for receiving water quality modeling as for surface runoff quality modeling: calibration/verification data (that is, measured *in situ* concentrations) are essential for accurate predictions of concentrations. Without such data, only relative comparisons can be made. Of course, accurate concentrations are important for comparison of predicted concentrations with water quality standards.

The models discussed below are all "far-field" models, that is, models for which transport is influenced only by the hydrodynamics of the receiving waters. "Near-field" models consider the effects of plumes and jets at the discharge location and may be used for mixing zone calculations and are not considered herein. These dilution calculations are hydrodynamic in nature and discussed by Fischer *et al.* (1979) and Holley and Jirka (1986). Another category of models not included below is simple eutrophication models for lakes. Procedures for analyzing lakes in a spatially lumped manner for eutrophication screening are described, for example by Mills *et al.* (1985), Reckhow and Chapra (1983), and Thomann and Mueller (1987).

LINKAGE WITH SURFACE RUNOFF MODELS. Nonpoint source loadings used to "drive" the receiving water model typically are obtained from surface runoff models. A time series of loads (and flows) must be supplied as input to the receiving water model. This interface may be more or less difficult depending on the models used. The user should determine the nature of the interface requirements to ensure compatibility between the surface and receiving water models. For instance, the surface runoff model should be able to output a file containing the load and flow time series, and it should be possible to manipulate this file to produce the required format for the receiving water model. Obviously, the receiving water model documentation should specify this format. It can thus be seen that the interfacing of different models may be more or less difficult, depending on the models and their documentation. Use of surface and receiving water models from the same agency may alleviate this problem to a large extent.

SURVEY OF RECEIVING WATER QUALITY MODELS. Modeling is such a dynamic process that reviews and surveys are rapidly outdated. Typically, it is best to contact an agency or model distributor directly for current information. However, useful summaries are provided by Ambrose and Barnwell (1989), Ambrose *et al.* (1988), and Feldman (1981). Principles of fate and transport are discussed in references such as Bowie *et al.* (1985), Fischer *et al.* (1979), French and McCutcheon (Eds.) (1989), Holley and Jirka (1986), Krenkel and Novotny (1980), Mills *et al.* (1985), and Thomann and Mueller (1987).

SOURCES OF RECEIVING WATER MODELS. Models are available from federal agencies and private vendors. For water quality formulations (as opposed to detailed hydrodynamic components), the predominant federal source is the U.S. EPA Center for Exposure Assessment Modeling at Athens, Georgia. Additional federal sources include the U.S. Army Corps of Engineers, Waterways Experiment Station in Vicksburg, Mississippi, and the U.S. Army Corps of Engineers, Hydrologic Engineering Center, in Davis, California. The USGS has performed numerous receiving water quality studies, including development of two- and three-dimensional transient hydrodynamic/quality models. Most of these efforts are for a particular project, and local centers should be contacted for information about particular model availability. Similar remarks can be made about the National Oceanic and Atmospheric Administration for estuary/bay modeling and for the Tennessee Valley Authority for river/reservoir modeling. Still other federal agencies may perform quality modeling as a part of other studies.

BEST MANAGEMENT PRACTICE DATA REPORTING AND MONITORING

Auditing and monitoring BMPs are important applications of monitoring and modeling. This section proposes a standardized set of BMP data for reporting purposes and equipment considerations for monitoring specific BMP facilities based on Urbonas (1995a and 1995b).

NEED FOR STANDARDIZED REPORTING. There is a need to develop an approach for reporting data on the physical, chemical, climatic, geological, biological/ecological, and meteorological parameters in the assessment of the performance of BMPs used to enhance urban runoff quality. Transferability of performance results and consistency or lack of it in the performance of various BMPs have been ongoing problems. By defining a standardized approach it is expected that over time this standardization will conserve the resources being expended by various field investigations and will lead to improvements in the selection and design of various BMPs. Further, this standardization provides a workable listing of parameters that are the focus of monitoring and modeling efforts.

FACILITIES COVERED FOR REPORTING. A standard reporting format is provided for the following BMP technologies:

- Retention basin (dry pond, wet pond),
- Extended detention basin,
- Wetland basin,
- Wetland channels,
- Sand filters,
- Oil–grit separators (traps), and
- Infiltration and percolation facilities.

For facilities that contain more than one type of BMP in a BMP train, the analyst should report data for the overall unit, if performance assessment occurs on this basis, and for specific BMPs, if monitoring is done on this basis.

PARAMETERS FOR RETENTION PONDS. Retention ponds always have some surcharge detention storage above the permanent pool water surface. There are several pollutant removal mechanisms at work within a retention pond. These include sedimentation during runoff events and between runoff events and other physical, chemical, and biological processes. As a result, more information needs to be reported for these types of facilities than for facilities that remove pollutants primarily though physical processes. The following parameters emerge as important reporting points to assess retention pond removal efficiency.

Surface area and pond layout parameters:

A_P = surface area of the permanent pool, m^2 (sq ft);
A_L = surface area of the littoral zone (zone ≤ 0.5 m [1.5 ft] deep), m^2 (sq ft);
A_D = surface area of the top of the surcharge detention basin, m^2 (sq ft);
L_P = length of the permanent pool or flow path, m (ft);
L_D = length of the surcharge detention basin, m (ft);
A_F = surface area of the forebay, m^2 (sq ft); and
L_F = length of the forebay, m (ft).

Basin volume parameters:

V_P = volume of the permanent pool, m^3 (cu ft);
V_D = design volume of the surcharge detention basin above the permanent pool's water surface, m^3 (cu ft); and
V_F = volume of the forebay, m^3 (cu ft).

Emptying time parameters:

T_E = time needed to empty 99% of V_D assuming no inflow takes place while the surcharge pool is emptying, hours; and
$T_{0.5E}$ = time needed to empty the upper one-half of V_D assuming no inflow takes place while the surcharge pool is emptying, hours.

PARAMETERS FOR EXTENDED DETENTION BASINS. Extended detention basins use sedimentation as their primary pollutant removal mechanism. As a result, extended detention basins have to be viewed somewhat differently than retention ponds. In a retention pond, sediments that settle below the overflow outlet level are essentially trapped within the permanent pool and are less likely to be discharged through the outlet. The trapped sediment continues to settle to the bottom of the pond even after the surcharge volume is drained off. In an extended detention basin, stormwater empties through an outlet located on the bottom. As the sediments settle to the bottom, they concentrate within the lower levels of the ever-shrinking pool and discharge through the outlet. Unless they are scoured out, only the sediments that deposit on the bottom can be trapped within the basin.

The list that follows reflects most of the parameters of importance for an extended detention basin. Many of the same parameters that were recommended for retention ponds are repeated.

Surface area and plan layout parameters:

A_D = surface area of the extended detention basin, m^2 (sq ft);
L_D = length of the extended detention basin, m (ft);
A_B = surface area of the bottom stage (that is lower basin), m^2 (sq ft); and
L_F = length of the forebay, m (ft)

Basin volume parameters:

V_D = total volume of the extended detention basin, m^3 (cu ft);
V_B = volume of the bottom stage only of the basin, m^3 (cu ft); and
V_F = volume of the forebay, m^3 (cu ft).

Time variables: Use the same emptying time parameters as defined for the retention pond.

PARAMETERS FOR WETLAND BASINS. Some wetland basins are similar in their operation to retention ponds, while others resemble extended detention basins. The difference between the two is whether or not the wetland basin has standing water or a wetland meadow as its bottom. The pollutant removal mechanisms are probably similar to those found in retention ponds and in detention basins, except that stormwater comes in contact with wetland flora and fauna. This contact and the physical structure of the wetland provide pollutant removals through adsorption and biochemical processes and possibly through reoxygenation of the sediments and detoxification of the water column—processes that may or may not be available in retention ponds and that are not available in detention basins.

Each performance monitoring program should report parameters that are particular to the wetland studied. Most currently available wetland monitoring data rarely contain such information, often not even reporting many of the parameters typically reported for other BMPs. Because the quantification of wetland performance as a BMP is relatively new, little information can be found in the literature, and it is difficult to suggest parameters to report when reporting the performance data of wetland basins. Table 3.2 and the follow-

Table 3.2 Additional general parameters to report for wetlands.

Type of wetland	Cattail marsh, northern peat land, meadow, palustrine, southern marshland, hardwood swampland, brackish marsh, high-altitude riverine, freshwater riverine, constructed or natural wetlands
Rock filter?	Is there a rock filter media present in the wetland bottom?
Dominant plant species	Lists the dominant plant species in the wetland and the age of these plants (that is, the time since their original planting or replanting)

ing list suggest the parameters that appear to be most important, many of which are identical to those recommenced for retention ponds.

Surface area and layout plan parameters:

- A_P = surface area of permanent wetland pool, if any, m^2 (sq ft);
- A_M = surface area of the meadow wetland, if any, m^2 (sq ft);
- $P_{0.30}$ = percent of permanent pool less than 0.30 m (12 in.) depth;
- $P_{0.60}$ = percent of the permanent pool more than 0.60 m (24 in.) depth;
- A_S = surface area of the surcharge detention basin's top, m^2 (sq ft),
- L_S = length of the wetland surcharge/detention pool or flow path, m (ft);
- A_F = surface area of the forebay, m^2 (sq ft); and
- L_F = length of the forebay, m (ft).

Basin volume parameters:

- V_P = volume of the permanent pool, if any, m^3 (cu ft);
- V_D = design volume of the surcharge/detention basin, m^3 (cu ft); and
- V_F = volume of the forebay, m^3 (cu ft).

Time variables: Use the same emptying time parameters as defined for the retention pond.

PARAMETERS FOR WETLAND CHANNELS. Channels can be designed to have a wetland bottom that is designed to flow slowly. When properly designed, the channel's bottom is covered by wetlands, with only the sideslopes having terrestrial vegetation. The flow velocity is controlled by transverse berms, check dams, or an outlet at the downstream end of a given channel's reach. In the last case, the channel is essentially a long and narrow wetland basin. Figure 3.1 shows a profile of an idealized wetland bottom channel.

The pollutant removal mechanisms in wetland bottom channels are similar to those found in wetland basins, except that contact time of stormwater with the wetland vegetation is likely to be less. Because of the flowing channel nature of this BMP, the following parameters should provide some of the information needed to compare the performance of different installations:

- $V_{2\text{-yr}}$ = average channel velocity during a 2-year runoff event, m/s (ft/sec);
- A_D = surface area of the wetland bottom, m^2 (sq ft);
- L_D = length of the wetland channel, m (ft); and
- Prt = describe any pretreatment provided ahead of the channel (such as detention).

There are no emptying time parameters to report for wetland channels.

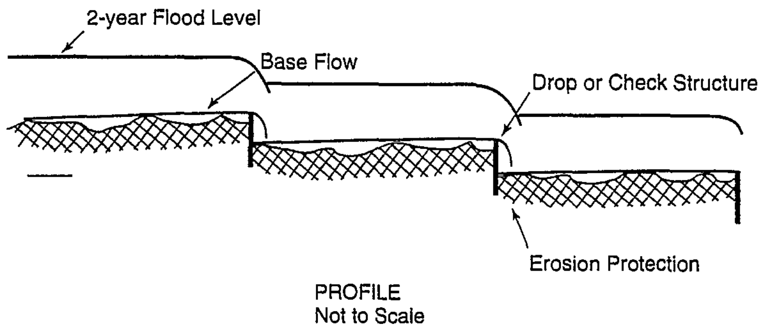

Figure 3.1 **Profile of an idealized wetland bottom channel (UDFCD, 1992).**

PARAMETERS FOR SAND FILTERS. Sand filters can be installed as basins or as sand filter inlets. Figures 3.2 through 3.4 illustrate typical sand filter designs. These installations will have a detention basin or a retention pond (or tank) upstream of the filter to remove the heavier sediment and, if properly designed, some of the oil and grease found in stormwater. However, such a pretreatment basin is not always present. All of the parameters required for a retention pond or for an extended detention basin should also be reported, along with the information about the sand filter whenever the filter is preceded by a pretreatment basin. For example, a filter inlet is often equipped with an underground tank, which helps to remove some of the sediment, oil, and grease before stormwater is applied to the filter. Such a tank is similar to a retention pond, and all of the parameters associated with a retention pond, such as volume, surface area, length, and surcharge volume, should be reported.

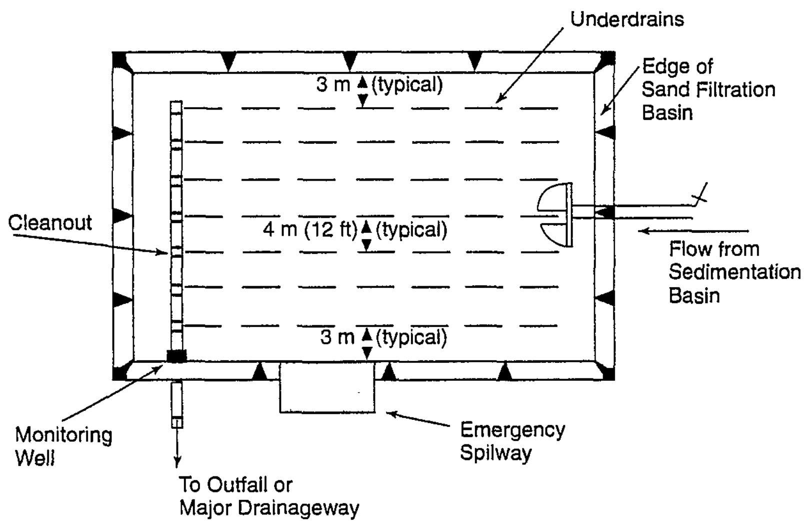

Figure 3.2 **Plan of an idealized sand filter basin.**

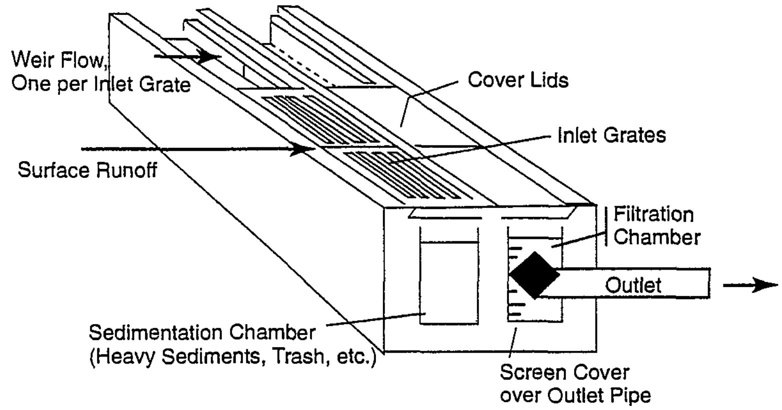

Figure 3.3 An idealized sand filter inlet.

In addition to the parameters of the pond or basin associated with the filter, provide the following:

- Dimensions of the installation;
- Depth of various filter material layers;
- Type of filter media, its median particle size (D_{50}), and its coefficient of uniformity;
- Maintenance frequency; and
- All associated drainage and flooding problems attributed to the installation because of its configuration size and maintenance practices.

Use the same parameters for *emptying time* as defined for the retention pond.

PARAMETERS FOR OIL, GREASE, AND SAND TRAPS. An oil, grease, and sand trap is an underground tank, similar to the one illustrated in Figure 3.4. It is nothing more then a special configuration of a retention pond. As a result, all parameters listed for a *retention pond* should be reported for these installations. Typically, these installations have a forebay and an outlet basin. In addition to reporting the parameters for a pond, pro-

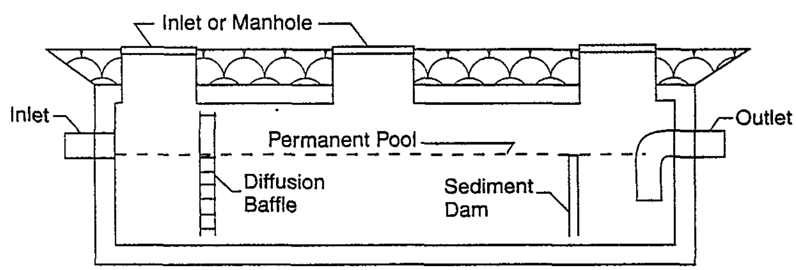

Figure 3.4 An idealized oil, grease, and sand trap.

vide the dimensions of the installation, details of its design (including skimmers, sorbent pillows, lamella plates, and baffles), and the maintenance provided during the testing period. Because these traps are much smaller than a surface pond, the flow-through velocity is of concern because it can cause trapped oil, grease, and sediment to be remobilized and flushed out of the trap. As a result, provide the average flow velocity that can be expected to occur in this device during a 2-year storm. This velocity can be used as an index for comparing the performance among a variety of installations. Use the same *emptying time* parameters as defined for a retention pond.

PARAMETERS FOR INFILTRATION AND PERCOLATION FACILITIES. For percolation trenches and for infiltration basins, report all of the parameters suggested for the extended detention basin. In addition, report the following:

- Depth to high groundwater and impermeable layers below the infiltrating surface of the basin or below the bottom of the percolation trench;
- The hydraulic conductivity of soils adjacent to percolation trenches and the saturated surface infiltration rates of soils underlying infiltration basins;
- Dimensions of the installation;
- Maintenance needs and associated drainage and flooding problems attributed to the installation; and
- Failures to empty out the captured water completely within the design emptying time.

Use the same *emptying time* parameters as defined for a retention pond.

SUMMARY

In summary, in the reporting of various BMP parameters and the field testing data on their performance, we can find a model for the selection of parameters useful in both more general monitoring programs and modeling. Table 3.3 lists the parameters identified in standardized procedures for BMP performance monitoring.

Table 3.3 Summary of reportable best management practice site parameters.

Parameter	Ret. pond	Ext. det. basin	Wet-land basin	Wet-land channel	Sand filter	Oil/ sand trap	Infilt. & perc.
Tributary watershed area—A_T	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total % trib. watershed is impervious—I_{IT}	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% of impervious area hyd. connected—I_{IC}	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gutter/sewer/swale/ditches in watershed?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average storm runoff volume—V_R	Yes	Yes	Yes	Yes	Yes	Yes	Yes
50th percentile runoff volume—V_{R50}	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coeff. var. of runoff volumes—CV_{VR}	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Av. daily base flow volume—V_B	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average runoff interevent time—T_S	Yes	Yes	Yes	Yes	Yes	Yes	Yes
50th percentile interevent time—T_{S50}	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coeff. var. of interevent times—CV_{TS}	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average storm duration—T_D	Yes	Yes	Yes	Yes	Yes	Yes	Yes
50th percentile storm duration—T_{D50}	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coeff. var. of storm durations—CV_{TD}	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Water temperature	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alkalinity, hardness, & pH	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sediment settling velocity dist.—V_{SD}	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Type and frequency of maintenance	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Inlet and outlet dimensions and details	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Solar radiation	Yes	No	Yes	Yes	No	No	No
Volume of permanent pool—V_P	Yes	No	Yes	No	Yes	Yes	No
Perm. pool surface area—A_P	Yes	No	Yes	No	Yes	Yes	No
Littoral zone surface area—A_L	Yes	No	No	No	No	No	No
Length of permanent pool—L_P	Yes	No	Yes	No	Yes	Yes	No
Detention (or surcharge) vol.—V_D	Yes	Yes	Yes	No	Yes	Yes	Yes
Detention basin's surface area—A_D	Yes	Yes	Yes	No	Yes	Yes	Yes
Length of detention basin—L_D	Yes	Yes	Yes	No	Yes	Yes	Yes
Brim-full emptying time—T_E	Yes	Yes	Yes	No	Yes	Yes	Yes
1/2 Brim-full emptying time—$T_{0.5E}$	Yes	Yes	Yes	No	Yes	Yes	Yes
Bottom stage volume—V_B	No	Yes	No	No	No	No	No
Bottom stage surface area—A_B	No	Yes	No	No	No	No	No
Forebay volume—V_F	Yes	Yes	Yes	No	Yes	Yes	Yes
Forebay length—L_F	Yes	Yes	Yes	No	Yes	Yes	Yes
Wetland type, rock filter present?	No	No	Yes	Yes	No	No	No
% of wetland surface at $P_{0.3}$ & $P_{0.6}$ depths	No	No	Yes	Yes	No	No	No
Meadow wetland surface area—A_M	No	No	Yes	Yes	No	No	No
Plant species and age of facility	Yes	Yes	Yes	Yes	No	No	No
Two-year flood peak velocity	No	No	No	Yes	No	Yes	No
Depth to groundwater or impermeable layer	No	Yes	Yes	No	No	No	Yes

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Chapter 4
Source Controls

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Source controls are practices that prevent pollution by reducing potential pollutants at their source before they come into contact with stormwater, as opposed to treatment controls that remove pollutants from stormwater. A comprehensive urban runoff quality management program requires that certain source control best management practices (BMPs) be implemented on existing development. In addition, some source controls will be applied in developing areas after the new development has been completed. Twenty-two source control BMPs are described in this chapter.

Typically, source controls for urban areas can be grouped into the following seven categories:

- Public education—this is an institutional practice intended to change the way the general public manages many of the constituents that wind up in stormwater runoff. How the public uses and disposes of automotive fluids, fertilizers, pesticides, herbicides, and many other household products can have a profound effect on the quantities of these materials that come into contact with stormwater and the amounts of these substances that are eventually discharged to the receiving waters. Although this promises to be a cost-effective way of affecting stormwater quality, the effectiveness of public education on the actual reductions of the target constituents in receiving waters has yet to be definitively demonstrated.

- Planning and management of developing areas—these practices by local governments can be aimed at reducing runoff and the discharge of pollutants through stormwater from new developments and are most effective when applied during the site-planning phase of new development. Examples include the adoption of zoning ordinances and subdivision regulations aimed at stormwater quality management. These ordinances may require buffers and setbacks from all streams, lakes, and natural wetlands and may include provisions to reduce impervious areas that are connected directly to the formal stormwater drainage system.
- Materials management—these practices include controlling the use, storage, and disposal of chemicals that could pollute runoff. The objective is to reduce the opportunity for rainfall or runoff to come into contact with these chemicals. This BMP includes the following three categories of activities:
  - — Material use controls,
  - — Material exposure controls, and
  - — Material disposal and recycling controls.
- Spill prevention and cleanup—this category includes programs that reduce the risk of spills during outdoor handling and the transportation of chemicals and other materials and the development of plans and programs to respond, contain, and rapidly clean up spills when they do occur so that they do not enter the storm drain system.
- Illegal dumping controls—this category comprises ordinances, public education programs, and enforcement aimed at keeping individuals and businesses from dumping various waste products onto the urban landscape and the drainage system.
- Street/storm drain maintenance—this applies to the removal of pollutants from paved areas and the maintenance of runoff quality controls that exist within the drainage system. Examples include street sweeping, catch basin cleaning, road and bridge maintenance, and maintenance of structural controls in the system for runoff quality management. This group also includes the use of good housekeeping measures whenever performing pavement maintenance such as asphalt overlays or seal and chip procedures.
- Illicit connection controls—this group of controls is directed at preventing, by ordinance, and eliminating, by discovery and removal, connections to the storm drainage system that discharge any material except stormwater runoff. Bans on connection of floor drains, washdown areas, septic tank overflows, and the like to the stormwater conveyance system are all a part of this BMP category.

General Guidance for Selection of Stormwater Best Management Practices

Selecting the proper stormwater quality controls or BMPs is often driven by the following:

- Federal, state, and local regulations;
- Real or perceived receiving water problems or beneficial uses to be protected; or
- The cost of the BMPs being considered.

The reduction of pollutants in stormwater discharges to the maximum extent practicable (MEP) is the statutory requirement of stormwater regulations. Ultimately, however, the goal is to reduce the effects of urban stormwater runoff on the receiving water. Despite the best of intentions, the cost of the selected BMPs is a major consideration, especially when considering retrofitting treatment control BMPs in developed areas. Retrofitting any treatment control BMP is expensive and often unfeasible on a citywide basis. For this reason, source controls are often the only affordable option.

There is no single BMP that will prevent all of the effects on receiving waters caused by urban runoff. However, through the use of a combination of BMPs, both source controls and treatment controls, the greatest benefits will be gained. Figure 2.2 illustrates a multilevel strategy suggesting that urban runoff quality management begins with source controls, followed by on-site treatment controls. These can be further supplemented, where required, by regional, subregional, or communitywide control facilities. This so-called "treatment train" (Livingston *et al.*, 1988) can use the numbers and types of controls that best serve the community or the watershed. Land availability, capital, and operation and maintenance (O & M) costs, balanced against the benefits of pollutant removal, should be the bases for determining the nature of such a treatment train at each site.

SELECTING SOURCE CONTROLS. Table 4.1, with locally defined selection criteria for various factors, contains a worksheet that can be used to assist a municipality in selecting source controls. Several municipalities have used this system or a similar one to select BMPs (City of Stockton, 1993, and County of San Bernardino, 1993). Some of the locally defined selection criteria may include

Table 4.1 **Worksheet for evaluating municipal source control practices (Camp Dresser & McKee *et al.,* 1993).**

Worksheet 1
Source control practices

Program activities: (such as residential/commercial), See Table 4.2
Program element: (such as roadway and drainage facility maintenance), see Table 4.2

Practice	Meets regulatory requirements (1–5)	Effectiveness of pollutant removal (1–5)	Public acceptance (1–5)	Implementable (1–5)	Institutional contraints (1–5)	Costs (1–5)	Total (30 maximum)

- Ability to meet regulatory requirements,
- Effectiveness of the practice to remove pollutants of concern,
- Public acceptance of the practice,
- Ability to implement,
- Institutional constraints, and
- Costs.

Selection criteria provide for a sliding scale of 1 to 5 and can be used to rank the practices in how well they meet the factors or concerns represented by the criteria. To use the Table 4.1 worksheet, first determine which proposed stormwater program elements are addressed by the various management practices or source control BMPs previously listed. Table 4.2 provides an example of how this can be done. For each BMP identified, the municipality ranks it according to its ability to meet selection criteria.

After the worksheets are completed for each program element and the ratings are scored, the municipality will have a ranking of BMPs. It should be kept in mind that the ranking is only a tool for comparing BMPs and provides the information for the municipality to decide which BMPs should be implemented immediately, which BMPs should be targeted for pilot-scale study, and which BMPs should be phased for later implementation. Such ranking may also serve the purpose of defining MEP as required under stormwater regulations.

Selection criteria and the scoring system presented in this chapter are similar to other qualitative selection processes developed to screen and rank alternatives for stormwater management programs. The user may wish to modify the selection process to accommodate local requirements. Modification of the following selection process attributes may be considered:

- Criteria—the user may want to redefine some of the criteria or add or subtract criteria.
- Scores—likewise, the user may want to modify the scoring to a simple +, 0, and/or 1, 2, and 3.
- Weighing—in addition, it may be appropriate to group the criteria into tiers reflecting their relative importance to solid waste management practice goals. By multiplying the scores of the highest tier by some factor (for example, ×2) the first-tier scores could be weighted more heavily than the others to reflect this importance.
- Fatal flaw—scoring the BMPs should provide for some fatal flaw (for example, the BMP is illegal or its implementation is unacceptable to the public) that would make implementation impossible. Scoring a fatal flaw as a "0" is one way of highlighting the flaw. Any BMP scoring a "0" against a criterion would be eliminated from consideration, regardless of its overall ranking.

Ranking Criteria. A suggested criteria for ranking source control BMPs follows.

MEETS REGULATORY REQUIREMENTS. Does the BMP comply with federal stormwater regulations or a state permit condition? For the most part, the selected BMP will address the requirements of the stormwater regulations. In certain situations, the state agency may require a specific BMP, in which case it will become a mandated best management practice.

Rating score:
5 = Meets specific state requirements.
3 = Meets federal storm water regulations.
1 = Does not meet regulatory requirements.

EFFECTIVENESS OF POLLUTANT REMOVAL. Does the BMP have a high likelihood of reducing pollutants of concern? This is probably one of the hardest questions to answer, especially for source control BMPs. As of 1996, the knowledge required to make this assessment is lacking. Consequently, most source control BMPs will receive a low rating, not so much because they are not effective in removing pollutants, but because the ability to quantify the removal is not available. It is more likely that the ratings of source control BMPs will be relative to each other. Also, some BMPs are more suited to removing a specific pollutant than others.

Table 4.2 **Application of source control practices to stormwater management plan program elements (Camp Dresser & McKee *et al.*, 1993).[a]**

	Source control practice							
Required elements of solid waste management program	**Planning management**	**Material use control**	**Material exposure controls**	**Material disposal and recycling**	**Spill prevention and cleanup**	**Illegal dumping controls**	**Illicit connection controls**	**Street/storm drain maintenance**
For residential/commercial activities:								
Roadway and drainage facility maintenance		X						X
Best management practice planning for new development and redevelopment projects	X							X
Retrofitting existing or proposed flood control projects with best management practices								

Municipal waste handling and disposal operations	X	X	X	X	X	
Pesticide, herbicide, and fertilizer use controls	X	X	X	X	X	
For improper discharge activities:						
Prevention, detection, and removal of illegal connections to storm drains						X
Spill prevention, containment, and response	X	X	X	X	X	
Promote proper use and disposal of toxic materials	X	X	X	X	X	
Reduce stormwater contamination by leaking/overflowing separate sanitary sewers				X	X	

Rating score:

5 = Highly effective in removing pollutants with sufficient data to support such a claim.

3 = Expected to provide moderate level of pollutant removal.

1 = Ineffective in removing pollutants or insufficient data are available to make an assessment.

PUBLIC ACCEPTANCE. Does the BMP have public support? Some source control BMPs will carry more public support than others (for example, stream cleanup versus tighter land-use controls). The successful implementation of source controls depends, to a large extent, on the amount of public support. Such support can be identified by knowing the community interests. Without the public support (which should include understanding the issues and problems), the BMP will be ineffective.

Rating score:

5 = Public understands the problem and supports the BMP implementation.

3 = Likely that the public will support the BMP once it understands the problem but presently does not know the issues.

1 = Public does not support the BMP.

IMPLEMENTABLE. Can the BMP be implemented through existing programs or departments? The ability of the municipality to implement a BMP will, to a certain extent, depend on whether existing programs can be used or expanded. Obviously, the likelihood of a BMP being implemented is greatest if it can be incorporated to an existing program (or department). Another issue to be considered under this criterion is the availability of staff (or necessity of additional staff) and equipment. Also, the municipality should consider how the BMP will affect interdepartmental coordination and communication. (Is there overlap? Will there be "turf battles"?)

Another issue to consider under implementation is whether the BMP should be implemented in a specific area or a larger watershed area. Some BMPs will be more appropriate for a specific target group within a limited area (for example, the industrial illicit connection program), while others need to be implemented areawide (for example, the elimination of motor oil dumping). Those BMPs that apply to the larger watershed should receive higher consideration.

Rating score:

5 = Existing program or department can be used and adequate personnel and equipment are available; applies to larger watershed area.

3 = Existing program will need to be expanded with either more staff or equipment.

1 = Existing program or department does not exist to implement BMPs.

INSTITUTIONAL CONSTRAINTS. Are there any institutional constraints that limit the ability to implement the BMP? Typical institutional constraints would include legal and intergovernmental coordination. Many of the source control BMPs can be implemented under existing ordinances or regulations. A new ordinance will be required in some situations. Source control BMPs may also require interjurisdictional coordination, to be effective. This coordination, whether it is through complementary watershed protection ordinances, common public education programs, or shared maintenance duties, is critical to selecting BMPs.

Rating score:

5 = Existing ordinances and intergovernmental agreements are in place to implement BMP.

3 = New ordinances and intergovernmental agreements will need to be developed; however, there is consensus among the parties that the BMP is important.

1 = New ordinances and intergovernmental agreements will need to be developed. Such ordinances and agreements will require extensive time and cost to develop a consensus.

COST. How much is the BMP going to cost initially and over the long term, and does the municipality have adequate financial means to fund its implementation? Many source control BMPs do not require significant capital investments (such as storm drain stenciling), while others do (such as the purchase of vacuum street sweepers). Also, it is important to look at the means for generating the funds required for the BMP (or for the stormwater program in general). Is the existing funding mechanism (for example, user fees or general funds) adequate for funding the BMP, or does a new mechanism need to be developed (such as a utility fund)? Additionally, the municipality may want to consider the cost to the community at large, although this may be a difficult task.

Rating score:

- 5 = Low-cost BMPs that can be funded with the existing municipal funding mechanism.
- 3 = Moderate-cost BMPs that will require an adjustment to the city's funding mechanism for support.
- 1 = High-cost BMP or a BMP that will require a major restructuring of the municipal funding mechanism.

There are a few points to remember about selection processes:

- Have several people or a stormwater committee conduct the selection independently to get a broad perspective on the relative merits of each BMP and to help reach consensus.
- The validity and accuracy of any scoring system is only as good as the available information.
- Keep the selection system as simple as possible and use "best professional judgment" to interpret and conduct a reality check on the total scores. Differences of a few points in the total score are probably not significant.
- The final rankings may be used to plan and prioritize the stormwater management program. For example, those BMPs with the highest scores may be implemented in the first year of a new program, while low-scoring BMPs may need time for development, relegating their implementation to later years or to further study.
- The exercise of working through this selection will provide the necessary data to promote the stormwater program to other departments, political leaders, regulatory agencies, and the public.

PUBLIC EDUCATION AND PARTICIPATION

Public education and participation, like an ordinance or piece of equipment, is not so much a BMP as it is a method by which to implement BMPs. The Clean Water Act and the 1990 stormwater regulations require public participation and the establishment of public education programs. This section highlights the importance of integrating elements of public education and participation to a municipality's overall plan for urban runoff quality management. Public education and participation are vital components of many of the individual source control BMPs that follow in this chapter.

A public education and participation plan provides the municipality with a strategy for educating its employees, the public, and businesses about the importance of protecting stormwater from improper use, storage, and disposal of pollutants. Municipal employees must be trained, especially those who work in departments not directly related to stormwater but whose actions affect stormwater. Residents must become aware that a variety of hazardous products are used in the home and that their improper use and disposal can pollute stormwater. Businesses, particularly smaller ones that may not be regulated by federal, state, or local regulations, must be informed of ways to reduce their potential to pollute stormwater.

The specific public education and participation aspects of each of the source controls are highlighted in the sections for each BMP discussed in this chapter. The focus of this section includes the overall objectives and approaches for ensuring public involvement in local stormwater management programs.

OBJECTIVES. The public education and participation plan should be based on five objectives:

- Promote a clear identification and understanding of the problem and the solutions;
- Identify responsible parties and efforts to date;
- Promote community ownership of the problems and the solutions;
- Change behaviors; and
- Integrate public feedback to program implementation.

APPROACH. The approach to public education and participation is detailed in the following bulleted items:

- Pattern a new program after the many established programs from municipalities around the state and country. Whenever possible, integrate stormwater public education and participation to existing programs from other departments at the municipality.
- Implement public education and participation as a coordinated campaign in which each message is related to the last.
- Present a clear, consistent message and image to the public regarding how they contribute to stormwater pollution and what they can do to reduce it.
- Stick to the program. There is a lag in the public's response to anything new, so it is important to stick with the message long enough to get the bulk of the audience. The point in time when municipal staff are ready to "move on" to another message is probably about the time that most of the audience is just starting to get the original message.
- Expand the definition of "public" to include small businesses that often possess the same limited levels of awareness of the problems, regulations, and solutions as the general public. As a result, small busi-

nesses need the same level of technical assistance (education) and participation in the process as the general public.

- Use a multimedia approach to reach the full range of audiences.
- Translate messages to the foreign languages of the community to reach the full spectrum of the populace and avoid misinterpretation of messages. Account for cultural differences in translating messages and concepts. Outreach in a non-English language is not just a matter of transcription.
- Create an awareness and identification of the local watershed.
- Involve focus or advisory groups in the development of a public education and participation plan. This will create a more effective plan and promote ownership of the plan by those involved.
- Use everyday language in all public pieces. Use outside reviewers to highlight and reduce the use of technical terminology, acronyms, and jargon.
- Make sure all statements have a sound, up-to-date technical basis. Do not contribute to the spread of misinformation.
- Break up complicated subjects into smaller, more simple concepts. Present these concepts to the public in a simplified and organized way to avoid "overloading" and confusing the audience.
- Choose quality over quantity. One good message or outreach piece is more effective than many poor attempts.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. Because most of the BMPs discussed in this publication require some public education and participation, a qualified public education specialist can be critical to the success of source control programs.

EXAMPLES OF EFFECTIVE PROGRAMS. There are a number of communities with effective public education and participation programs. The most proactive include the Alameda Countywide Clean Water Program, the City and County of San Francisco, the Santa Clara Valley Nonpoint Source Pollution Control Program, and the City of Palo Alto, California; the Municipality of Metropolitan Seattle (Metro), Washington; and the Unified Sewerage Agency of Washington County, Oregon. In addition, large businesses, such as utility companies, have used inserts in their bill mailings to educate their customers.

LAND-USE PLANNING AND MANAGEMENT

This BMP presents an important opportunity to reduce the pollutants in stormwater runoff by using a comprehensive planning process to control or prevent certain land-use activities in areas where water quality is sensitive to development. It is applicable to all types of land use and represents one of the most effective pollution prevention practices. Land-use planning and management are critical to watershed management.

APPROACH. The land-use planning process need not be complex. A basic schematic model involves six basic phases as follows:

- Phase 1—goals: clear-cut water quality goals are determined.
- Phase 2—study: activities of this phase are identifying planning area, gathering pertinent data, and writing a description of the planning area and its associated problems.
- Phase 3—analysis and synthesis: the water quality goals are determined and prioritized as they relate to land use.
- Phase 4—recommendations: future courses of action are developed to address the identified problems and needs.
- Phase 5—adoption: recommendations are presented to a political body for acceptance and implementation.
- Phase 6—implementation: recommendations adopted by the local government are implemented by the community.

COST CONSIDERATIONS. The majority of the cost for this BMP is associated with establishing a comprehensive land-use plan that addresses the quality of stormwater runoff after projects are completed.

REGULATORY CONSIDERATIONS. Ordinances typically are required to implement and enforce land-use plans, including those relating to stormwater runoff quality. Several federal initiatives influence land-use planning, including the National Environmental Policy Act, the Clean Water Act, and the Clean Air Act.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. Site plans or environmental impact documents for projects must be reviewed for compliance. Additional staff may be required to implement a site plan review and inspection program. Also, interdepartmental and decisionmaker cooperation is crucial.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. To gain the necessary support for land-use policies, public participation is a necessity. The public should be educated regarding the positive environmental effects of land-use management, including the improvement to stormwater runoff quality. To increase public awareness, public education materials should be as specific as possible about the effects of land-use policies on watersheds and water quality. Geographic information systems can be a dynamic and effective tool to illustrate water quality effects.

LIMITATIONS. Land-use planning and management frequently address sensitive public issues. Restrictions on certain land uses required to mitigate stormwater pollution may not be politically feasible. Zoning ordinances that are not reinforced by a comprehensive planning process typically are less effective because they are often applied illogically for pollution prevention and are more easily circumvented politically.

EXAMPLES OF EFFECTIVE PROGRAMS. The city of Austin, Texas, has chosen to manage the effects of new development in two fundamental ways: through treatment control requirements and through impervious area minimization requirements. The city of Olympia, Washington, studied the feasibility of a 20% reduction in impervious surfaces throughout northern Thurston County, Washington, and found the goal achievable through policy changes, new standards, and education. In Virginia, the Chesapeake Bay Preservation Act requires no net increase in pollutants in stormwater runoff from previously undeveloped sites. Runoff from redeveloped sites must contain 10% fewer pollutants than before redevelopment.

HOUSEKEEPING PRACTICES

The promotion of efficient and safe housekeeping practices (storage, use, cleanup, and disposal) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals can be an effective source control BMP. Good housekeeping practices include storing hazardous products securely, safely, and in original containers; reading and following product instructions; working in well-ventilated areas; and properly disposing of products.

Related information is provided in source control BMPs for safer alternative products, household hazardous waste collection, used oil recycling, and spill prevention and cleanup.

APPROACH. The following housekeeping practices may be effective:

- Pattern a new program after the many established programs from municipalities around the state and country. Integrate this BMP as much as possible with existing programs in the municipality.
- This BMP involves three key audiences: municipal employees, the general public, and small businesses.
- Implement this BMP in conjunction with the safer alternative products BMPs.

COST CONSIDERATIONS. The primary cost for good housekeeping practices is for staff time. More information follows under the heading Administrative and Staffing Considerations.

REGULATORY CONSIDERATIONS. There are no additional regulatory requirements to this BMP. Existing regulations already require municipalities to properly store, use, and dispose of hazardous materials and waste. This source control also focuses on materials and waste that may not be hazardous in the regulatory sense but are deleterious to water quality and organisms. Housekeeping practices of the general public are addressed through education rather than regulation.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. Staff are needed to train municipal employees and coordinate public education efforts. Municipal employees who handle potentially harmful materials should be trained in good housekeeping practices.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. Public awareness is a key to this BMP. The continued use or switch to good housekeeping practices is a behavior, and behavior is based on awareness.

LIMITATIONS. There are no major limitations to this BMP.

EXAMPLES OF EFFECTIVE PROGRAMS. There are a number of communities with effective programs. The most proactive include Santa Clara County, the city of Palo Alto, and the city and county of San Francisco, California, and the Municipality of Metropolitan Seattle (Metro), Washington. These programs are characterized by high-profile, comprehensive efforts to reach all audiences (that is, the general public, small businesses, and agency employees) using a variety of tools.

SAFER ALTERNATIVE PRODUCTS

Promoting the use of less harmful products can reduce the amount of toxic and deleterious substances that enter stormwater and ultimately reach receiving waters. Alternatives exist for most product classes, including fertilizers, pesticides, cleaning solutions, and automotive and paint products. There are natural alternatives to most garden products and less toxic alternatives to home and automotive repair products.

Related information is provided in source control BMPs for housekeeping practices, household hazardous waste collection, used oil recycling, and spill prevention and cleanup.

APPROACH. Pattern a new program after the many established programs from municipalities around the country. Integrate this BMP as much as possible with existing programs at the municipality. This BMP has three key audiences: municipal employees, the general public, and small businesses. Implement this BMP in conjunction with the housekeeping practices BMP.

COST CONSIDERATIONS. The primary cost of this BMP is for staff time. More information is available in the following sections.

REGULATORY CONSIDERATIONS. This BMP has no additional regulatory requirements. Existing regulations already require municipalities to reduce the use of hazardous materials. Safer alternatives for use by the general public are presented through education rather than required by regulation.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. Staff are needed to educate municipal employees and coordinate public education efforts. Municipal employees who handle potentially harmful materials should be trained in the use of safer alternatives. Purchasing departments should be encouraged to procure less hazardous materials.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. Awareness is the key to this BMP. It promotes a willingness to try alternatives and modify old behaviors.

LIMITATIONS. Safer alternative products may not be available, suitable, or effective in every case.

EXAMPLES OF EFFECTIVE PROGRAMS. There are a number of communities with effective programs promoting safer alternative products. The most proactive include Santa Clara County, the city of Palo Alto, and the city and county of San Francisco, California, and the Municipality of Metropolitan Seattle (Metro), Washington. The Bio-Integral Resource Center in Berkeley, California, conducts research and produces brochures and a newsletter on integrated pest management.

MATERIAL STORAGE CONTROL

Material storage controls can prevent or reduce the discharge of pollutants to stormwater from material delivery and storage areas. This can be done by reducing the storage of hazardous materials on site, storing materials in a designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.

This BMP primarily concerns material delivery and storage for municipal and commercial operations. For material storage related to the general public (for example, the storage of pesticides), refer to the Housekeeping Practices section of this chapter.

APPROACH. The key is to design and maintain material storage areas that reduce exposure to stormwater by

- Storing materials inside or under cover on paved surfaces;
- Using secondary containment, where needed;
- Minimizing storage and handling of hazardous materials; and
- Inspecting storage areas regularly.

Keep an ample supply of spill cleanup materials near the storage area.

COST CONSIDERATIONS. Costs will vary depending on the size of the facility and the necessary controls.

REGULATORY CONSIDERATIONS. The storage of reactive, ignitable, or flammable liquids must comply with the Uniform Fire Code and the National Electric Code. The storage of reactive, ignitable, or flammable liquids and chemicals is regulated by Superfund Amendments and Reauthorization Act Title III, in excess of the minimum quantities set forth in the act.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. Accurate and up-to-date inventories should be kept of all stored materials. Employees should be well trained in proper material storage. Employee education is paramount for successful BMP implementation.

LIMITATIONS. Storage sheds often must meet building and fire code requirements.

VEHICLE-USE REDUCTION

Reducing the discharge of pollutants to stormwater from vehicle use can be achieved by highlighting the stormwater effects from vehicle emissions, promoting the benefits to stormwater of alternative transportation, and integrating initiatives with existing or emerging regulations and programs.

APPROACH. The following practices may be successful in implementing vehicle-use reduction BMPs:

- Build alliances with air quality agencies to identify common challenges and opportunities.
- Integrate this BMP as much as possible with efforts being developed and implemented by government agencies and businesses to reduce vehicle use and improve air quality, including the designation of high-occupancy vehicle or carpool lanes in most major cities in America. Integration will help avoid redundant or conflicting programs and will be more effective and efficient.

- Establish trip reduction programs at government offices or large businesses.

COST CONSIDERATIONS. The primary cost is for staff time.

REGULATORY CONSIDERATIONS. Support efforts to pass reasonable regulations at the state and local level (land-use plans and zoning ordinances) aimed at reducing vehicle use and developing transit-oriented communities. Also, support development of regional governing bodies to address the issue in a comprehensive way.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. This BMP requires at least one staff person to track, review, and comment on emerging legislation and programs.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. Educate the public and municipal employees about the water quality benefits of reduced vehicle use. Also, help coordinate public participation in ride-sharing programs.

LIMITATIONS. The limitations for this BMP include

- The possible lack of cooperation and integration between departments and programs, and
- The fact that the use of alternative transportation may be dependent on its convenience and relative cost.

STORM DRAIN SYSTEM SIGNS

Stenciling of the storm drain system (inlets, catch basins, channels, and creeks) with prohibitive language and graphic icons discourages the illegal dumping of unwanted materials.

APPROACH. Create a volunteer workforce to stencil storm drain inlets, and use municipal staff to erect signs near drainage channels and creeks. Enlist the aid of city code enforcement staff to stencil curb inlets that show signs of being used for dumping.

COST CONSIDERATIONS. The following bulleted items should be considered for this BMP:

- A volunteer workforce serves to lower program cost.
- Stenciling kits require procurement of durable and disposable items.
- The storage and maintenance of stenciling kits requires planning.

- The program should aid in the cataloging of the storm drain system.

REGULATORY CONSIDERATIONS. Develop, implement, and enforce an ordinance that requires inlets, catch basins, channels, and creeks to be fitted with antidumping, pollution prevention signs.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. The primary staff demand is for program setup to provide marketing and training. Ongoing/follow-up staff time is minimal because of volunteer services. A minimum of two persons is required for stenciling in high-traffic areas and commercial and industrial zones with appropriate safety measures in use (for example, reflective vests, flag person, and signage). Additional staff may be required at program headquarters for emergencies or to answer questions.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. Promote volunteer services (individual and business) through radio, television, and mail-out campaigns. Encourage public reporting of improper waste disposal by a hotline number stenciled onto the storm drain inlet. Training sessions of approximately 10 to 15 minutes will cover stenciling procedures, including how to stencil, recordkeeping, and problem drain notation. Also, consider proper health and safety protocols (such as the buddy system, traffic, and health concerns).

LIMITATIONS. The following limitations may apply.

- Private property access limits stenciling to publicly owned areas.
- This program is dependent on volunteer response.
- Storm drain inlets that are physically blocked will be missed or require follow-up.
- High-traffic, commercial, or industrial zones will be the responsibility of city staff.

EXAMPLES OF EFFECTIVE PROGRAMS. The city of Palo Alto, California, has a combined volunteer/contractor program that greatly facilitates storm drain stenciling. The city used the Conservation Corps to paint approximately 75% (2 000) of its storm drains, leaving the 25% (700) of its drains in more residential areas to be done by volunteers. This strategy speeds up the stenciling, reduces the city's liability, supports a worthwhile program, and still allows plenty of storm drains for volunteers.

The Association of Bay Area Governments in Oakland, California, has sponsored a nine-county stenciling effort on Earth Day since 1992. This association has up-to-date information on stencil and program development.

The city of Huntington Beach, California, has a stencil that includes the municipal code section number for illegal dumping to facilitate incident reporting and enforcement.

HOUSEHOLD HAZARDOUS WASTE COLLECTION

Household hazardous wastes (HHWs) are defined as waste materials that typically are found in homes or similar sources and exhibit characteristics such as corrosivity, ignitability, reactivity, and/or toxicity or are listed as hazardous materials by the U.S. Environmental Protection Agency (U.S. EPA). This source control also focuses on the collection of deleterious chemicals that sometimes are disposed of in a manner that threatens stormwater quality.

APPROACH. Integrate efforts with a municipal solid waste program that likely has already been established. Optimize collection method(s) (for example, permanent, periodic, mobile, and curbside) and frequency (for example, monthly and quarterly) based on waste type, community characteristics, existing programs, and budgets.

COST CONSIDERATIONS. The following cost considerations may apply to this BMP:

- Both collection and disposal can be expensive and are partly a function of the frequency of collection, which depends on the collection program implemented.
- Trained operators are required.
- Laboratory and detection equipment are necessary.
- Extensive recordkeeping is required including dates, types, and quantities.
- Many communities have deferred HHW programs because of the high cost.
- Cost depends on the type of program chosen and available disposal costs.

REGULATORY CONSIDERATIONS. Federal regulations (such as the Resource Conservation and Recovery Act; the Superfund Amendments and Reauthorization Act; and the Comprehensive Environmental Response, Compensation, and Liability Act) and state regulations regarding the disposal of hazardous waste apply to this BMP. Local ordinances to discourage improper disposal may be necessary. Municipalities may be required to have HHW elements within their integrated waste management plans.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. This BMP may require a minimum of six highly trained persons per collection site or event to handle traffic, waste drop-off, characterization, and disposal.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS.
The following considerations may be applicable for this BMP:

- Educate the public about hazardous materials in the home and consequences of improper use or disposal.
- Identify and promote the use of nonhazardous alternatives.
- Identify proper storage and disposal methods.
- Promote HHW reuse and recycling.
- Promote participation in local HHW collection programs.
- Distribute posters, handouts, and educational efforts aimed at local schools.
- Use public service announcements on local television, radio, and newspapers.
- Try utility bill inserts.
- Make video or slide presentations to community organizations.
- Develop a "speakers bureau" made up of local environmental professionals and recycling experts.

LIMITATIONS. This BMP maybe limited to areas with convenient access to hazardous waste disposal facilities and recycling facilities because of the cost associated with transport. This BMP can be a high-cost option compared to other source controls. There are significant liability issues involved with the collection, handling, and disposal of household hazardous waste.

EXAMPLES OF EFFECTIVE PROGRAMS. There are a number of communities, using a variety of approaches, with established and effective HHW collection programs. Seattle/King County, Washington, uses a mobile collection program that was initiated in 1989. One of the oldest (1988) and most convenient permanent collection centers in the country is in San Francisco, California. The Regional Water Quality Control Plant in Palo Alto, California, hosts a periodic program on the first Saturday morning of each month.

USED OIL RECYCLING

Used oil recycling is a responsible alternative to improper disposal practices, such as dumping oil in the sanitary sewer or storm drain system, applying oil to roads for dust control, placing used oil and filters in the trash for landfill disposal, or simply pouring used oil on the ground.

APPROACH. The following approaches may be effective for used oil recycling:

- Integrate efforts with a municipal solid waste program that likely has already been established.

- Set up a municipal collection center funded by the city.
- Contract out the collection and hauling of used oil to a private hauler or recycler.
- Use the automobile service industry (for example, service stations and fast-oil-change businesses) for the collection of used oil.
- Work with automotive parts supply stores and their parking lots, where consumers often change their automotive fluids improperly.

COST CONSIDERATIONS. A collection facility or curbside collection may result in significant costs. Using commercial locations (such as automobile service stations and fast-oil-change businesses) as collection points eliminates hauling and recycling costs for a municipality.

Staffing costs are minimal when using commercial locations as collection points; staffing costs are higher if the city performs collection services.

REGULATORY CONSIDERATIONS. Some states have enacted legislation requiring the state agency to pay a recycling incentive to curbside collection programs and certified used oil collection centers. Municipalities must comply with all applicable state and federal regulations regarding storage, handling, and transport of petroleum products. The municipality may be required to have a used oil recycling element within its integrated waste management plan.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. Staffing requirements are minimal if collection and recycling are contracted out to a used oil hauler or recycler or required at commercial locations.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. Create procedures for collection, such as collection locations and schedules, acceptable containers, and maximum amounts accepted. Promote public participation through the use of posters, handouts, brochures, and announcements in the print and broadcast media; provide a list of commercial recyclers. Also, develop incentive programs (such as a return deposit) for commercial locations and used oil haulers or recyclers.

LIMITATIONS. The availability of reliable, licensed used oil haulers and recyclers may be limited. The program requires frequent public education/notification messages. The used oil/hazardous waste separation requirement under federal law may also be a limitation. Meeting zoning, fire, and health and safety laws associated with collecting used oil may not be possible at all locations.

EXAMPLES OF EFFECTIVE PROGRAMS. There are numerous locations throughout the country that accept used oil. As is the case with HHW, communities have used different methods to collect and recycle used oil. Examples of effective programs include the permanent Household Hazardous

Waste Collection Facility in San Francisco, California, and curbside collection programs in Sacramento and Palo Alto, California. Statewide programs include California Integrated Waste Management Boards's program in which businesses that accept used oil from the public are listed as "Certified Oil Collection Centers" and receive payment for those collections. Another nationally recognized used oil program is Project R.O.S.E. (Recycled Oil Saves Energy), operated by the University of Alabama and funded by the Science, Technology, and Energy Division of the Alabama Department of Economic and Community Affairs.

VEHICLE SPILL CONTROL

Methods for preventing or reducing the discharge of pollutants to stormwater from vehicle leaks and spills include reducing the chance for spills by preventive maintenance, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials, and training employees. This BMP covers only prevention and cleanup of spills from vehicles; it does not contain information on underground storage tanks.

APPROACH. Vehicles will leak and spill fluids. The key is to reduce the frequency and severity of leaks and spills and, when they do occur, prevent or reduce the environmental effects. The following approaches to vehicle spill control may be effective:

- Perform fluid removal and changes inside or under cover on paved surfaces.
- Properly store hazardous materials and waste.
- Have spill cleanup supplies readily available.
- Clean up spills and leaks immediately.
- Use dry cleanup methods.
- Prepare a written contingency plan between local agencies that outlines responsibilities for major spills from tanker trucks.

COST CONSIDERATIONS. The prevention of leaks and spills is inexpensive. Treatment and disposal of contaminated soil or water can be expensive. Keep ample supplies of spill control and cleanup materials at municipal facilities, near storage and maintenance areas. Also, update spill cleanup materials as changes occur in the types of chemicals stored on site.

REGULATORY CONSIDERATIONS. The federal government and most states have specific laws concerning oil, oil filters, and batteries.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. This BMP has no significant administrative or staffing requirements. Training is crucial to reduce the frequency, severity, and effects of leaks and spills.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. The following considerations may be useful for vehicle spill control:

- Encourage the general public to regularly inspect and maintain their vehicles.
- Educate car repair shops to identify leaks and advise the vehicle owner.

LIMITATIONS. For larger spills, a private spill cleanup company or hazardous materials team may be necessary.

EXAMPLES OF EFFECTIVE PROGRAMS. Typically, more advanced HHW and used oil collection programs include educational outreach to do-it-yourselfers (DIYs) who do their own oil changes. Using state grant funds, San Mateo County, California, developed a DIY program that links used oil disposal with stormwater quality. The Santa Clara Valley and Alameda countywide stormwater programs joined the Palo Alto Regional Water Quality Control Plant to develop and distribute "Keeping It All in Tune," a car care brochure in multiple languages for DIYs.

ABOVEGROUND TANK SPILL CONTROL

Prevention or reduction of the discharge of pollutants to stormwater from aboveground storage tanks can be done by installing safeguards against accidental releases, installing secondary containment, conducting regular inspections, and training employees in standard operating procedures and spill cleanup techniques.

APPROACH. Integrate efforts with existing aboveground petroleum storage tank programs through the local fire and health departments and with area business emergency response plans through the city, county, or fire district. Use engineering safeguards to reduce the chance for spills. Perform regular maintenance. Also, keep ample supplies of spill control and cleanup materials at municipal facilities. Update spill cleanup materials as changes occur in the types of chemicals stored on site.

COST CONSIDERATIONS. Costs will vary depending on the size of the facility and the necessary controls.

REGULATORY CONSIDERATIONS. Consider requiring smaller secondary containment areas (less than 60 m [200 sq ft]) to be connected to the sanitary sewer and prohibiting any hard connections to the storm drain.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. This BMP has no significant administrative or staffing requirements. However, employees should be trained in spill prevention and cleanup.

LIMITATIONS. For larger spills, a private spill cleanup company or hazardous materials team may be necessary.

ILLEGAL DUMPING CONTROL

The use of measures to detect, correct, and enforce against the illegal dumping of pollutants in gutters and streets and into the storm drain system and creeks can have a significant effect on stormwater quality. This BMP includes controls of indirect sources (for example, overwatering after pesticide use on a lawn) and direct sources.

The remedial focus of this BMP contrasts with the preventive focus of the material disposal and recycling BMPs in this chapter. Illegal discharges through physical connections are addressed in the section on illicit connection BMPs.

APPROACH. Public awareness is the key to this BMP. Train municipal employees and educate the general public to recognize and report illegal dumping. Deputize municipal staff with the authority to write environmental tickets. Establish a system for tracking incidents. Consider indirect sources to be as important and typical, if not more so, than direct sources.

COST CONSIDERATIONS. The primary cost is for staff time. The cost depends on how aggressively a program is implemented. Additionally, a database is useful for defining and tracking the magnitude of the problem.

REGULATORY CONSIDERATIONS. Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants to the storm sewer system. State laws may authorize the confiscation or impoundment of vehicles involved in illegal dumping.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. This BMP requires technical staff to detect and investigate illegal dumping violations and coordinate public education. Legal staff members are required to pursue prosecution. The training of technical staff in identifying and documenting illegal dumping incidents is also required.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. Educate the public about antidumping ordinances (fold into existing household hazardous waste program). Awareness of the issue accomplishes two things: the receiver of the information understands the issue and, therefore, is unlikely to cause a problem, and the public's awareness often helps detect other violations.

LIMITATIONS. The elimination of illegal dumping depends on the availability, convenience, and cost of alternative means of disposal. Some communities encourage homeowners and commercial establishments to rake yard or green waste into the street for pickup. For the most part, the general public does not know when they are using the storm drain system, which leads to a large volume of indirect discharges.

STREET CLEANING

Some reduction in the discharge of pollutants to stormwater from street surfaces can be accomplished by conducting street cleaning on a regular basis.

APPROACH. The following approaches may be effective in implementing and maintaining the street-cleaning BMP:

- Prioritize cleaning to use the most sophisticated sweepers, at the highest frequency, and in areas with the highest pollutant loading.
- Optimize cleaning frequency based on interevent times (for example, the dry period between storms).
- Increase sweeping frequency just before the rainy season.
- Keep in mind that proper maintenance and operation of sweepers greatly increases their efficiency.
- Keep accurate operation logs to track program.

COST CONSIDERATIONS. Any street-cleaning program for water quality improvement requires a significant capital and O & M budget. Sweeper costs range from $65 000 to $120 000 per machine, depending on the type. There is a definite cost–benefit relationship between increased sweeping efficiency/frequency and pollutant removal that a municipality should understand before making significant changes to its existing street-sweeping program.

REGULATORY CONSIDERATIONS. Densely populated areas or heavily used streets may require parking regulations to clear streets for cleaning.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. The following considerations may apply to the street-cleaning BMP:

- Sweeper operators and maintenance, supervisory, and administrative personnel are required.
- Traffic control officers may be required to enforce parking restrictions.

- Skillful design of cleaning routes is required for a program to be productive.
- Arrangements must be made for disposal of collected wastes.
- Operators must be trained in proper sweeper operation.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. The general public should be educated about the need to obey parking restrictions and participate by using litter receptacles to reduce street litter.

LIMITATIONS. The following limitations may apply to this BMP:

- No currently available conventional sweeper is effective at removing oil and grease.
- Mechanical sweepers are not effective at removing fine sediment.
- Parked cars are the primary obstacles to effective street sweeping.
- Effectiveness may also be limited by street condition, traffic congestion, presence of construction projects, climatic conditions, and condition of curbs.

EXAMPLES OF EFFECTIVE PROGRAMS. In San Francisco, California, 90% of the streets are swept at least once per week, and some sections are swept two to three times per week. San Francisco is also converting as much of its fleet as possible to vacuum sweepers. The effects of these actions are less clear in separate sewer areas, but there are examples of other effective programs. These include the city of Beverly Hills, California, which sweeps all streets in the commercial district six times per week and all streets in the residential area at least once per week.

CATCH BASIN CLEANING

Catch basin and stormwater inlet maintenance should be done on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, and restore the catch basin's sediment-trapping capacity.

APPROACH. Catch basins should be cleaned regularly enough to reduce the possibility of sediment and pollutant loading from the flushing effect of stormwater inflow. A catch basin that becomes a source rather than a sink for sediments is not being cleaned frequently enough. Prioritize maintenance to clean catch basins and inlets in areas with the highest pollutant loading and in areas near sensitive water bodies. Keep accurate operation logs to track the program.

COST CONSIDERATIONS. A catch basin cleaning program requires a significant capital and O & M budget because of the typically large number of catch basins in any given area and the high cost of labor and specialized equipment to do the work. Except for small communities, with relatively few catch basins that may be cleaned manually, most municipalities will require mechanical cleaners such as eductors, vacuums, or bucket loaders.

REGULATORY CONSIDERATIONS. There are no regulatory requirements for this BMP. Municipal codes should include sections prohibiting the disposal of soil, debris, refuse, hazardous waste, and other pollutants into the storm sewer system.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. The following administrative and staffing considerations may apply to this BMP:

- Two-person teams are required to clean catch basins with vacuum trucks.
- Arrangements must be made for the proper disposal of collected wastes.
- Crews must be trained in proper maintenance, including recordkeeping, disposal, and safety procedures.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. For this BMP to be successful, educate contractors (cement, masonry, painting) and utility employees (telephone, cable, gas, and electric) about proper waste disposal.

LIMITATIONS. The metal content of the decant and solids cleaned from a catch basin should be periodically tested to determine if the decant violates limits for disposal to the wastewater treatment plant or if the solids would be classified as a hazardous waste.

VEGETATION CONTROLS

Vegetation control typically involves a combination of mechanical methods and careful application of chemicals (herbicides). Mechanical vegetation methods are discussed herein; vegetation control by herbicides is addressed in the housekeeping practices BMP described earlier in this chapter. Mechanical vegetation control includes leaving existing vegetation, cutting less frequently, hand cutting, planting low-maintenance vegetation, collecting and properly disposing of clippings and cuttings, and educating employees and the public.

APPROACH. The following are areas of concern:

- Steep slopes,
- Vegetated drainage channels,

- Creeks,
- Areas adjacent to catch basins, and
- Detention/retention basins.

These areas are of less concern to stormwater quality:

- Flat or relatively flat vegetated areas,
- Areas not adjacent to drainage structures, and
- Areas screened from drainage structures by vegetation.

COST CONSIDERATIONS. Additional costs will result from upgrading certain mowing equipment for bagging and hiring additional laborers involved in cutting by hand and picking up clippings.

REGULATORY CONSIDERATIONS. Local municipal antidumping ordinances can be used to ensure that when vegetation is controlled by cutting or removal the waste is disposed of properly. Grading ordinances often prescribe controls and limits on exposure of soil after removal of vegetation. In an effort to meet solid waste reduction goals, many municipalities require or encourage composting yard waste instead of landfill disposal.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. Additional labor may be needed to hand cut and pick up clippings from areas where mechanical cutting and collection are not practical.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. Educate the public about careful use of or alternatives to herbicides, proper disposal of clippings and cuttings, and the effect of erosion from exposed soil.

LIMITATIONS. The public may not find existing, natural, or low-maintenance vegetation as attractive or desirable as ornamental or higher maintenance vegetation in some situations.

STORM DRAIN FLUSHING

A storm drain is "flushed" with water to suspend and remove deposited materials. Flushing is particularly beneficial for storm drain pipes with grades too flat to be self-cleansing. Flushing helps ensure pipes convey design flow and removes pollutants from the storm drain system.

APPROACH. Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup. Also, consider flushing portions of the storm drain system upstream of the problem area, including gutters and streets, as a preventive measure and an opportunity to remove more pollutants (assuming the collection system is sufficient).

COST CONSIDERATIONS. Unless flushing is done to a dry or wet detention area or the sanitary sewer, the collection of liquid and sediments may be costly in terms of pollutant removal benefits.

The following equipment may be required:

- Water source (water tank truck, fire hydrant),
- Sediment collector (evacuator/vacuum truck, dredge),
- Inflatable bladders to block flow from exiting pipe, or
- Sediment and turbidity containment and treatment equipment, if flushing to an open channel.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. With storm drain flushing, the following considerations should be noted:

- Two-person teams are needed for routine sediment removal and flush water collection.
- Equipment operators are required.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. If large-scale flushing activities are undertaken, local residents should be informed in advance. The public should be educated about the purpose of storm drains and the problems created by illegal dumping.

LIMITATIONS. These limitations may apply:

- Flushing is most effective in small-diameter pipes.
- The availability of sufficient water to do the job must be ensured.
- Personnel may have difficulty finding a downstream area to collect sediments.
- Flushing requires liquid/sediment disposal.
- The disposal of flushed effluent to the sanitary sewer may be prohibited in some areas because of inflow capacity and water quality concerns of the local wastewater treatment plant.

ROADWAY AND BRIDGE MAINTENANCE

Methods to prevent or reduce the discharge of pollutants to stormwater from roadway and bridge maintenance include paving as little area as possible, designing bridges to collect and convey stormwater, using measures to prevent

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runon and runoff, properly disposing of maintenance wastes, and training employees and subcontractors.

APPROACH. Address stormwater pollution from roadway and bridge maintenance on a site-specific basis. The disposition and subsequent magnitude of pollutants found in road and bridge runoff is variable and affected by climate, surrounding land use, roadway or bridge design, traffic volume, and frequency and severity of accidental spills.

COST CONSIDERATIONS. This BMP is typically low in cost. Additionally, keep ample supplies of drip pans or absorbent materials on site.

REGULATORY CONSIDERATIONS. Consider requiring new bridges to incorporate treatment control BMPs to the design. For more information on treatment control BMPs, see Chapter 5 of this publication.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. This BMP has no significant administrative or staffing requirements. Inspect the activities of employees and subcontractors to ensure that measures to reduce the stormwater effects of roadway and bridge maintenance are being followed. Require engineering staff or consulting firms to address stormwater quality in new bridge designs or existing bridge retrofits.

LIMITATIONS. There are no significant limitations to this BMP.

EXAMPLES OF EFFECTIVE PROGRAMS. The county of Alameda, California, recently wrapped a 56-year old bridge with tarpaulins so that workers could remove lead paint without allowing toxics to fall into the local estuary or blow away in the wind.

DETENTION AND INFILTRATION DEVICE MAINTENANCE

Proper maintenance and sediment removal are required on both a routine and corrective basis to promote effective stormwater pollutant removal efficiencies for wet and dry detention pond and infiltration devices.

APPROACH. These approaches may be beneficial for a detention and infiltration device maintenance BMP:

- Remove silt after sufficient accumulation.
- Periodically clean accumulated sediment and silt from pretreatment inlets.

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- Infiltration device silt removal should occur when the infiltration rate drops below 13 mm (0.5 in.) per hour.
- Removal of accumulated paper, trash, and debris should occur at least every 6 months or as needed to prevent clogging of control devices.
- Vegetation growth should not be allowed to exceed approximately 4.5 m (18 in.) in height.
- Mow the slopes periodically and check for clogging, erosion, and tree growth on the embankment.
- Corrective maintenance may require more frequent attention.

COST CONSIDERATIONS. Frequent sediment removal is labor intensive and costly. Transport and disposal costs for waste material will vary proportionately with the volume of material. Disposal costs can be high if sediments have high levels of toxics. Other cost considerations are vehicles, dump trucks, bulldozers, backhoes, excavators, mowers, weed trimmers, sickles, machetes, shovels, rakes, and personal protective equipment (goggles, dust masks, coveralls, boots, and, gloves).

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. Two-person teams are needed for routine silt removal and excavation. A program manager is needed to track maintenance activities and provide field assistance. A staff team is needed for corrective maintenance activities. Training in appropriate excavation and maintenance procedures and proper waste disposal procedures is needed.

REGULATORY CONSIDERATIONS. Permits may be required by the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, or state parks and wildlife agencies.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. It may be useful to create a public education campaign to explain the function of wet and dry detention pond and infiltration devices and their operational requirements for proper effectiveness. Also, encourage the public to report wet and dry detention pond and infiltration devices needing maintenance.

LIMITATIONS. Dredging sediments in a wet detention pond produces slurried waste that often exceeds the limits for acceptability used by many landfills. Frequent sediment removal is labor and cost intensive. Care should be taken when using monitoring wells so as not to provide a conduit to the unsaturated zone under basins, which might lead to groundwater contamination.

EXAMPLES OF EFFECTIVE PROGRAMS. Because of flat terrain and few water courses, the city of Fresno, California, built almost 100 stormwater retention/recharge basins to dispose of surface runoff and recharge an aquifer. Monitoring confirmed that a variety of organic and inorganic contaminants generated in the catchments are removed by sorption within the top 4 cm of sediment in the recharge basins, making these contaminants available for removal and disposal through routine maintenance. Monitoring results also show that contaminants have not degraded groundwater quality beneath the basins.

STORM CHANNEL AND CREEK MAINTENANCE

Reduction of pollutant levels in stormwater can be achieved by regularly removing illegally dumped items and material from storm drainage channels and creeks. Channel characteristics can be modified to enhance pollutant removal and hydraulic capacity.

APPROACH. The following approaches may be beneficial to storm channel and creek maintenance:

- Identify illegal dumping "hot" spots; conduct regular inspection and cleanup of hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Post "No Littering" signs with a phone number for reporting a dumping in progress.
- Adopt and enforce substantial penalties for illegal dumping and disposal.
- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel and creek aesthetic and habitat value.
- Maintain accurate logs to evaluate materials removed and improvements made.
- Establish buffer zones along creeks.

COST CONSIDERATIONS. The following cost considerations may apply to this BMP:

- The purchase and installation of signs,
- The cost of vehicle(s) to haul illegally disposed items and material to landfills,
- The rental of heavy equipment to remove larger items (for example, car bodies) from channels,
- The purchase of landfill space to dispose of illegally dumped items and material, and
- Capital and maintenance costs for channel modifications.

REGULATORY CONSIDERATIONS. Regulatory considerations include the adoption of substantial penalties for illegal dumping and disposal.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. Larger municipalities should commit at least one full-time staff person; smaller municipalities should commit at least one part-time staff person. Additional staff can be added as needed. Staff will need training in channel maintenance and use of heavy equipment and training in the identification and handling of hazardous materials and wastes.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. The storm channel and creek maintenance BMP may require the following:

- Education on the need for proper disposal of refuse;
- Notification of penalties for illegal dumping and disposal; and
- Promotion of volunteer services to create litter collection groups (such as Adopt-a-Stream).

LIMITATIONS. Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Tradeoffs may exist between channel hydraulics and water quality habitat. Worker and public safety may be at risk in high-crime areas.

ILLICIT CONNECTION PREVENTION

Preventing unwarranted physical connections to the storm drain system from sanitary sewers and floor drains through regulation, regular inspection, testing, and education can remove a significant source of stormwater pollution.

APPROACH. The following steps are components of this BMP:

- Ensure that existing municipal building and plumbing codes prohibit physical connections of nonstormwater discharges to the storm drain system.
- Require visual inspection of new developments or redevelopments during the development phase.
- Develop documentation and recordkeeping protocols to track inspections and catalog the storm drain system.
- Use techniques such as zinc chloride smoke testing, fluorometric dye testing, and television camera inspection to verify physical connections.

COST CONSIDERATIONS. Zinc chloride smoke testing, fluorometric dye testing, and television camera inspection can be cost considerations. Also, there may be additional labor and equipment costs for verification of plumbing connections.

REGULATORY CONSIDERATIONS. Ensure that existing building and plumbing codes prohibit physical connection to the storm drain system of nonstormwater discharges, and establish penalties for such action. Implement procedures to inspect and verify that new construction development does not interface with the storm drain system.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. Building and plumbing inspectors must verify and document that inappropriate discharges are not allowed through connections to the storm drain system. Zinc chloride smoke testing, fluorometric dye testing, or television inspection may be necessary for the verification of illicit connections. Additional staff time is required for verification and documentation of proper connections to the storm drain system.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. Consider a community awareness program (using various media), targeting appropriate audiences (homeowners, businesses, and contractors) to warn against improper connections to the storm drain system and encourage public reporting of illegal connections through a community hot line telephone number. Notify community and local fire departments before testing with zinc chloride smoke testing and fluorometric dye testing in targeted areas.

LIMITATIONS. The following limitations may be applicable:

- Proper connections may be verified on date of inspection but could be altered afterwards by illicit connections.
- The cost for inspection equipment can be high.
- The removal of an illicit connection from the storm drain system to the sanitary sewer may require the approval of the local sewer authority.
- Improper physical connections to the storm drain system can occur in a number of ways, such as the overflow of crossconnects from sanitary sewers and floor drains from businesses such as auto shops and restaurants.

ILLICIT CONNECTION— DETECTION AND REMOVAL

Control procedures for the detection and removal of illegal connections from the storm drain conveyance system should be implemented to reduce or prevent unauthorized discharges to receiving waters. Procedures include field screening, follow-up testing, and complaint investigation.

APPROACH. The approach can involve any or all of the following:

- Field screening program;
- Sampling program, including beach sampling during dry weather;
- Fluorometric dye testing (suspected source testing);
- Zinc chloride smoke testing (suspected source testing);
- Television camera inspection;
- Physical inspection testing;
- Citizens' complaints on a community hotline to report suspected illegal connections; and
- Correction by plugging, disconnecting, or otherwise eliminating the discharge route.

COST CONSIDERATIONS. Considerations for this BMP can include program initialization costs for procuring necessary equipment and training. Explore the possibility of equipment sharing with municipal wastewater treatment departments.

Keep in mind that illegal connection location techniques can be labor and equipment intensive.

The following equipment may be necessary:

- Personal protective equipment such as hardhats, boots, plastic gloves, and coveralls;
- Sampling containers and equipment;
- U.S. EPA-recommended stormwater test kits;
- Fluorometric dye and fluorometer (optional);
- Zinc chloride smoke and dispersal fans;
- Pipeline television camera with videocassette recorder;
- Self-contained breathing apparatus;
- Oxygen/toxic/combustible gas detection meters;
- Vehicle(s); and
- Aboveground communication.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. Administrative and staffing considerations include the following items:

- Two-person teams are required for field screening and sampling activities.
- Larger staff teams (at least one additional member) are required for fluorometric dye and zinc chloride smoke testing or television camera inspection and physical inspection with confined space entry.
- Staffing a community hotline telephone number may be necessary.

- Program coordination is needed for emergencies and recordkeeping.
- Health and safety training required by the Occupational Safety and Health Administration (OSHA) (29 CFR 1910.120), with annual refresher training, may be needed.
- Confined space entry training (federal OSHA 29 CFR 1910.146) may be needed as required by OSHA.
- Procedural training (field screening, sampling, dye or smoke testing, television or other inspection, source training, and corrective and mitigative techniques) of staff may be necessary.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. Encourage public reporting of improper waste disposal or evidence of illicit connections. Community notification, including notifying the local fire department, is required in targeted areas for zinc chloride smoke testing.

LIMITATIONS. Local ordinances must specify access rights to private property to allow for field screening and testing along storm drain system right-of-ways. Additionally, local ordinances may require that the source be suspected for guaranteed rights of entry to conduct verification testing.

EXAMPLES OF EFFECTIVE PROGRAMS. The Fort Worth, Texas, Drainage Water Pollution Control Program is action-oriented and designed to monitor and correct nonstormwater discharges in urban storm drain systems using innovative screening, tracing, and corrective techniques. Staff requirements are one full-time staff member equivalent per year (three part-time staff members are used from other programs) for a total labor cost of $30 000. Equipment, supplies, and services range from $20 000 to $50 000 per year, depending on the level of activity and co-utilization of city services. Costs could be higher for initial start-up and equipment purchases. If another program were unable to use existing city staff, additional costs would be expected.

LEAKING SANITARY SEWER CONTROL

Control procedures should be implemented for identifying, repairing, and remediating infiltration, inflow, and wet weather overflows from sanitary sewers to the storm drain conveyance system. Procedures include field screening, follow-up testing, and compliance investigation.

APPROACH. The approaches listed below may be useful for sanitary sewer control:

- Identify dry weather infiltration and inflow first. Wet weather overflow connections are difficult to locate.
- Locate wet weather overflows and leaking sanitary sewers using conventional source identification techniques, including
  - — Field screening program (including field analytical testing),
  - — Fluorometric dye testing,
  - — Zinc chloride smoke testing,
  - — Television camera inspection,
  - — Nessler reagent test kits for ammonia detection, and
  - — Citizens' hot line for reporting of wet weather sanitary overflows.

COST CONSIDERATIONS. Cost considerations include the following:

- There may be program costs for procuring necessary equipment and training.
- Departmental cooperation is recommended for sharing or borrowing staff resources and equipment from municipal wastewater treatment departments. Infiltration, inflow, and wet weather overflows from sanitary sewers can be labor and equipment intensive to locate.
- The following equipment may be needed:
  - — Personal protective equipment (such as hardhats, boots, plastic gloves, and coveralls);
  - — Sampling containers/equipment;
  - — Stormwater test kits (recommended by U.S. EPA);
  - — Zinc chloride smoke and dispersal fans;
  - — Fluorometric dye and fluorometer (optional);
  - — Pipeline television camera with videocassette recorder;
  - — Self-contained breathing apparatus;
  - — Oxygen/toxic/combustible gas detection meters;
  - — Vehicle(s), and
  - — Aboveground communication.

ADMINISTRATIVE AND STAFFING CONSIDERATIONS. Two-person teams are needed to perform field screening and associated sampling. Larger teams (at least one additional member) are required for fluorometric dye testing, zinc chloride smoke testing, television camera inspection, and physical inspection with confined space entry. Program coordination is required for handling emergencies and recordkeeping.

Health and safety training (required by OSHA, 29 CFR 1910.129), with annual refresher training, is needed. Confined space entry training (federal OSHA, 29 CFR 1910.146) may be needed. Also, procedural training (field screening, sampling, dye/smoke testing, television or other inspection, source training, and corrective/mitigative techniques) of staff may be needed.

PUBLIC EDUCATION AND PARTICIPATION CONSIDERATIONS. Consider a public awareness program through local media to identify the problem of sanitary infiltration, inflow, and wet weather overflows to the storm sewer system.

Establish a community response hotline for reporting observed sanitary infiltration or leaks and wet weather sanitary overflows to the storm sewer system. Finally, remember that public notification, including notifying the local fire department, is required for fluorometric dye or zinc chloride smoke testing in targeted areas.

LIMITATIONS. The local ordinance must specify access rights to private property to allow for field screening and testing along storm drain system right-of-ways. Also, local ordinances may require that the source be suspected for guaranteed rights of entry to conduct verification testing.

EXAMPLES OF EFFECTIVE PROGRAMS. The city of Stockton, California, Municipal Stormwater Discharge Management Program contains a comprehensive program element created to prevent, detect, and eliminate illegal connections to storm sewers.

The city of Fort Worth, Texas, Drainage Water Pollution Control Program is an action-oriented program designed for corrective measures using innovative biotoxicity testing. Staffing requirements are one full-time person per year for a total labor cost of $30 000. Equipment, supplies, and services costs approximately $50 000 per year.

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Chapter 5
Selection and Design of Passive Treatment Controls

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The selection and successful design of selected passive treatment controls often called structural best management practices (BMPs) for stormwater quality enhancement is the cornerstone of stormwater management in newly developing and redeveloping urban areas. It is also possible sometimes to retrofit BMPs in already developed parts of a municipality; however, the costs can be high.

Overall, structural BMPs are most applicable to developing and redeveloping areas. The cost effectiveness of each control has to be considered and measured against the actual environmental benefits realized. One price of urban society is the indelible mark it leaves on the ecology of urban areas. Through the use of structural BMPs, these effects can be, in part, mitigated as new urban centers develop and the old ones redevelop or expand. It is unlikely, however, that all effects of urbanization can be eliminated.

This chapter will address how several known structural BMPs can be evaluated for use at any given site and, after being selected, how each can be sized and configured. The control practices described are those that have a known performance track record. Other practices and types of controls are evolving and may eventually prove to be superior to those described herein. However, this manual is limited to established state of practice at the time of publication. New and evolving practices will be the topic of future updates. Structural BMPs require commitment of resources for initial construction and continuing operation and maintenance. Despite the development of technology mandates that new concepts be tried and tested, the bottom line is that whatever controls are used, the designer, the client, and often the regulator need to have sufficient confidence in their performance before attempting to use them. As a result, the testing of newer concepts is sometimes better left to government agencies or risk takers in industry, who can provide the new design technologies to the stormwater professionals.

This chapter will cover the following topics:

- Stormwater quality hydrology;
- Selection of treatment facilities (that is, structural BMPs);
- Operation and maintenance needs of treatment facilities;
- Swales and filter strips;
- Stormwater infiltration, including minimized connected impervious area;
- Extended detention;
- Retention (wet) ponds;
- Constructed wetlands;
- Media filtration; and
- Oil and water separators.

The above topics can be better understood when the reader has a thorough understanding of the municipal system and its relationship to stormwater quality and quantity management infrastructure. Issues such as community needs and fiscal strength, local priorities and preferences, regulatory demands, other infrastructure needs and fiscal demands, and many other's are part of the equation. Also, this chapter is most useful if the reader has become familiar with the topics discussed in Chapters 1 through 4.

Ideally, structural BMPs should be a part of the treatment train discussed in Chapter 4—namely, source control BMPs. Good housekeeping measures need to be practiced to ensure adequate performance and longevity of structural facilities. For example, if erosion control during construction is not being rigorously practiced within the catchment being served by the structural control facility, the facility will probably be rendered inoperative in a short time. For example, a detention basin, a retention pond, or a constructed wetland will fill with sediment, and infiltration devices will fail. Thus, without implementing source erosion controls, the investment in the structural facilities will be lost, and expensive rehabilitative maintenance or reconstruction of these facilities will then be needed to return them to a working condition.

It is best that the practices described in Chapter 5 be selected through a comprehensive planning process. This could involve systemwide simulation of rainfall and runoff processes, preferably using a continuous model. Some of the selection of practices actually may be based on monitoring, bioassessments, or the understanding of effects on the receiving systems. Chapters 1, 2, and 3 address all of those topics and form the foundation and an introduction to all topics covered in this chapter.

HYDROLOGY FOR THE MANAGEMENT OF STORMWATER QUALITY

In 1990, the U.S. Environmental Protection Agency (U.S. EPA) promulgated National Pollution Discharge Elimination System regulations regarding the permitting of stormwater discharges from municipal storm sewer systems. These rules require the municipalities to reduce the pollutants in urban runoff to the maximum extent practicable (MEP). The definition of MEP for the control of stormwater pollutant discharges has focused primarily on the application of economically achievable management practices. Because stormwater runoff rates and volumes vary from storm to storm, the statistical probabilities of runoff events and their management have to be considered in the development of practices to meet the MEP goal. It is paramount that the hydrology of urban runoff be examined within this context.

The type and size of storm runoff events to use for the design of runoff treatment systems need to be examined. "Treatment systems" are those measures that are often referred to in the literature as "BMPs." Among these are swales; buffer strips; infiltration basins and percolation trenches; extended detention basins; "wet" ponds that retain some or all of one event's runoff until it is displaced by the runoff from a subsequent event; media filters; and a variety of other devices and facilities. Guidelines for the design of these types of facilities can be found in this chapter and elsewhere (Livingston *et al.,* 1988; Roesner *et al.,* 1989; Schueler, 1987; Urbonas and Roesner [Eds.], 1986; and Urbonas and Stahre, 1993).

LONG-TERM RAINFALL CHARACTERISTICS. Hydrologists typically look at the infrequent events: either large storms for drainage and flood protection or drought periods for water supply development. But what characteristics are representative of the storms that produce most rainfall on a long-term basis?

Figure 5.1 presents the cumulative probability distribution of daily precipitation data for 40 years at Orlando, Florida, and Cincinnati, Ohio. These data have been screened to include only precipitation events 2.5 mm (0.1 in.) or greater in Cincinnati and 1.5 mm (0.06 in.) or greater in Orlando. Cumulative occurrence probabilities were computed for values ranging from 2.5 to 51 mm (0.1 to 2.0 in.).

Examination of Figure 5.1 reveals most of the daily values to be less than 25 mm (1 in.) in total depths. In Orlando, which averages 1 270 mm (52 in.) of rainfall per year, 90% of these events produce less than 36 mm (1.4 in.) of rainfall. In Cincinnati, which has 1 016 mm (40 in.) per year of precipitation, 90% of the events produce less than 20 mm (0.8 in.) of rainfall. By contrast,

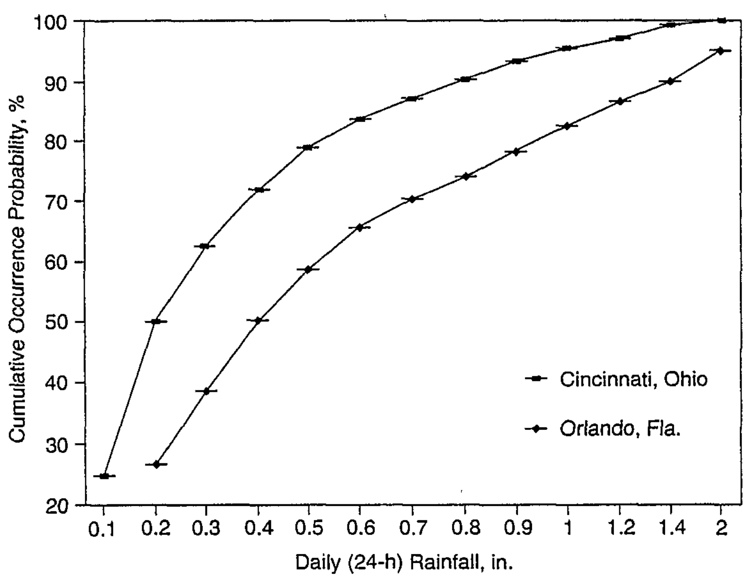

Figure 5.1 **Cumulative probability distribution of daily precipitation for two cities in the U.S. (in. $\times$ 25.4 = mm) (Roesner *et al.*, 1991).**

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the 2-year, 24-hour storm produces precipitation of 127 mm (5.0 in.) in Orlando and 74 mm (2.9 in.) in Cincinnati. This suggests that capturing and treating runoff from "smaller" storms should capture a large percentage of the runoff events and runoff volume that occur from the urban landscape. Also, a water quality facility capable of capturing these smaller storms would also capture the "first flush" portion of the larger, infrequently occurring runoff events.

CAPTURE OF STORMWATER RUNOFF. To illustrate the terms "smaller" and "most" discussed earlier, long-term simulations of runoff were examined for six U.S. cities by Roesner *et al.* (1991) using the Storage, Treatment, Overflow, Runoff Model (STORM). The six cities were Butte, Montana; Chattanooga, Tennessee; Cincinnati, Ohio; Detroit, Michigan; San Francisco, California; and Tucson, Arizona. The Storage, Treatment, Overflow, Runoff Model is a simplified hydrologic model that translates a time series of hourly rainfall to runoff then routes the runoff through detention storage.

Hourly precipitation records of 40 to 60 years were processed by Roesner *et al.* (1991) for a variety of detention basin sizes for the six cities. These simulations were performed using the characteristics of the most typically occurring urban developments found in each city. Table 5.1 lists the average annual rainfall and the area-weighted runoff coefficient at each of the study watersheds. Runoff capture efficiencies of detention basins were tested using an outflow discharge rate that emptied or drained the design storage volume in 24 hours. This drawdown time was based on field study findings by Grizzard *et al.* (1986) in the Washington, D.C., area. They determined that a detention basin had to be designed to empty out a volume equal to the average runoff event's volume in no less than 24 hours to be an effective stormwater quality enhancement facility. The findings by Roesner *et al.* (1991) are illustrated in Figure 5.2.

One way to define a cost-effective basin size is to represent it as that which is located on the "knee of the curve" for capture efficiency. This "knee" is evident on the six curves in Figure 5.2. Urbonas *et al.* (1990) have

Table 5.1 Hydrologic parameters used at six study watersheds (Roesner *et al.*, 1991).

City	Average annual rainfall, in. (mm)	Runoff coefficient of study watershed
Butte, Montana	14.6 (371)	0.44
Chattanooga, Tennessee	29.5 (749)	0.63
Cincinnati, Ohio	39.9 (1 013)	0.50
Detroit, Michigan	35.0 (889)	0.47
San Francisco, California	19.3 (490)	0.65
Tucson, Arizona	11.6 (295)	0.50

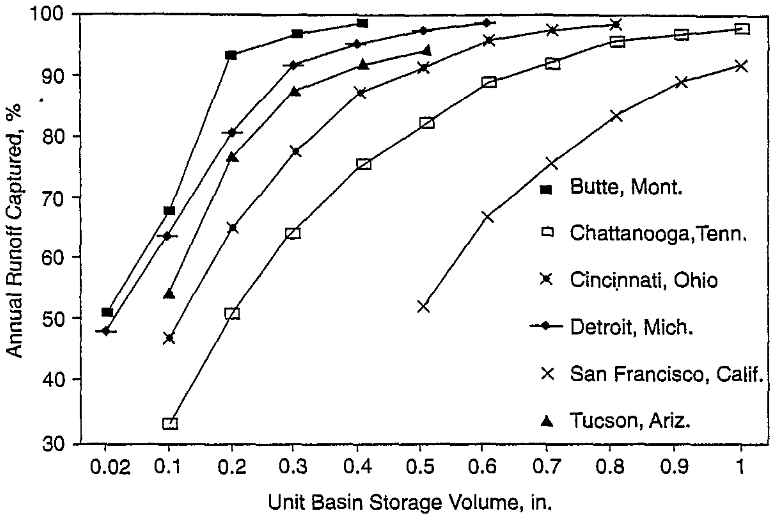

Figure 5.2 **Runoff capture rates versus unit storage volume at six study sites (Roesner *et al.*, 1991).**

defined this "knee" as the "optimized" capture volume and reported on a sensitivity study they performed relative to this volume for the Denver, Colorado, area. Later, Urbonas and Stahre (1993) redefined this "knee" as the "maximized" volume because it is the point at which rapidly diminishing returns in the number of runoff events captured begin to occur. For each of the six study watersheds previously described, the maximized storage volume values are listed in Table 5.2.

The sensitivity investigation by Urbonas *et al.* (1990) also estimated the average annual stormwater removal rates of total suspended sediments using the maximized volume as the surcharge storage above a permanent pool of a retention pond. Estimates of total suspended sediment removals were performed using the procedure reported by Driscoll (1983). Similarly, the runoff

Table 5.2 **Maximized unit storage volume at six study watersheds (Roesner *et al.,* 1991).**

City	Maximized storage volume[a]	
	in. (mm)	ac-ft/ac (m³/ha)
Butte, Montana	0.25 (6.4)	0.021 (63.5)
Chattanooga, Tennessee	0.50 (12.7)	0.042 (127)
Cincinnati, Ohio	0.40 (10.2)	0.033 (102)
Detroit, Michigan	0.30 (7.6)	0.025 (76.2)
San Francisco, California	0.80 (20.3)	0.067 (203)
Tucson, Arizona	0.30 (7.6)	0.025 (76.2)

[a] Based on the ratio of runoff volume captured from all storms.

Table 5.3 **Sensitivity of the best management practice capture volume in Denver, Colorado (Urbonas *et al.*, 1990).**

Capture volume to maximized volume ratio	Annual runoff volume captured, %	Number of storms completely captured	Average annual total suspended sediments removed, %
0.7	75	27	86
1.0	85	30	88
2.0	94	33	90

capture and total suspended sediment removal efficiencies were estimated for capture volumes equal to 70 and 200% of the maximized volume. These findings are summarized in Table 5.3.

Review of Table 5.3 shows that doubling of the maximized capture volume results in a very small increase in the total annual runoff volume captured and an insignificant increase in the average annual removal of total suspended sediments. When 70% of the maximized volume is used, only a moderate decrease occurs in the volume of runoff captured and an insignificant decrease in the annual total suspended sediment load removed. Based on these findings, the Denver, Colorado, municipal area adopted an 80th percentile runoff event (that is, 95% of the maximized event) as the basis for the sizing of stormwater quality BMPs. This 80th percentile runoff event is now considered by the municipalities in this semiarid region of the U.S. as cost effective for stormwater quality management and is viewed as the design event that achieves MEP definition under the Clean Water Act.

Although the MEP event is not clearly defined by the regulations, insight to the appropriate MEP design event can be gained by performing an analysis of local long-term hourly rainfall data similar to those reported in Tables 5.1 though 5.3. These analyses form a basis for making a rational decision in defining sizing criteria for various BMPs. As an example, the maximized unit runoff volume for a watershed in Denver, Colorado, with a runoff coefficient $C = 0.5$, is 7 mm (0.28 watershed in.), or 70 m^3/ha (0.023 ac-ft/ac). This compares well with the maximized storage volumes listed in Table 5.2 for Butte, Montana, and Tucson, Arizona—namely, the two semiarid communities on that list.

As can be seen from Figure 5.2 and Tables 5.2 and 5.3, most runoff-producing events occur from the predominant population of smaller storms, namely, less than 13 to 25 mm (0.5 to 1.0 in.) of precipitation. To be effective, stormwater quality management should be designed based on these smaller events. As a result, detention facilities, wetland basins, infiltration facilities, media filters, and possibly swales need to be sized to accommodate runoff volumes and flows from such storm events to maximize pollution control benefits in a cost-effective manner.

AN APPROACH FOR ESTIMATING STORMWATER QUALITY CAPTURE VOLUME. Estimating a Maximized Water Quality Capture Volume. Whenever local resources permit, the stormwater quality capture volume may best be found using continuous hydrologic simulation and local long-term hourly (or lesser time increment) precipitation records (see Chapter 3). However, it is possible to obtain a first-order estimate of the needed capture volume using simplified procedures that target the most typically occurring population of runoff events.

Figure 5.3 contains a map of the contiguous 48 states of the U.S. with the mean annual runoff-producing rainfall depths superimposed (Driscoll *et al.*, 1989). These mean depths are based on a 6-hour interevent time to define a new storm event and a minimum depth of 2.5 mm (0.10 in.) of precipitation for a storm to produce incipient runoff. After an extensive analysis of a number of long-term precipitation records from different meteorological regions of the U.S., Guo and Urbonas (1995) found simple regression equations to relate the mean precipitation depths in Figure 5.3 to "maximized" water quality runoff capture volumes (that is, the knee of the cumulative probability curve).

The analytical procedure was based on a simple transformation of each storm's volume of precipitation to a runoff volume using a coefficient of runoff. To help with this transformation, a third-order regression equation, Equation 5.1 (Urbonas *et al.,* 1990), was derived using data from more than 60 urban watersheds (U.S. EPA, 1983). Because the data were collected nationwide over a 2-year period, Equation 5.1 should have broad applicability in the U.S. for smaller storm events.

$$C = 0.858i^3 - 0.78i^2 + 0.774i + 0.04 \tag{5.1}$$

Where

C = runoff coefficient, and
i = watershed imperviousness ratio; namely, percent total imperviousness divided by 100.

Equation 5.2 relates mean precipitation depth taken from Figure 5.3 to the "maximized" detention volume. The coefficients listed in Table 5.4 are based on an analysis of long-term data from seven precipitation gauging sites located in different meteorological regions of the U.S. The correlation of determination coefficient, r^2, has a range of 0.80 to 0.97, which implies a strong level of reliability.

$$P_0 = (a \cdot C) \cdot P_6 \tag{5.2}$$

Where

P_0 = maximized detention volume determined using either the event capture ratio or the volume capture ratio as its basis, watershed in. (mm);

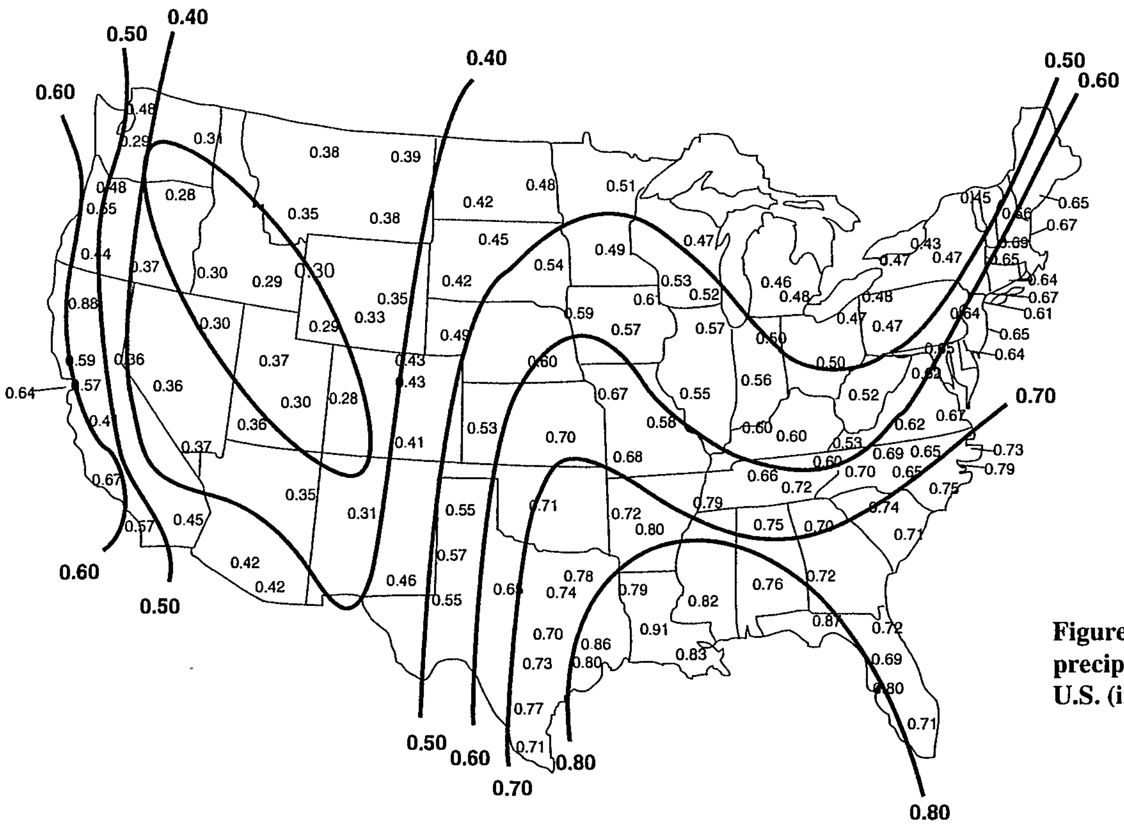

Figure 5.3 Mean storm precipitation depth in the U.S. (in. [in. × 25.4 = mm]).

Table 5.4 **Values of coefficient a in Equation 5.2 for finding the maximized detention storage volume (Guo and Urbonas, 1995).[a]**

		Drain time of capture volume		
		12 hours	**24 hours**	**48 hours**
Event capture ratio	a =	1.109	1.299	1.545
	r^2 =	0.97	0.91	0.85
Volume capture ratio	a =	1.312	1.582	1.963
	r^2 =	0.80	0.93	0.85

[a] Approximately 85th percentile runoff event (range 82 to 88%).

a = regression constant from least-squares analysis;
C = watershed runoff coefficient; and
P_6 = mean storm precipitation volume, watershed in. (mm).

Table 5.4 lists the maximized detention volume/mean precipitation ratios based on either the ratio of the total number of storm runoff events captured or the fraction of the total stormwater runoff volume from a catchment. These can be used to estimate the annual average maximized detention volume at any given site. All that is needed is the watershed's runoff coefficient and its mean annual precipitation.

The actual size of the runoff event to target for water quality enhancement should be based on the evaluation of local hydrology and water quality needs. However, examination of Table 5.3 indicates that the use of larger detention volumes does not significantly improve the average annual removal of total suspended sediments or other settleable constituents. It is likely that an extended detention volume equal to a volume between the runoff from a mean precipitation event taken from Figure 5.3 and the maximized event obtained using Equation 5.2 will provide the optimum-sized and most cost-effective BMP facility. A BMP sized to capture such a volume will also capture the leading edge (that is, first flush) of the runoff hydrograph resulting from larger storms.

Runoff volumes that exceed the design detention volume either bypass the facility or receive less efficient treatment than do the smaller volume storms and have only a minimal net effect on the detention basin's performance. If, however, the design volume is larger and has an outlet to drain it in the same amount of time as the smaller basin, the smallest runoff events will be detained only for a brief interval by the larger outlet. Analysis of long-term precipitation records in the U.S. shows that small events always seem to have the greatest preponderance. As a result, oversizing the detention can cause the most frequent runoff events to receive less treatment than provided by properly designed smaller basins.

Example of a Water Quality Capture Volume Estimate. It is desired to estimate the maximized storage volume for a 223-ha (550-ac) watershed that has 40% of its area covered by impervious surfaces. Assume that this site is located in Houston, Texas (that is, the largest storm region of the U.S.). The detention basin needs to be sized and designed to drain its water quality capture volume in no fewer than 24 hours. Substituting a value of 0.40 (that is 40/100) for the variable I in Equation 5.1 yields a runoff coefficient C = 0.30. Using Figure 5.3 we find the mean storm precipitation depth in Houston: $P6$ = 20.3 mm (0.8 in.). From Table 5.4 we find the coefficient a = 1.299 for the 24-hour drain time. Thus, the maximized detention volume is calculated as follows:

$$P_0 = (1.299 \cdot C) = 0.39 \text{ in. } (0.026 \text{ ac-ft/ac})$$

$$P_0 = 7.9 \text{ mm } (79 \text{ m}^3\text{/ha})$$

The volume of an extended detention basin for this 223-ha (550-ac) watershed needs to be 17 600 m^3 (14.3 ac-ft). It is recommended that this volume be increased by at least 20% to account for the loss in volume from sediment accumulation. The final design then can show a total volume for the basin of 21 200 m^3 (17.2 ac-ft) with an outlet designed to empty out the bottom 17 600 m^3 (14.3 ac-ft) of this volume in approximately 24 hours.

SELECTION OF TREATMENT CONTROL BEST MANAGEMENT PRACTICES

As discussed in Chapter 4, the selection of particular stormwater quality controls (that is, BMPs) is often decided by considerations other than technical issues. These issues, among others, include

- Federal, state, and local regulations;
- Real and perceived receiving water problems;
- Beneficial uses of receiving waters to be protected;
- The cost of the BMPs being considered;
- Subjective and sometimes arbitrary acceptance by the regulators or community groups; and
- Watershed studies.

While reduction of pollutants in stormwater discharges to the MEP is the statutory requirement of the stormwater regulations, the real goal has to be the reduction of effects to urban stormwater runoff on the receiving water. The cost of the BMP is always a major consideration. Recognize that no single BMP is as effective as a "train" (that is series) of practices and controls. The selection and design of structural BMPs is the topic of Chapter 5.

POINTS TO CONSIDER WHEN SELECTING BEST MANAGEMENT PRACTICES. There are several general points that need to be considered whenever selecting and designing any treatment control. The following discussion highlights some of these points.

Source Control. As a first step in the treatment train, source controls should be considered before the more expensive treatment controls are selected. These good housekeeping practices can help to reduce the amount of pollutants coming into contact with stormwater and being transported to receiving waters. Because the structural treatment controls will not remove all pollutants, the use of source controls will supplement, and thereby increase, the efficiency of the total stormwater quality management system.

Local Climate. Many treatment controls rely on the "wet" state where vegetation, biological processes, or the presence of a permanent pool can enhance pollutant removals. In arid and semiarid areas such as the southwest, such treatment controls are not practical unless water losses resulting from evapotranspiration are replaced in part or in total by municipal or irrigation supplies. The state of practice today has emerged from the observations of facilities in climates where the rainfall season is coincident with the growth of vegetation and evaporation losses of pond surfaces. The designer needs to make certain that controls being selected are compatible with local climatology and availability of water to keep these controls functional. For example, a wetland basin in a semiarid climate may not have sufficient water to keep the wetland species alive or healthy unless supplemental irrigation water is provided, which may make this choice economically impractical.

Design Storm Size. The use of design storms for the sizing of water quality controls are not the same as those selected for the design of facilities to control runoff rates for urban drainage. For example, the effect on a receiving water by the pollutant washoff of a 25-year storm is inconsequential compared to the potential hydraulic damage. Of concern for water quality control are the small, frequent events, smaller than the 1-year storm, that carry the vast majority of runoff and pollutants. Stormwater quality hydrology is discussed earlier in this chapter.

Soil Erosion. The success of any BMP control facility is influenced by how rigorously soil erosion protection is being practiced in the tributary watershed. In arid and semiarid climates, native vegetation can be sparse, allowing for greater erosion during storms than in more moist climates. But, irrigated lawns in semiarid climates tend to reduce excessive erosion after the land becomes urbanized. Regardless of climate, higher-than-normal sediment loads will affect the performance and maintenance requirements of treatment controls.

Stormwater Pollutant Characteristics. Potential pollutants can be either in particulate or dissolved form. Some BMPs will only remove particulates. Other BMPs, such as wet ponds, are purported to remove dissolved constituents and particulates. However, the data confirming this premise are limited and sometimes contradictory. Whenever specific pollutants are of particular concern, the designer needs to select treatment controls that are most likely to best remove the constituents of greatest concern.

Multiple Uses. Consider the opportunities for integrating stormwater treatment needs with other community objectives. These include active and passive recreation, enhancing or protecting wildlife habitat, flood control, and groundwater recharge.

Maintenance. None of the treatment controls described herein requires active operation of equipment such as mechanical or chemical systems. Nonetheless, they need to be maintained to operate as designed. The operation and maintenance needs of each facility have to be addressed because their life-cycle costs should be considered.

Physical and Environmental Factors. The most typical physical and environmental factors that need to be considered in the selection of treatment controls are

- Slope—most BMPs are sensitive to the local terrain slope. Certain BMPs, such as swales and infiltration basins, cannot be used in steep terrain, while others, such as detention basins and filters, can be made to work on most reasonably sized land parcels.
- Area required—most BMPs require considerable land area. Some can be placed underground at considerable expense.
- Soil—infiltration systems must be located on porous soils and subsoils. Vegetation requires good soils, while wet ponds require impermeable soils or lining.
- Water availability—the BMPs that rely on vegetation or a permanent water pool for pollutant removal require water, which has to be available in adequate quantity during dry seasons.
- Aesthetics and safety—where visible or accessible to the public, aesthetics and safety are of concern.
- Hydraulic head—some BMPs need a drop in water elevation (for example, an extended detention outlet), which is a site topography issue.
- Environmental side effects—the design process should consider mos-

quito breeding, groundwater contamination, opportunities for aquatic and wildlife habitat, and active and passive recreation.

Regardless of the above factors, in all cases the treatment controls to be used must be compatible with existing drainage or flood control objectives.

To assist the user with the selection of treatment control BMPs in a given watershed, the decision tree shown in Figure 5.4 was developed. This decision tree will lead to treatment control BMPs that are potentially applicable

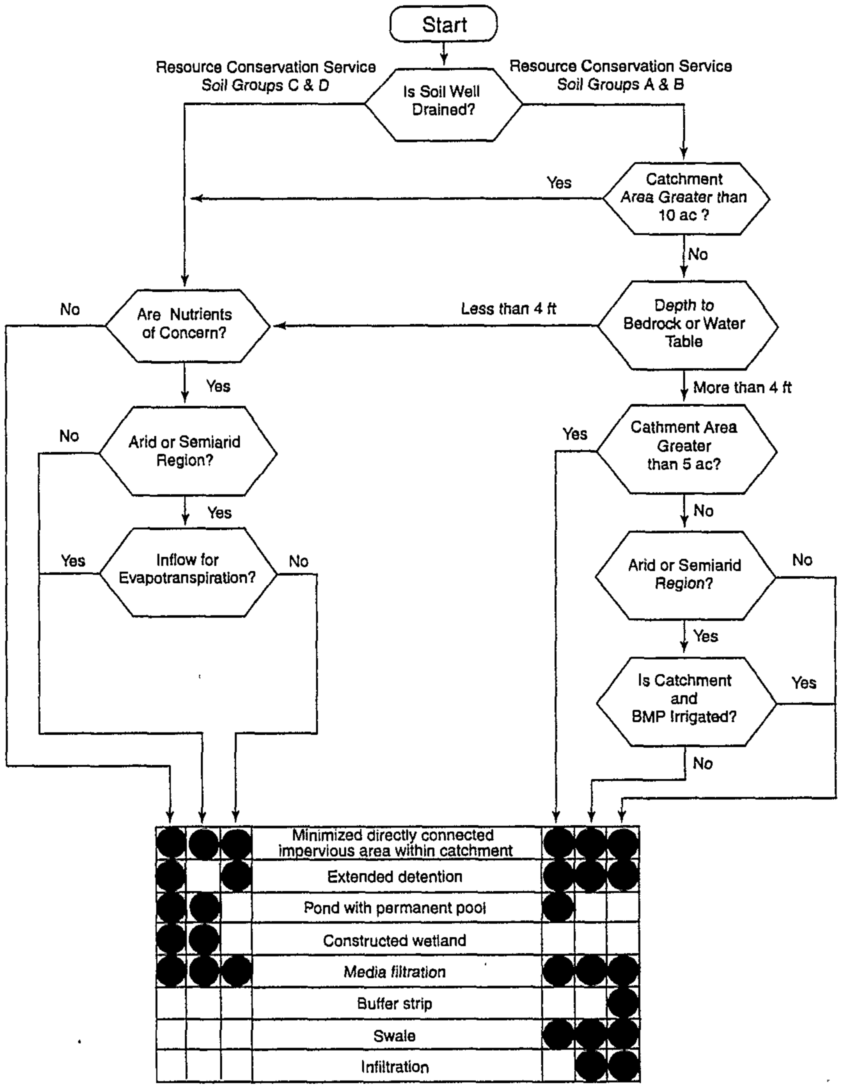

Figure 5.4 **Decision tree for identifying potential treatment controls (ac × 0.404 = ha; ft × 0.304 8 = m).**

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to a given site/region. Using the site characteristics and the design guidance for the BMPs contained in this chapter, potentially applicable BMPs can be designed and their cost can be estimated. Table 5.5 can then be filled out for the watershed(s) or pollutant(s) of concern to narrow the focus to the most cost-effective BMPs appropriate for the specific site and purpose.

On-Site Versus Regional Controls. Some structural BMPs can be used either as stand-alone, on-site treatment controls or as part of regional controls for stormwater quality enhancement, while others can only be used on site. Swales, filter strips, infiltration and percolation, media filters, oil and water separators, and other controls are not applicable for large-scale, regional controls. Extended detention, wet retention ponds, and wetland basins can be used as regional controls serving large catchments and, if local conditions permit, can also be used as on-site controls. Because large numbers of on-site controls, sometimes exceeding several hundred or even several thousand, can eventually be installed within an urban watershed, it becomes difficult to reliably quantify their cumulative hydrologic effects on receiving waters. Water quality, however, can be improved by both regional and on-site controls, although the degree of improvement for the accumulated effect in numerous on-site controls is less predictable than with regional controls.

Large numbers of on-site controls complicate the quality assurance during design and construction because they are probably designed by a variety of individuals and are constructed by a variety of different contractors under varying degrees of quality control. Further, they may be maintained and operated in a variety of ways impossible to anticipate or to control.

A simple example illustrates what a municipality faces with on-site controls. If the average size of a new land development is 8 ha (20 ac) and only one type of a treatment BMP is installed for each new development, there will be 14 on-site controls per km^2 (32 on-site controls per sq mile). A city or county with more than 260 km^2 (100 sq miles) area would then have to keep track of 3 200 controls. It is not unusual for an on-site control to serve less than 4 ha (10 ac) or even 2 ha (5 ac), and the outlet diameters become small. To ensure maintenance for a large number of such controls, a municipality needs a large, properly trained staff to keep track of their condition. Merely mandating that these facilities be built when land development occurs is not enough.

A more logical approach is to use regional controls serving 32 to 240 ha (80 to 600 ac). This eliminates the uncertainty of large numbers of on-site controls. Large sites need multistage outlets to detain small events. As the watershed becomes larger and the outlets become bigger, runoff from small storms experience little "throttling." To compensate for this, multistage outlets can be used to release small runoff events in 12 to 24 hours and empty the total water quality capture volume in 24 to 48 hours.

Wiegand *et al.* (1989) estimated that regional controls are more cost effective because fewer controls are less expensive to build and maintain than

Table 5.5 **Form for evaluating structural best management practices.**

Worksheet for evaluation of treatment control best management practices								
Pollutant of concern	Best management practice	Area of application, ha	Annual pollutant removed, kg/a	Annual capital costs,[a] $/a	Annual operation and maintenance cost,[b] $/a	Annual administrative costs, $/a	Total annual costs, $/a	Removal cost[c] $/kg

[a] Annual capital costs based on a 20-year design period.
[b] Annual administration costs are best determined by a given community after a citywide program is established.
[c] Removal costs are in units of ($/a)/(kg/a) = $/kg.

a large number of on-site controls. Another benefit is that water quality control outlets are larger and are easier to design, build, operate, and maintain. Also, because regional controls are often maintained by some form of public body, they are more likely to receive ongoing maintenance.

Regional controls can provide treatment for existing and new developments and typically will capture all runoff from public streets, which is often missed by on-site controls. Because regional controls cover large land areas, this permits other compatible uses such as recreation, wildlife habitat, or aesthetic open space to occur within their boundaries.

The two major disadvantages of regional controls are that they require advanced planning and up-front financing. Lack of financing early in the watershed's land development process, before sufficient developer contributions are available, can preclude their timely installation. The use of on-site controls often is the only practical institutional and political alternative.

Overview of Specific Treatment Controls. Treatment controls, often called structural BMPs, can occupy much land area. They often require flat side slopes for access, ease of maintenance, and public safety. Although vertical sides can be used to reduce the needed land area, safety fencing may be needed to reduce the owner's potential liability, which then affects the facility's aesthetics.

The most frequently used treatment controls include swales, buffer strips, infiltration basins and trenches, and extended detention basins and ponds.

SWALES. Swales are shallow sideslope channels with a relatively mild longitudinal slope, typically grassed or vegetated. They are designed for slow velocities during small storms, allowing opportunity for infiltration along the swale bottom and for the trapping of sediment and organic biosolids in the vegetative cover.

FILTER STRIPS. Sometimes called buffer strips, filter strips perform in a manner similar to swales but are not channels. These are mildly sloping vegetated surfaces that are located off, and abut, an impervious surface area. They are designed to slow the velocity of the runoff from the impervious area, increasing the opportunities for infiltration and the trapping of pollutants.

INFILTRATION BASINS AND PERCOLATION TRENCHES. These treatment controls capture runoff generated by small storms from small catchments and, when they work, provide good stormwater treatment by transferring surface runoff to the groundwater regime. This filters out suspended pollutants and provides other treatment processes before water returns to the surface system.

DETENTION CONTROLS. These include extended detention basins (dry), which drain out completely between storm events, and retention ponds (wet), which "retain" some or all of the storm runoff from a given event within its permanent pool until the next storm occurs. Detention basins remove pollutants primarily through sedimentation of solids, while retention ponds remove pollutants through sedimentation and through physical and biochemical processes in the permanent pool during the dry weather periods that follow. Typically, retention ponds are larger than detention basins and can be more efficient than detention basins in the removal of many constituents found in stormwater.

WETLAND BASINS. Wetland basins can be efficient stormwater quality treatment controls. Because of the regulatory protection of wetlands in the U.S., whatever their origin may be, wetland basins for stormwater treatment must be artificially created. Even so, federal or state regulatory agencies can assume control of these artificially "constructed" wetlands, requiring the owners to obtain permits before they can perform needed maintenance. Failure to obtain such permits can become a problem for the owner, individual, or organization performing mechanical cleaning, excavation, or dredging operations within these control treatment facilities.

MEDIA FILTRATION. These controls include sand filters with presettlement to avoid clogging. Other media mixtures of peat, sand, and compost mix and geotextiles are used but with mixed results.

OIL AND WATER SEPARATORS. These controls are designed to remove petroleum compounds, grease, sand, and grit. These devices are designed to remove floatable debris.

Robustness of Design Technology. High robustness of design implies that, when all of the design parameters are correctly defined and quantified, the design has a high probability of performing as intended. In other words, the design technology is well established and has undergone the test of time. Low robustness implies that there are many uncertainties in how the design will perform over time. In the definition used here, it is assumed that the facility will be properly operated and maintained over time as we currently understand its maintenance needs (which are not factors in judging design robustness).

Table 5.6 summarizes the collective opinion of senior professional engineers involved in the field of stormwater quality management about the design robustness of various structural stormwater quality controls. Some of these opinions acknowledge the dependence on local site-specific conditions, such as climates, geology, soil types, and nature of constituents. In some cases, the hydraulic design governs how reliable the design will be and how adequately it will perform. In those cases, even when water quality enhancement performance is known to be excellent when the facility functions properly, its ability to provide water quality enhancement cannot be ensured when its hydraulic design robustness is low. The reverse is also true; namely, a fa-

Table 5.6 Robustness of best management practice design technology.[a]

Type	Hydraulic design	Removal of constituents in stormwater: Total suspended sediments and solids	Dissolved	General Performance
Swale	Moderate-high	Low-moderate	None-low	Low
Buffer strip	Low-moderate	Low-moderate	None-low	Low
Infiltration basin	Moderate-high[a]	High	Moderate-high	Moderate
Percolation trench	Low-moderate[a]	High	Moderate-high	Moderate-high
Extended detention	High	Moderate-high	None-low	Moderate-high
Wet retention pond	High	High	Low-moderate	Moderate-high
Wetland	Moderate-high	Moderate-high	Low-moderate	Low-high[b]
Media filter	Low-moderate	Moderate-high	None-low	Low-moderate
Oil separator	Low-moderate	Low	None-low	Low
Catch basin inserts	Technology unknown	NA[d]	NA	NA
Monolithic porous pavement[b]	Low-moderate	Moderate-high	Low-high[c]	Low-moderate
Modular porous pavement[b]	Moderate-high	Low-high	Low-high[c]	Low-high[c]

[a] Weakest design aspect, hydraulic or constituent removal, governs overall design robustness.
[b] Robustness is site-specific and maintenance dependent.
[c] Low-moderate whenever designed with an underdrain and not intended for infiltration and moderate-high when site conditions permit infiltration.
[d] Not applicable.

cility that has high hydraulic reliability and low water quality enhancement predictability will have a low combined design robustness. In other words, the weakest design link governs the overall reliability of the design.

MAINTENANCE OF TREATMENT CONTROLS

Regular inspection and maintenance of treatment controls (that is, BMPs) are a necessity if these controls are to consistently perform up to expectations. Sediment and debris removal from inlets and outlets are the most important requirements. The following discussion presents an overview of maintenance requirements. Further information may be found in *Design and Construction of Urban Stormwater Management Systems* (ASCE and WEF, 1992). Detailed maintenance requirements for specific treatment BMPs can be found among the references listed in this chapter.

INSPECTIONS. Inspections should be performed at regular intervals to ensure that the BMP is operating as designed. Annual inspection should be considered, with additional inspections following storm events. For the inspection following a major storm, the inspector should visit the site at the end of the specified drawdown period to ensure that any detention or infiltration device is draining properly. Some inspections can be arranged to coincide with scheduled maintenance visits to reduce site visits and ascertain that maintenance activities are performed satisfactorily. Check for accumulations of debris and sediment at the inlets and outlets, and check side slopes for signs of erosion, settlement, slope failure, or vehicular damage. Check emergent vegetation zones to ensure that water levels are appropriate for vegetative growth, that acceptable survival rates are being maintained, and that vegetative cover is above acceptable limits.

ROUTINE MAINTENANCE. Routine or preventive maintenance refers to procedures that are performed on a regular basis to keep the BMP aesthetic and in proper working order. Routine maintenance should include debris removal, silt and sediment removal, and clearing of vegetation around flow control devices to prevent clogging. It is expected that silt removal will have to be performed every 5 to 15 years, as needed.

Routine maintenance also includes the maintenance of a healthy vegetative cover. Dead turf or other unhealthy vegetative areas will need to be replaced after being discovered.

NONROUTINE MAINTENANCE. Nonroutine or corrective maintenance refers to any rehabilitative activity that is not performed on a regular basis. This includes flow control structure replacement or the major replacement and cleaning of aquatic vegetation.

Erosion and Structural Repair. Areas of erosion and slope failure should be repaired and reseeded (or sodded) as soon as possible. Eroded areas near the inlet or outlet may also need to be lined with riprap.

Any major damage to inlet, outlet, or other structures should be repaired immediately. Delay in such repairs can invite structural failure the next time the facility is in operation. When that occurs, it may require total reconstruction of the structure.

Sediment Removal and Disposal. Although considered by some to be routine maintenance, silt and other sediment removal, with few exceptions, is anything but routine. First, it does not occur annually in most treatment facilities. Second, when it is done, it is typically a project that requires mechanized equipment, careful survey, transport and disposal of removed materials, and the reestablishment of the original design grades and sections of the BMP.

Sediment may need to be removed on a regular schedule but rarely on an annual basis. The only exceptions are certain types of oil and grit separators, media filters, and infiltration systems. For most treatment systems, the exact schedule will depend on the annual total suspended sediment load being removed by the facility and the size of the area on which it is being deposited.

Several field observations reported accumulation rates of 6 to 13 mm per year in retention ponds. This rate of accumulation has also been reported to be 10 to 100 times greater whenever construction activities take place in the tributary watershed, especially when effective erosion control practices are not used.

Equation 5.3 (Urbonas, 1994) can be used to estimate the average depth of sediment accumulation within almost any facility that removes total suspended sediments from stormwater:

$$V_P = 1.45 \cdot 10^{-6} \cdot \frac{h \cdot T_{SS} \cdot f_r}{R} \tag{5.3}$$

Where

V_P = average annual depth of bottom sediment deposit, mm;
h = average annual runoff depth from the watershed, mm;
T_{SS} = average annual concentration of total suspended sediments in runoff, mg/L;
f_r = fraction of TSS retained in pond; and
R = (pond's surface area)/(tributary watershed area) ratio.

As an example, estimate the annual accumulation rate within a retention pond with a surface area of 0.53 ha (1.3 ac), a tributary catchment of 223 ha (550 ac) with a runoff coefficient $C = 0.28$, an annual runoff-producing precipitation of 352 mm (12.8 in.), and an average concentration of $T_{SS} = 400$ mg/L in the runoff, of which the retained fraction in the pond is $f_r = 0.80$. First, find the annual runoff depth from the watershed—namely, $h = 0.28 \times 352$ mm $= 99$ mm. Then, the average annual accumulation of sediment is

$$V_P = 1.45 \cdot 10^{-6} \cdot \frac{99 \cdot 400 \cdot 0.80}{0.002\,4} = 19 \text{ mm (0.75 in./yr)}$$

If the pond's original design allowed for a total of 305 mm (12 in.) of sediment accumulation, the pond's bottom will need to be cleaned once every 18 years. This assumes that the bed load fraction is part of the reported TSS concentration and that there are no other sources of sediment, such as construction activities, being delivered to the ponds. Chances are that the actual accumulation rate will be somewhat higher and that more frequent cleanout will be needed.

Accumulation rates of heavy metals such as lead, zinc, copper, or other constituents may be a concern if such accumulations can create hazardous waste. If this is a concern, more frequent removal of sediments and periodic monitoring can be done to avoid these situations. Also, occasional core samples of pond or basin bottom will reveal if buildup of pollutants is occurring. If bottom sediment concentrations approach levels that would restrict disposal on site or in local landfills, site rehabilitation and total cleanout may be required.

Under existing U.S. EPA regulations (40 CFR Part 261), material cleaned from a detention pond should periodically be screened using the toxic characteristics leaching procedure (TCLP). This test should be carried out on accumulated sediment within the pond. If the sediment fails the test, it is subject to Resource Conservation and Recovery Act (RCRA) regulations and must be disposed of in an approved manner at a RCRA-approved facility. If the TCLP test is negative, sediments are subject to state and local solid waste disposal regulations.

If the material has been sufficiently dried to be a "workable material" and can pass a TCLP test, it can also be disposed of off site. This can be done at a landfill or as unclassified fill. However, sediments from any treatment facility can be nutrient-rich soils and, if other characteristics do not disqualify it, can be used in landscaping or as unclassified fill material. Disposing of accumulated sediment as fill or in landscaping avoids depleting landfill volume.

OTHER MAINTENANCE REQUIREMENTS. Mowing. Side slopes, embankments, emergency spillways, and other grassed areas of stormwater controls must be periodically mowed to prohibit woody growth and control weeds. More frequent mowing may be required in residential areas. Mowing can constitute the largest routine maintenance expense.

Debris and Litter Removal and Control. Debris and litter accumulate mostly near the inlet and outlet structures of stormwater controls and need to be removed during regular mowing operations. Particular attention should be paid to floatable debris that can eventually clog the outlet control structure or riser. Trash screens or trash racks can be strategically placed near inflow or outflow points to capture debris and assist with maintenance.

Litter and debris from illegal dumping should also be cleaned up on a regular basis, and an accurate log should be maintained of materials removed and improvements made. Controlling illegal dumping is difficult, but the posting of "no littering" or "no dumping" signs, with a phone number for reporting a violation in progress, may help. Adoption and enforcement of substantial penalties for illegal dumping and disposal could also be a deterrent.

Nuisance Control. Standing water or soggy conditions within a stormwater treatment control facility can create nuisance conditions for nearby residents. Odors, mosquitoes, weeds, and litter can all be potential problems in stormwater controls. However, wetland plants within a littoral zone of a retention pond (wet) provide a habitat for birds, predacious insects, and fish that serve as a natural check on mosquitoes. Also, regular maintenance to remove debris and ensure control structure functionality may also help control potential nuisance problems.

VEGETATED SWALES AND FILTER STRIPS

Biofilters consist primarily of vegetated swales and filter strips. Swales are shallow channels with flow depths often below the height of the vegetation that grows within them. Filter strips are vegetated flat surfaces over which water flows in a thin sheet. Planted vegetation can be turf grasses, emergent wetland, or high marsh plants. Some infiltration occurs through the underlying soil cover, but that is not the primary mode of treatment. Suspended solids are removed by filtering through the vegetation and settling. Dissolved constituents may also be removed through chemical or biological mechanisms mediated by the vegetation and the soil.

PLANNING CRITERIA AND GUIDELINES. Local governments and stormwater professionals should view biofilters as an element of the stormwater management infrastructure and as a part of the treatment train. For example, roadside ditches can be designed as biofilters and as landscaping amenities. Also, when land is limited, surrounding a pond with a biofilter will treat low flows before they enter the pond. Consider retrofitting biofilters in developed areas.

Effective biofiltration depends on proper design, construction, and maintenance. Also, local jurisdictions need to provide for access easements on private land for their inspection, monitoring, and maintenance, and they need to enforce long-term maintenance commitments by private parties to the control facilities owned by private parties.

Every effort should be made to prevent sediment-laden construction runoff, oil, and grease from entering biofilters. Catch basins, detention basins, presettling devices, and oil–water separators can be installed upstream of biofilters to help remove these materials before they reach the biofilter. Any of these devices or controls can improve the performance and the life of a biofilter.

DESIGN AND INSTALLATION CRITERIA AND GUIDELINES. Provisions Applying Equally to Swales and Filter Strips. It is important to maximize water contact with the biofilter vegetation and the soil surface. Graveled and coarse sandy soils are not desirable because they have difficulty sustaining vegetation. Heavy clay soils, materials toxic to vegetation, stones, and debris should also be avoided. When suitable, use on-site materials and scarify and till compacted soils before planting.

Vegetate biofilters uniformly with fine, turf-forming, water-resistant grasses. In arid and semiarid areas, supplemental irrigation will be needed to maintain healthy filter strips. Where biofilters intercept groundwater or where there is little slope for proper drainage, emergent herbaceous wetland vegetation is an acceptable planting alternative. Whenever possible, use vegetation native to the region. It is important to select grass and wetland species that work best for the region, climate, and native soils. Do not assume that information from other regions can be used at every site. Also, if wildlife habitat is being provided, select vegetation accordingly.

Use grass seed and mulch application rates specified by the supplier. If at all possible, do not use animal manure as an amendment and avoid using fertilizers. If fertilizer must be used, apply only the amount needed by the selected plants in the existing soil conditions and use a slow-release fertilizer. Establish grasses when natural moisture is adequate but irrigate if necessary. If wetland plants are used, they may need to be protected from predation with netting during establishment. If possible, divert runoff, other than necessary irrigation, during the period of vegetation establishment.

Vegetate upslope areas to prevent erosion. Use barrier shrubs to reduce intrusion by people and domestic animals. Avoid trees that shade biofilter grasses, and if trees cannot be avoided, space them at least 6.5 m (20 ft) apart. Landscape beds near biofilters should be at a slightly lower elevation than the adjacent ground surface.

Provide for a 1.0 to 2.0% slope in the direction of flow, with 6.0% being the maximum and 0.5% being the minimum. When the longitudinal slope is less than 1.0 to 2.0%, install a perforated underdrain or, if moisture is adequate, establish wetland species. If the slope is greater than 2.0%, use check dams to reduce the effective slope to approximately 2.0%. Install energy dissipating riprap at the toe and for a short distance downstream at the toe of these check dams to control erosion. When the land slopes more than 6%, swales can be installed to traverse the grade at a lesser slope. Grade biofilters carefully to attain uniform longitudinal and lateral slopes and eliminate high and low spots.

If curb cuts are used to distribute the flow over a biofilter, they should be at least 0.3 m (12 in.) wide to reduce clogging. Place the pavement slightly above the adjacent biofilter elevation. Install a flow-spreading device with sediment cleanouts (such as weirs, stilling basins, and perforated pipes) to uniformly distribute flow at an inlet to a swale or across the width of a filter strip. Protect inlet areas from erosion by using stilling basins and riprap pads with rock sized large enough not to be moved by the inflow.

A high-flow bypass is not needed if the biofilter is preceded by a runoff quantity control device designed to release flow at rates that will not cause erosion or scour within the biofilter. When a bypass is used, provide it with an inflow regulating device and use a pipe or a stabilized channel to convey the flow.

Provisions for Swales. At minimum, design for the peak runoff rate during the "maximized" storm. Base this storm depth on the rainfall depth using a runoff coefficient $C = 1.0$ (that is, complete runoff, no infiltration) and a 12-hour "drain time." Relate this "maximized" depth to an approximate intensity-duration curve for the area that can then be used with the rational formula by assuming the storm occurs over 1 or 2 hours. Using the time of concentration for the catchment and its runoff coefficient C, find the design flow rate. Unless larger events will bypass the swale, enlarge its capacity for flood passage of the 10- to 100-year peak flow.

The following criteria are probably most applicable in warm and temperate, non-semi-arid climates and should be met or exceeded during the biofiltration capacity design event:

- "Maximized" runoff hydraulic residence time of 5 minutes or more;
- Maximum flow velocity less than 0.3 m/s (0.9 ft/sec);
- Manning's $n = 0.20$ for routinely mowed swales;
- Manning's $n = 0.24$ for infrequently mowed swales;
- Maximum bottom width of 2.4 m (8 ft);
- Minimum bottom width of approximately 0.6 m (2 ft);
- Maximum depth of flow no greater than one-third of the gross or emergent wetland vegetation height for infrequently moved swales or greater than one-half of the vegetation height for regularly mowed swales, up to a maximum of approximately 75 mm (3 in.) for grass and approximately 50 mm (2 in.) below the normal height of the shortest wetland plant species in the biofilter; and
- Minimum length of 30 m (100 ft).

Use a trapezoidal cross section for ease of construction with side slopes no steeper than 4:1 for ease of maintenance. Terracing needs to be used when side slopes become steeper than 3:1.

Provisions for Filter Strips. Design filter strips to carry the "maximized" storm peak runoff rate described in the section titled Provisions for Swales. Base the flow capacity design to meet or exceed the following criteria during the design storm event. The following specifications may be used:

- Hydraulic retention time of no fewer than 5 minutes;
- Average velocity not greater than 0.3 m/s (0.9 ft/sec);
- Manning's $n = 0.20$ for routinely mowed strips;
- Manning's $n = 0.24$ for infrequently mowed strips;
- Limit filter strip width to achieve uniform flow distribution;
- Average depth of flow no more than 25 mm (1.0 in.); and
- Hydraulic radius taken to be equal to the design flow depth.

In arid and semiarid areas, biofilter strips will need irrigation to maintain a dependable grass cover.

OPERATION AND MAINTENANCE OF BIOFILTERS. To keep biofilters operating properly, keep all inlet flow spreaders even and free of debris. Remove debris for aesthetic reasons. Mow grass-covered biofilters regularly during the growing season to promote growth and pollutant uptake. Remove cuttings and dispose of them properly or through composting. If the objective is to prevent nutrient transport, mow grasses or cut emergent wetland plants to a low height, but still above the maximum flow depth, at the end of the growing season. For trapping floatables and debris pollution control objectives, let the plants stand at a height exceeding the design water depth by at least 50 mm (2 in.) at the end of the growing season.

Remove sediment by hand with a flat-bottomed shovel during the summer months whenever sediment covers vegetation or begins to reduce the biofilter's capacity. Reseed damaged or recently maintained areas immediately with a mix used for initial establishment or use grass plugs from adjacent upslope areas. If possible, redirect flow until new grass is firmly established. Otherwise, cover the seeded areas with a high-quality erosion control fabric.

Inspect biofilters periodically, preferably monthly, especially after heavy runoff. Maintain clean curb cuts to avoid soil and vegetation buildup. Educate local residents about the importance of keeping biofilters free of lawn debris and pet waste. Base roadside ditch cleaning on hydraulic analysis. Remove only the amount of sediment necessary to restore needed hydraulic capacity, leaving as much of the vegetation in place as possible. Eventually, sufficient sediment will be trapped that the entire biofilter will need to be removed with the sediment and reconstructed to begin a new cycle of stormwater quality control.

BIOFILTER DESIGN PROCEDURE. Preliminary Steps. The design procedures for swales and filter strips are almost identical. The design steps described below are for swales, with notes provided for filter strip design when appropriate:

- P1: estimate runoff flow rate for the design event and limit the discharge to approximately 0.03 m^3/s (1.0 cu ft/sec) by dividing the flow among several swales, installing upstream detention to control release rates, or reducing the developed surface area to reduce runoff coefficient and gain space for biofiltration.
- P2: establish the slope of the proposed biofilter.
- P3: select a vegetation cover suitable for the site.

Design for Biofiltration Capacity. This analysis emphasizes biofiltration rather than efficient hydraulic conveyance, thereby promoting sedimentation, filtration, and other pollutant removal mechanisms. Typically, a lower maximum velocity is arrived at than required for slope stability, and the biofilter dimensions typically do not have to be modified after a check for stability.

- D1: estimate the height of vegetation that is expected to occur during the storm runoff season. The design flow depth should be at least 50 mm (2.0 in.) less than this vegetation height and a maximum of approximately 75 mm (3.0 in.) in swales and 25 mm (1.0 in.) in filter strips.

- D2: select Manning's n as discussed.
- D3: typically swales are designed as trapezoidal channels (skip this step in filter strip design). When using a rectangular section, provide reinforced vertical walls. See Figure 5.5 for relationships for estimating cross-sectional area, top width, and hydraulic radius for typical channel geometrics.

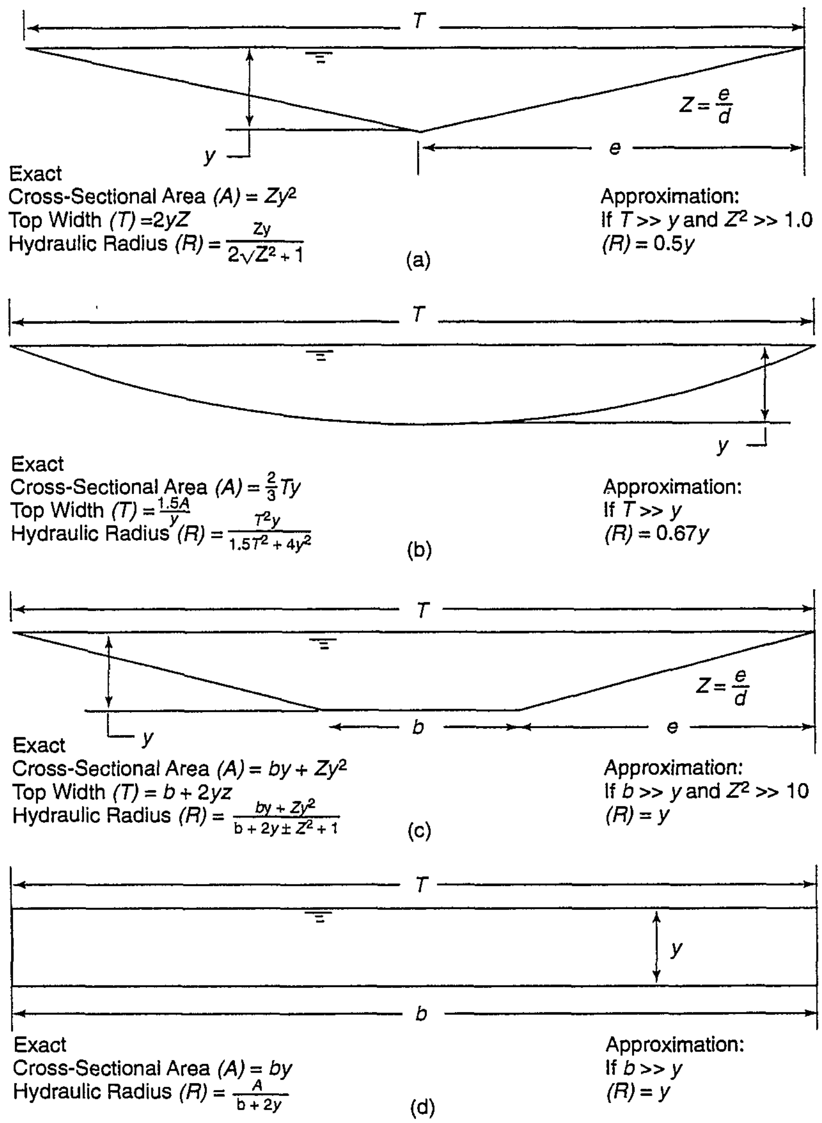


Figure 5.5 **Geometric formulas for common swale shapes: (a) v-shape, (b) parabolic shape, (c) trapezoidal shape, and (d) rectangular shape.**

- D4: use Manning's equation to approximate initial dimensions. For trapezoidal shape, select a side slope that is no steeper than 3:1, with 4:1 or flatter preferred. Set the bottom width to be between approximately 0.6 and 2.5 m (2.0 to 8.0 ft).
- D5: compute cross-sectional area.
- D6: compute the flow velocity for the design flow rate. Limit velocities during the "maximized" design storm to less than 0.3 m/s (0.9 ft/sec). Greater velocities were found to knock grasses from a vertical position in the Pacific Northwest (U.S.), reducing filtration. Experience in other regions may be different. Adjust for local experience. If the flow velocity exceeds the limit value, repeat steps P1 through D6.
- D7: compute the swale length using the design velocity from step D6 and an assumed hydraulic retention time. A suggested retention time value in the Pacific Northwest is 9 minutes. However, it is acceptable to use other accepted regional values, preferably no fewer than 5 minutes. If the computed swale length is less than 30 m (100 ft), increase to 30 m and adjust bottom width.

Check for Stability to Reduce Erosion. The "stability" check is performed for the combination of highest expected flow and least vegetation coverage and height.

- S1: unless runoff will bypass the biofilter, perform the "stability" check for the 10- to 100-year design storm. Estimate the design discharge as in step P1.
- S2: estimate the vegetation coverage (for example, "good" or "fair") and flow depth for conditions that will exist whenever the coverage and vegetation height are the least.
- S3: estimate the degree of retardance using Table 5.7. Because emergent wetland species typically grow less densely than grasses, assume a "fair" coverage.
- S4: establish the maximum permissible velocity (V_{max}) from Table 5.8 to prevent erosion.

Table 5.7 Guide for selecting degree of retardance.

Average grass height, in.[a]	Degree of vegetation coverage	
	"Good"	"Fair"
>30	A. (Very high)	B. (High)
11–24	B. (High)	C. (Moderate)
6–10	C. (Moderate)	D. (Low)
2–6	D. (Low)	D. (Low)
<2	E. (Very low)	E. (Very low)

[a] in. × 25.40 = mm.

Table 5.8 **Recommended maximum velocities for swale stability.**

Cover	Slope, %	Maximum velocity, ft/sec[a] Erosion-resistant soils	Easily eroded soils
Kentucky bluegrass	0–5	6	
Tall fescue			5
Kentucky bluegrass	5–10	5	4
Ryegrass			
Western wheat-grass			
Grass–legume mix	0–5	5	4
	5–10	4	3
Red fescue	0–5	3	2.5
Redtop	5–10	NR[b]	NR[b]

[a] ft/sec × 0.304 8 = m/s.
[b] Not recommended.

- S5: select a trial Manning's n. A reasonable initial choice under poor vegetation cover conditions is $n = 0.04$.
- S6: use Figure 5.6 to help approximate the value for VR (that is the product of velocity and hydraulic radius) using retardation information from step S3 and V_{max} from step S4.
- S7: estimate a new hydraulic radius by dividing (VR) from step S6 by V_{max} from step S4.
- S8: use Manning's equation to solve for the actual VR.
- S9: compare the actual VR from step S8 against the first approximation in step S6. If they do not agree within 10%, repeat steps S5 through S9 until acceptable agreement is reached.
- S10: compute the actual V for the final design conditions and check to be sure that $V < V_{max}$, from step S4.
- S11: compute the cross-sectional area for "stability."
- S12: compare the area computed in step S11 with the area computed from the biofiltration "capacity" analysis (step D5). If less area is required for "stability" than is provided for "capacity," the "capacity" design is acceptable. If not, use area from step S11 and recalculate channel dimensions.
- S13: calculate the depth of flow at the "stability" check design flow rate condition for the final dimensions.
- S14: compare the depth from step S13 to the depth used in the biofiltration "capacity" design. Use the larger of the two and add 0.3 m (1.0 ft) freeboard. Calculate the top width for the full depth. Skip this step in filter strip design.
- S15: make a final check for discharge capacity based on the "stability" check design storm and maximum vegetation height and cover (this

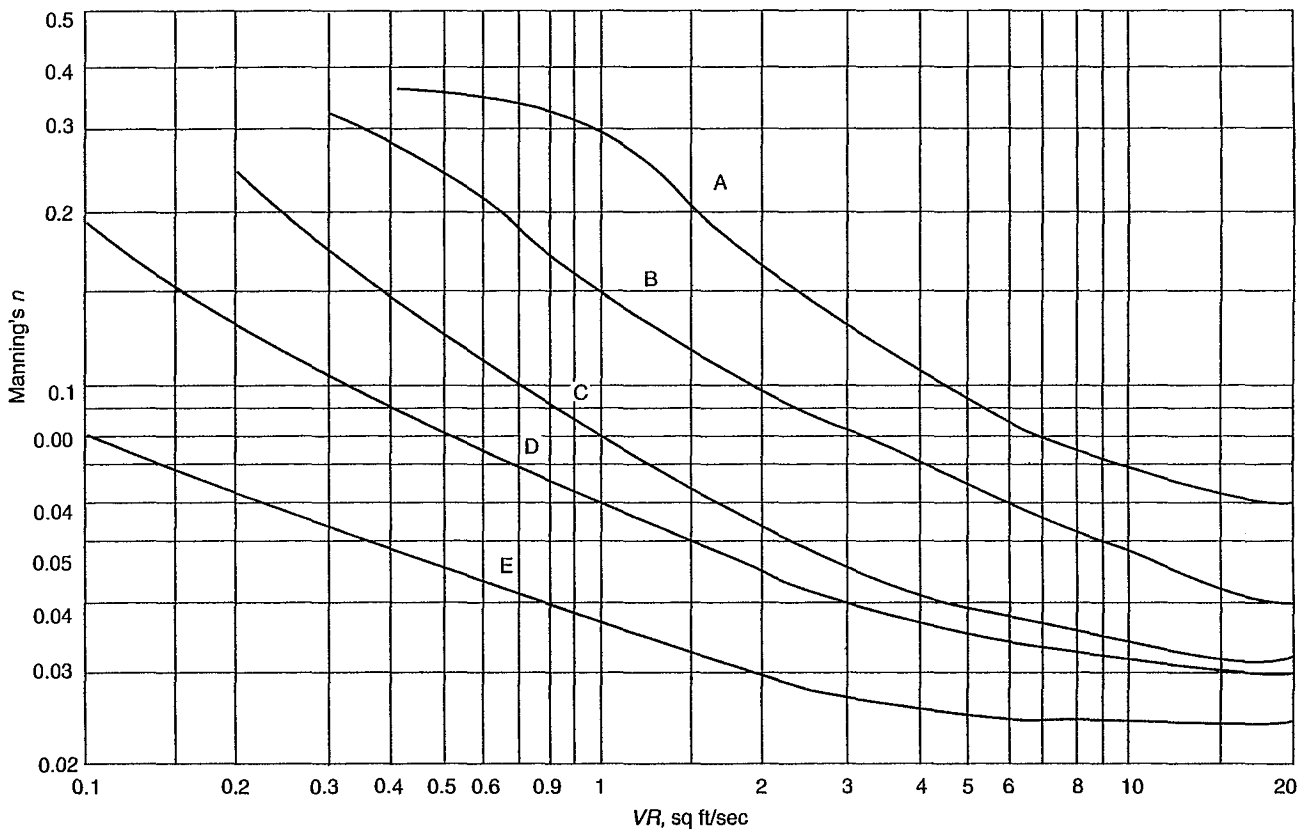


Figure 5.6 Manning's n versus VR versus degrees of flow retardance (note that VR is the product of velocity and hydraulic radius) (sq ft/sec $\times$ 0.092 9 = m^2/s).

check will ensure capacity is adequate if the largest expected event coincides with the greatest retardance). Using Manning's n selected in step D2 and the calculated channel dimensions (including freeboard), and compute the flow capacity of the channel under these conditions. If this flow capacity is less than the "stability," check design storm flow rate, increase the channel cross-sectional area as appropriate, and repeat calculations. Specify the new channel dimensions.

Completion Step. Review guidelines provided in Sections 1, 2, and 3 for biofilter planning, design, installation, and operation, and specify all appropriate features applicable for installation.

STORMWATER INFILTRATION AND PERCOLATION

Whenever site conditions permit, a portion of urban stormwater runoff can be disposed of locally through infiltration. Surface infiltration can be encouraged to occur through the use of grass buffer strips, swales, porous pavement, and dedicated infiltration basins. Stormwater runoff can also infiltrate to the ground near its origin through percolation trenches similar to those used in wastewater septic system leach fields.

Although surface infiltration has received much attention in recent years, it has long been in use and was practiced because good site drainage was lacking. The use of "inefficient" surface runoff in urban areas through the use of permeable vegetated surfaces has gained considerable but not universal acceptance in recent years.

The practice of minimizing directly connected impervious area (MDCIA) is a practice that is most appropriate for sites that are planning to have less than 60% imperviousness with relatively flat terrain. When properly designed and used, effective site drainage can still be provided. Figure 5.7 shows a comparison between traditional and MDCIA land development practices. Note that this is done by reducing the amount of directly connected impervious area, directing all roof downspouts onto lawns instead of to the curb and gutter, using stabilized road shoulders and swales, using modular block porous pavement whenever feasible, and maximizing the lengths of the surface paths leading to formal infiltration areas.

Formal on-site stormwater infiltration is accomplished through the use of infiltration basins and percolation trenches. These facilities need to be designed to also provide good surface and subsurface site drainage. On-site disposal is most successful when used to control runoff from individual building sites and small urban catchments (that is, up to 4 ha [10 ac] of single family residential and up to 2 ha [5 ac] of commercial lands).

Infiltration and percolation facilities are susceptible to early failure. Fail-

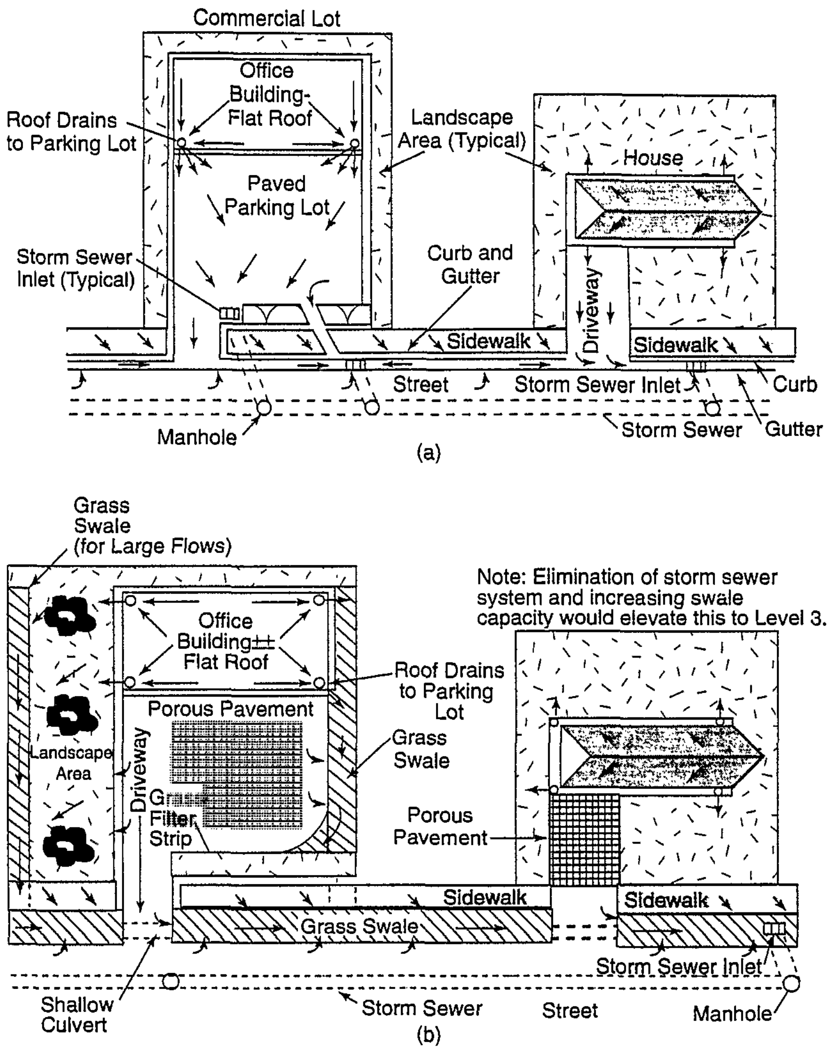


Figure 5.7 **Land development practice: (a) traditional site and street drainage design and (b) limiting directly connected impervious areas (UDFCD, 1992).**

ure is defined when stormwater no longer drains into the ground at design rates. Early signs of failure include excessively long periods of standing water on infiltrating surfaces or within percolation trenches. With failure, downstream stormwater systems and receiving waters experience increased higher runoff rates and greater volumes on a more frequent basis with corresponding pollutant loads.

Infiltration basins and percolation trenches can only be used at sites with porous soils, favorable site geology, and proper groundwater conditions. They should not be used when local institutions cannot ensure their proper installation and long-term maintenance. These infiltration basins and percolation trenches may

- Recharge groundwater,
- Reduce ground settlement in areas of groundwater depletion,
- Help to preserve and enhance local vegetation,
- Reduce pollutant loads transported to receiving waters,
- Reduce runoff volumes and peak flows, and
- Allow the use of smaller storm sewer systems.

Arguments against their use include

- Much of the surface runoff occurs from publicly owned streets and large commercial areas—infiltration and percolation facilities located on individually owned lots may have little effect on runoff rates and volumes experienced downstream;
- Infiltrating surfaces and soils seal as sediment and other solids clog soil pores, causing their failure;
- Individual infiltration and percolation facilities may not receive proper maintenance;
- Local groundwater mounding under these facilities can cause them to fail and may damage adjacent structures and flood basements;
- When they fail, they are expensive to reinstall; and
- They may degrade groundwater quality when used in certain types of industrial and commercial areas.

DESIGN CAPTURE VOLUME. The amount of urban surface runoff arriving at infiltration and percolation facilities is affected by the watershed's size and its imperviousness, local rainfall, snowmelt characteristics, and other factors such as lawn watering, car washing, and hydrant flushing. Of these, stormwater and snowmelt runoff typically are the most significant considerations for design, and the choice of a design is often dictated by local conditions or criteria. It is recommended that infiltration basins and percolation trenches be sized to handle no less than the "maximized" storm runoff volume described earlier in this chapter. Base the design volume for infiltration basins on the coefficients listed for the event capture ratio, 12-hour drain time, and the tributary catchment's runoff coefficient. Estimating the design volume for percolation trenches is somewhat more complex and is described later in this chapter.

SNOWMELT. In some locations, snowmelt can govern the size of infiltration and percolation devices, especially when the tributary catchment has little impervious area and much pervious area. Under extreme conditions, snowmelt rates can equal 4 mm (0.6 in.) of water per hour. Although it is not possible to typify snowmelt runoff rates from across the U.S., the following snowmelt rates may be used to check if snowmelt governs the size of these facilities: impervious surfaces—1.0 mm/h (0.04 in./hr), and pervious surfaces—0.5 mm/h (0.02 in./hr). Use local rates whenever available.

SURFACE INFILTRATION BASINS. Screening for Site Suitability. There are several conditions that can be used to eliminate a site for local stormwater infiltration. These include the following:

- Seasonal high groundwater is less than 1.2 m (4 ft) below the infiltrating surface;
- Bedrock or an impervious soil layer is within 1.2 m (4 ft) of the infiltrating surface;
- The infiltrating surfaces are located on top of fill or compacted soils; or
- The surface and underlying soils are Resource Conservation Service (RCS) hydrologic soil group C or D, or the saturated surface infiltration rate is less than 7.6 mm/h (0.3 in./hr).

If the above conditions do not rule out the new development as a candidate for infiltration, assess its suitability using a point evaluation system suggested by the Swedish Association of Water and Wastewater Works (1983). This assessment technique, when used properly and objectively, has been proven to be effective. It was first described in the U.S. by Urbonas and Stahre (1993) and is based on assessing various site conditions by assigning points for each category listed in Table 5.9.

A site with fewer than 20 points is considered unsuitable, while a site with more than 30 points is considered good. A site with 20 to 30 points is considered to be a fair candidate, with occasional standing water on the infiltration surfaces likely. This preliminary screening technique, however, is not a substitute for detailed site-specific engineering investigations. When the initial screening process finds the site acceptable, the infiltration surface area and the stormwater storage volume above this surface must then be determined. Note that Table 5.9 suggests that the surface area of all infiltration areas within a development (including buffer strips, lawns, and swales) be no less than one-half of the tributary impervious surface areas.

This screening procedure can best be illustrated by an example. For example, an infiltration site is to dispose of stormwater runoff from a roof having a 1.0-ha (2.5-ac) area. The site is a new lawn with a surface area of 1.0 ha (2.5 ac) and a 0.20% slope. The topsoil is normal humus, and the underlying soils are composed mostly of coarse silt. Determine if the site is suitable for infiltration.

Using the evaluation point system presented in Table 5.9, the results are as follows:

- The infiltrating area is 1.6 times larger than the impervious surface (that is, $A_{INF} = 1.6\,A_{IMP}$) = 10 points.

Table 5.9 **Point system for the evaluation of potential infiltration sites (STORMWATER—BEST MANAGEMENT PRACTICES by URBONAS/STAHRE, © 1993. Adapted by permission of Prentice-Hall, Inc., Upper Saddle River, N.J.).**

Site condition	**Evaluation points to award**
Ratio of tributary impervious area (A_{IMP}) to the infiltrating surface area (A_{INF})	
$A_{INF} > 2 \cdot A_{IMP}$ 20 points	10 points
$A_{IMP} < A_{INF} < 2 \cdot A_{IMP}$	5 points
$0.5 \cdot A_{IMP} < A_{INF} < A_{IMP}$	0 points
Urban catchments with pervious surface areas less than one-half of the impervious surfaces are poor candidates	
Surface soil layer type	
Coarse soils with low organic material content	7 points
Normal humus soil	5 points
Fine-grained soils with high ratio of organic matter	0 points
Underlying soils	
If the underlying soils are more coarse than surface soil, assign the same number of points for underlying soils as were given for the surface soil layer soils above	
If the underlying soils are finer grained than the surface soils, use the following points:	
Gravel, sand of glacial till with gravel or sand	7 points
Silty sand or loam	5 points
Fine silt or clay	0 points
Slope (S) of the infiltration basin's site	
$S < 0.007$ ft/ft (m/m)	5 points
$0.007 < S < 0.020$ ft/ft (m/m)	3 points
$S > 0.020$ m/m	0 points
Vegetation cover	
Healthy natural vegetation cover	5 points
Lawn well established	3 points
Lawn new	0 points
No vegetation, bare ground	−5 points
Degree of traffic on infiltration surface	
Limited foot traffic	5 points
Average foot traffic (park, lawn)	3 points
Much foot traffic (playing fields)	0 points

- The top soil layer is of normal humus type = 5 points.
- The underlying soil layers are coarse silt = 5 points.
- The slope of the infiltration surface is 0.002 = 5 points.
- The infiltration surface is a new established lawn = 0 points.
- The lawn is expected to have normal foot traffic = 3 points.
- The total is 28 points for this site. This site is judged to be an above-average candidate, runoff is not likely to puddle frequently, and occasional periods of standing water are likely.

Configuring a Basin. Infiltration basins need to empty through the basin's bottom within a reasonably short period. Otherwise, boggy and undesirable site conditions will occur, and the grasses lining these basins will die. Size the basin's surface area to drain the design capture volume in fewer than 6 hours. Also, design the basin with a shallow maximum ponding depth. An ideal site will not result in water ponding more than 0.3 m (1 ft) deep during the design storm, with the excess volume either overflowing or bypassing the basin. Recognize that the available soil pore volume will amplify each 0.3 m (1 ft) of ponding depth into 0.9 to 1.2 m (3 to 4 ft) of groundwater depth under the basin, which water column then needs to drain off laterally.

There is a strong possibility that unless the underlying soils have high hydraulic conductivity, it will take few runoff events to create a groundwater mound under a basin. In many soils, groundwater mounding drains off laterally slowly and can surface, causing a failure. These failures can be reduced if the development's infiltration is distributed uniformly throughout the development site. Using many infiltration basins distributed throughout the development tends to more closely reproduce the predevelopment condition. Thus, instead of concentrating all site runoff at one infiltration basin, it is better to install many small infiltration basins throughout the development site. Try to fit them into the landscape, even into individual residential or commercial lots.

Vegetate all infiltrating surfaces with grasses that can withstand and survive prolonged periods of inundation, followed by extended dry periods. Healthy vegetation is essential—without it, the surface soil pores quickly seal. Grass roots are needed to reopen them and will help to do so even when considerable deposition of silt has occurred. Eventually, the deposited sediment layer and old grass will need to be removed, the soils rehabilitated, and the basin revegetated.

Sizing Infiltration Basins. An infiltration basin cannot transfer stormwater to the ground as rapidly as stormwater arrives at the basin. As a result, a detention volume is needed above all infiltration surfaces to temporarily store this excess runoff. Table 5.10 contains a list of the infiltration rates for several typical soil groups. It is best, however, to perform several surface infiltration tests at each site and use an average of several of the lowest measured infiltration rates for design purposes. It is also important to recognize that as

Table 5.10 Typical infiltration rates of various soil groups.

Soil conservation service group	Typical soil type	Saturated infiltration rate mm/h	Saturated infiltration rate in./hr
A	Sand	200	8.0
A	Loamy sand	50	2.0
B	Sandy loam	25	1.0
B	Loam	12.7[a]	0.5[a]
C	Silt loam	6.3[a]	0.25[a]
C	Sandy clay loam	3.8	0.15
D	Clay loam and silty clay loam	<2.3	<0.09
D	Clay	<1.3	<0.05

[a] Minimum acceptable infiltration rate is 7.6 mm/h (0.3 in./hr). Sites with soils with lesser rates should not be used.

sediment accumulates on the basin's bottom, the effective infiltration rate will be governed by the sediment layer, which in turn will be affected by the presence or absence of a healthy grass surface. For this reason, it is suggested that when local soils exhibit high surface infiltration rates, the basin's design be based on infiltration rates that do not exceed 50 mm/h (2.0 in./hr). At the same time, when native soils have infiltration rates less than 50 mm/h (2 in./hr), the designer should consider using a somewhat reduced rate to account for the fact that soil infiltration rates will decline as sediment builds up on the bottom of the basin.

The detention volume of an infiltration basin is found using Equation 5.2. Use the "maximized" stormwater capture volume based on a 12-hour drain time. Next, estimate the basin's surface area using a maximum detention depth of 0.3 m (1 ft). The known soil's infiltration rate is then multiplied by the basin's surface area to find the exfiltration rate. Ascertain that the detention volume will drain in 6 hours or fewer. If it does not, increase the surface area until the volume drains in fewer than 6 hours. Last, check if the basin area has to be increased to handle snowmelt.

For example, use a 2.22-ha (5.5-ac) catchment in Minneapolis, Minnesota, located on sandy loam soils with saturated infiltration rate of 25 mm/h (1.0 in./hr). The catchment is 44% impervious (that is, runoff coefficient $C = 0.3$).

Using Equation 5.2 and Table 5.4, the "maximized" volume for a detention basin with a 12-hour drain time is

$$P_0 = 1.109 \times 0.5 \times 0.3 = 4.2 \text{ mm (0.166 watershed in.)}$$

The design volume then is

$$V_{WQ} = (0.166 \div 12) \times 5.5 = 0.076 \text{ ac-ft} = 94 \text{ m}^3 \text{ (3 320 cu ft)}$$

Limiting the ponding depth to 0.3 m (1 ft) establishes the basin's surface area at 308 m^3 (3 320 sq ft). The total exfiltration rate then is

$$Q_{out} = (3\,320 \times 1.0 \div 12) = 7.8\ m^3/h\ (277\ cu\ ft/hr)$$

This exfiltration rate will empty the design volume in 12 hours. Doubling the basin's surface area to 716 m^2 (6 640 sq ft) will empty the design volume in 6 hours at a rate of 15.7 m^3/h (554 cu ft/hr). Note that the resultant basin area occupies almost 3% of the total catchment area.

Next, check to see if the basin will handle prolonged snowmelt periods without overtopping. Using the snowmelt rates listed previously, we find the snowmelt rate for the site is 0.71 mm/h (0.028 in./hr), equal to a 15.8-m^3/h (55-cu ft/hr) runoff rate. This is virtually identical to the design rate of 15.7 m^3/h (554 cu ft/hr), and further adjustment to the basin's size is not justified.

PERCOLATION TRENCHES. Assessing a Site for Suitability. Darcy's law provides a basis for estimating the rate at which water can percolate into the ground through the sides of a percolation trench. It is expressed as Equation 5.4 and forms a basis for judging whether a site is suitable for the installation of a percolation trench:

$$U = k \cdot I \tag{5.4}$$

Where

U = flow velocity, m/s;
k = hydraulic conductivity, m/s; and
I = hydraulic gradient, m/m.

Because the bottom of the facility is above the high seasonal groundwater, assume the hydraulic gradient to be $I = 1.0$. Determine the hydraulic conductivity of the soils adjacent to the percolation trench. Table 5.11 lists ranges in hydraulic conductivity for a variety of typically found soil types. Note that conductivities can vary four orders of magnitude for a single soil group. It is best to perform several site-specific hydraulic conductivity tests and use the

Table 5.11 Hydraulic conductivity of five soil types.

Soil type	Hydraulic conductivity ft/sec	Hydraulic conductivity m/s
Gravel	3.3×10^{-3}–3.3×10^{-1}	10^{-3}–10^{-1}
Sand[a]	3.3×10^{-5}–3.3×10^{-2}	10^{-5}–10^{-2}
Silt	3.3×10^{-9}–3.3×10^{-5}	10^{-9}–10^{-5}
Clay (saturated)	$<3.3 \times 10^{-9}$	$<10^{-9}$
Till	3.3×10^{-10}–3.3×10^{-6}	10^{-10}–10^{-6}

[a] Minimum acceptable hydraulic conductivity for stormwater percolation is 2.0×10^{-5} m/s (6.5×10^{-5} ft/sec).

lowest field measured *in situ* hydraulic conductivities for final design purposes. Even under ideal conditions, soils adjacent to the trench will clog with time. A percolation trench is expensive to construct and more expensive to rebuild. Thus, being conservative in its design is appropriate.

The same factors, except for the use of soil hydraulic conductivity, affect site suitability for a percolation facility as affect a surface infiltration basin. Thus, if the following conditions are discovered or are likely to be at the site, disposal of stormwater by percolation is not recommended:

- Seasonal high groundwater is less than 1.2 m (4 ft) below the bottom of the percolation trench;
- Bedrock or impervious soils are within 1.2 m (4 ft) of the bottom of the percolation trench;
- The percolation trench is located within or on top of fill or recompacted soils; or
- The soils adjacent to the trench are RCS hydrologic group C or D or the field saturated hydraulic conductivity of the soils is less than 2.0×10^{-5} m/s (6.5×10^{-5} ft/sec).

If the above conditions do not rule out the site, the Swedish Association of Water and Wastewater Works (1983) provides design recommendations. This procedure is described by Urbonas and Stahre (1993).

Configuring a Percolation Trench. Percolation trench design uses the pore volume of trench fill media as the detention volume. Table 5.12 lists the porosity of the more typical trench fill materials. The bottoms of these trenches tend to clog first, often shortly after installation. As a result, the bottom of the trench is considered impervious and all water is assumed to percolate out only through its walls. Typically, long and deep trenches are most efficient and require the least amount of porous media. The maximum trench depth is limited by trench-wall stability, seasonal high groundwater levels, and the depth to any impervious soil layer. Trenches 1 m (3 ft) wide and 1 to 2 m (3 to 6 ft) deep seem to be most efficient.

If a percolation trench cannot be made sufficiently large to empty its fully available water storage volume (that is, granular media pore space volume)

Table 5.12 Porosity of commonly used granular materials.

Material	Effective porosity, %
Crushed and blasted rock	30
Uniform sized gravel	40
Graded gravel, 2.0 cm (0.75 in.)	30
Sand	25
Pit run gravel	15–25

within a 24-hour period, it is recommended that a collector pipe be installed near its bottom and the stored water be released slowly through a flow controller (that is, choked outlet). The outlet is designed to supplement the percolation outflow so that both combine to empty out the trench-full volume in 24 hours. This type of installation behaves, in part, like a detention basin.

Most important for percolation trench longevity is to filter all the stormwater entering the trench through a sand layer. Percolation trenches should not be used without first filtering its inflow or if these filter systems will not be adequately maintained. If stormwater is permitted to enter the trench without first being filtered, pore media and adjacent soils will seal with time and the facility will fail.

Figure 5.8 illustrates a percolation trench with a surface sand filter layer

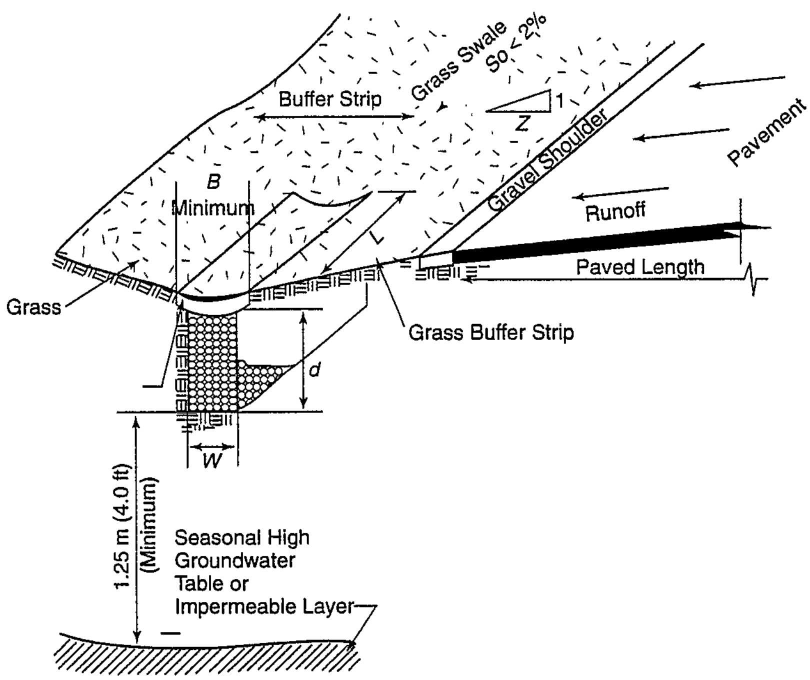


Figure 5.8 **A percolation trench with a sand filter layer for surface inflow (STORMWATER: BEST MANAGEMENT PRACTICES BY URBONAS/STAHRE, © 1993. Adapted by permission of Prentice-Hall, Inc., Upper Saddle River, N.J.). (Notes: Wrap all rock fill in geotextile fabric with coarse pores; buffer strip length > 25% paved length; length $L \leq K/(So/100)$ in which K = 0.3 m (1 ft) and So = slope, %; add trenches as needed to obtain required total length for infiltration; side slope $Z \geq 4.0$; sand or sand–turf filter layer surface area shall be sized to permit inflow to the trench with minimum of ponding; create ponding on sand–turf layer using a berm across the swale; $B > 2d$.)**

on top. This sand filter layer has to have sufficient surface area to permit stormwater to enter the trench with minimal ponding above it. However, some ponding volume will be needed above the sand filter to buffer higher rates of runoff. Such a sand surface filter layer can be a modular porous pavement. Other filter configurations are possible, including inlets with geotextile filter bags within them (Urbonas and Stahre, 1993). All filter devices will need aggressive routine maintenance for acceptable operation.

Unlike the surface infiltration facilities, failure of a percolation trench can be unnoticed for long periods of time because the trench is out of sight. A routine inspection program is needed to discover failed percolation trenches. It is unlikely that someone will randomly observe and report a trench failure during storm periods. One or more observation wells should be provided to facilitate inspections. A record of water in the trench not draining within 2 days after a wet period ends can indicate incipient failure and should be investigated.

Sizing a Percolation Trench. Because a percolation trench is used to limit runoff from a small catchment, rational formula (Equation 5.5) may be used for its design:

$$Q = K_u \cdot C \cdot I_t \cdot A \tag{5.5}$$

Where

Q = average runoff rate for the storm duration t, m^3/s (cu ft/sec);
K_u = unit conversion factor, 1.0 for U.S. standard units (36 for the International System of Units);
C = runoff coefficient, nondimensional;
I_t = rainfall intensity for the design storm at the storm duration t, mm/h (in./hr); and
A = area of the tributary watershed, ha (ac).

Multiplying the average runoff rate, Q, by the design storm's duration, t, results in Equation 5.6, which gives the cumulative runoff volume over time t:

$$V_{\text{in}}(t) = K \cdot 3\,600 \cdot C \cdot \frac{I_t}{1\,000} \cdot t \cdot A \tag{5.6}$$

Where

$V_{\text{in}}(t)$ = total volume of *inflow* over storm duration t, m^3 (cu ft); and
t = storm duration, hour.

Because the water depth in the trench varies during storm runoff, the sides of a percolation trench are not fully inundated during the runoff event. To simplify the sizing process, the designer can assume that the average outflow rate is the result of one-half of the trench depth being inundated. This then allows the designer to find the average effective area of percolation. Also, assume the hydraulic gradient, I, equals 1.0. Thus, Equation 5.7 is derived from

Darcy's law (that is, Equation 5.4):

$$V_{out}(t) = 3\,600 \cdot k \cdot (A_{perc} \div 2) \cdot t \tag{5.7}$$

Where

$V_{out}(t)$ = total volume of water percolated into the ground over time t, m^3;
k = hydraulic conductivity of the soil, m/s (ft/sec);
A_{perc} = total area of the sides of the percolation trench, m^2 (sq ft);
t = duration of the percolation time, hour.

The maximum volume of water stored, V, in the trench is the difference between $V_{in}(t)$ and $V_{out}(t)$, as expressed by Equation 5.8:

$$V = \max\,[V_{in}\,(t) - V_{out}\,(t)] \tag{5.8}$$

Thus, Equation 5.9 is derived by combining Equations 5.5 and 5.7 into Equation 5.8:

$$V = \max\,[3\,600 \cdot K_u \cdot I_t \cdot C \cdot A \cdot t - 1\,800 \cdot k \cdot A_{perc} \cdot t] \tag{5.9}$$

Configure the trench to drain the "maximized" storm volume discussed earlier in the chapter. First, find this volume using Equation 5.2 for the 12-hour drain time and a runoff coefficient $C = 1.0$. The trench is designed to dispose of the runoff from such a storm through percolation through the sides. Because the detention time in the trench is not the issue for water quality enhancement, the maximized depth is used to define the intensity-duration function of a design storm by assuming this rainfall depth occurs within 1 hour.

The next step is to select a cross section for the trench and the type of fill material. Assume a trench length and test it for adequacy. Eventually, through a trial-and-error process, the assumed trench length agrees with the calculated one. This procedure can be reduced to a spreadsheet to facilitate the iterative solution. Figure 5.9 presents an example of such a spreadsheet. After the known parameters are entered, the iterative process begins by entering an assumed trench length and calculating the "needed trench length." New "assumed length" values are entered until a balance is achieved between the "assumed" and "needed" lengths. In this example (that is, Figure 5.8) the needed trench length was found to be 44 m (144 ft).

OTHER INFILTRATION FACILITIES. Buffer Strips and Swales. The design for buffer strips and swales is described earlier in this chapter. Both buffer strips and swales can infiltrate stormwater to the ground. However, the duration of time that runoff actually is in contact with these surfaces is relatively short, and, as a result, the volume of infiltration is limited. Nevertheless, buffer strips and swales can infiltrate significant fractions of the smaller runoff events when they are located on porous soils. Their use is encouraged, Project Title: Percolation Trench Sizing

Tributary Catchment Area [A]:	**5.50** ac
Percent Impervious:	**44.0%**
Runoff Coefficient [$C = 0.858\ i\hat{}3 - 0.78\ i\hat{}2 + 0.774\ i + 0.04$]:	0.30
Maximized Rainfall Depth ($I_{1\text{-hour}}$); *C = 1.0 and 12-hour down time:*	**0.50** in.
Soil's Hydraulic Conductivity:	**0.001** ft/sec
Trench Width (W):	**3.00** ft
Height (H):	**6.00** ft
Assumed Length (L):	***144.0*** ft (trial length)*
Hydraulic Gradient:	**1.00**
Average Percolation Outflow Rate {$Q_{out} = kH(L + W)$}:	0.882 cu ft/sec
Rock Media Porosity (p):	**0.35**

Note: All values in bold typeface are user input values.

Rainfall Intensity I-D Curve Value at Duration T: $I = \{a*I_{1\text{-hour}}/(T + b)\hat{}c\}$

Local Coefficient a = **28.5** b = **10.00**

c = **0.786**

Storm duration, min.	Rainfall intensity, in./hr	Runoff volume, cu ft	Outflow volume, cu ft	Volume stored, cu ft	Needed trench volume, cu ft	Needed trench length, ft
T (1)	I (2)	$60\ CIAT$ (3)	$60\ Q_{out}\ T$ (4)	(3)–(4) (5)	(5)/p (6)	(6)/(WH) (7)
0.0	2.33	0	0	0	0	0
10.0	1.35	1 351	529	822	2 348	130
20.0	0.98	1 965	1 058	906	2 589	144*
30.0	0.78	2 350	1 588	763	2 180	121
40.0	0.66	2 630	2 117	513	1 466	81
50.0	0.57	2 848	2 646	202	578	32
60.0	0.51	3 028	3 175	−147	−421	−23
70.0	0.45	3 181	3 704	−524	−1 496	−83
80.0	0.41	3 314	4 234	−920	−2 628	−146
90.0	0.38	3 432	4 763	−1 331	−3 803	−211
100.0	0.35	3 538	5 292	−1 754	−5 012	−278
120.0	0.31	3 723	6 350	−2 628	−7 507	−417
150.0	0.26	3 953	7 938	−3 985	−11 386	−633
180.0	0.23	4 144	9 526	−5 382	−15 376	−854
210.0	0.21	4 309	11 113	−6 805	−19 442	−1 080
240.0	0.19	4 453	12 701	−8 247	−23 564	−1 309
300.0	0.16	4 701	15 876	−11 175	−31 929	−1 774
360.0	0.14	4 909	19 051	−14 143	−40 408	−2 245
420.0	0.12	5 089	22 226	−17 138	−48 965	−2 720
480.0	0.11	5 248	25 402	−20 154	−57 581	−3 199
540.0	0.10	5 392	28 577	−23 185	−66 243	−3 680
600.0	0.09	5 523	31 752	−26 229	−74 941	−4 163
660.0	0.09	5 643	34 927	−29 284	−83 669	−4 648
720.0	0.08	5 755	38 102	−32 348	−92 422	−5 135
840.0	0.07	5 957	44 453	−38 496	−109 989	−6 110
960.0	0.06	6 137	50 803	−44 667	−127 619	−7 090

* Needed Trench Length Matches Assumed Length

Figure 5.9 Example rational formula method for percolation trench sizing.

and they add to the treatment train as stormwater runoff migrates from its origin to the receiving waters.

Porous Pavement. When properly designed and operating, porous pavement can infiltrate, or otherwise treat, the runoff from 70 to 90% of all storm events. It, in effect, reduces the amount of directly connected impervious surface within a catchment.

There are three types of porous pavement: porous asphalt pavement, porous concrete pavement, and modular porous concrete block. Porous asphalt and concrete are constructed similarly to a conventional pavement, except sand and finer fraction of the aggregate are left out of the pavement mix. Such pavement typically is placed on top of a layer of granular base. The modular block pavement is constructed by placing the blocks over a layer of coarse gravel, which in turn is located on a porous geotextile fabric layer.

Whenever the porous pavement is expected to provide local disposal, the seasonal high groundwater and bedrock needs to be at least 0.9 m (3 ft) below the pavement's bottom. Typical porous pavement cross sections are illustrated in Figure 5.10. When the underlying soils, groundwater depth, or bedrock do not qualify the site for stormwater infiltration, porous pavement can be designed to be an underground detention facility. This can be done by installing an impermeable membrane between coarse rock media and the native soil subgrade. The granular base is then drained with the aid of perforated pipes installed at 3- to 8-m (10- to 25-ft) intervals. The release rate is controlled by a flow regulator, such as an orifice, which is designed to empty the pore storage volume within 6 to 12 hours.

Urbonas and Stahre (1993), after discussions with a number of public works departments, concluded that porous concrete and asphalt pavements have a tendency to seal and clog within 1 to 3 years. Also, faster sealing rates were reported in areas where extensive winter salting and sanding occur. One notable exception to surface clogging reports were the concrete pavement installations in the state of Florida (U.S.). Concrete and asphalt pavements need vigorous maintenance and the use of high-power vacuuming, though even then they seem to eventually seal. After sealed, this type of pavement has to be replaced.

Interlocking cellular concrete block pavement seems to seal at a slower rate than concrete and asphalt porous pavement and has a good record of service under a wide range of climatic conditions. After being sealed, the open spaces of modular blocks can be cleaned out by removing the vegetated soil or the sand layer and replacing it with fresh material. Individual blocks can settle and become misaligned, however, and this type of pavement is best suited for nontraffic areas such as parking pads and for overflow parking areas in sport event complexes, shopping centers, churches, and schools.

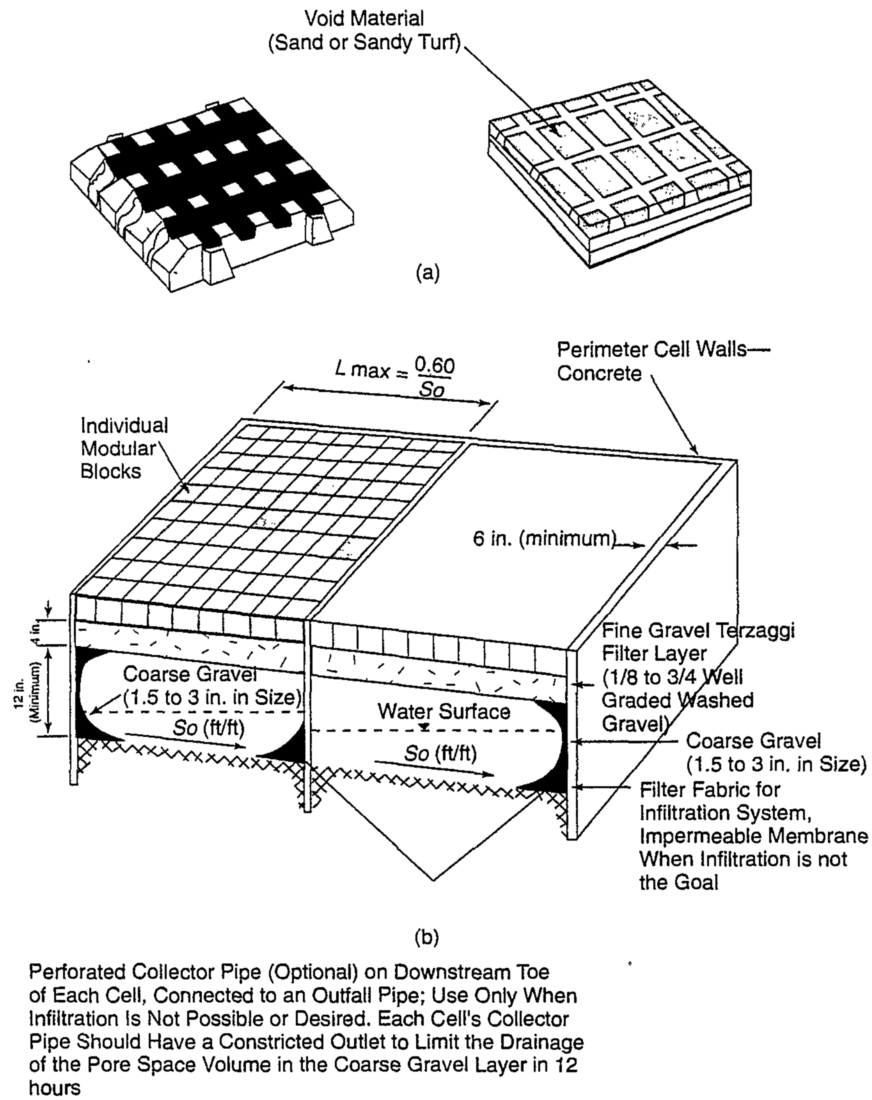


Figure 5.10 **Typical cross sections of porous pavement: (a) two examples of individual concrete modular paving block and (b) perspective of side-by-side modular block cells (ft × 0.304 8 = m; in. × 25.4 = mm).**

EXTENDED DETENTION (DRY) BASINS

Detention of urban stormwater runoff began to appear as an urban stormwater management practice in the early 1970s in North America, Europe, and

Australia to control runoff peaks from new land development sites. This was initially applied to control the 10-, 25-, 50-, or 100-year flow rates. By the mid- and late-1970s, Ontario (Canada) and the state of Maryland (U.S.) mandated detention to control the 2-year peak flow rate for stream bank erosion control purposes (with little success, as was determined later). The use of detention to control stormwater quality began to be used in the early 1980s. By the late 1980s, sufficient empirical data were available to design extended detention basins (that is, dry detention basins) for water quality purposes with reasonable confidence in their performance. Extended detention basins are best at removing suspended constituents. They are not particularly effective in removing solubles. Also, removal rates of solids by retention ponds tend to outperform detention basins. A comparison of constituent removal efficiencies of extended detention basins and retention ponds is described later in this chapter.

SIZING DETENTION BASINS. Using the Maximized Volume. There are several ways to size an extended detention basin. The simplest and most direct way for smaller catchments serving up to approximately 1.0 km^2 (0.6 sq mile) is to use the maximized volume described earlier in this chapter. The volume may be found for locations in the U.S. for basins emptying their entire volume in 24 and 48 hours. If one wishes to use another emptying time, simply interpolate between the results found using the 24- and 48-hour time. It is suggested that the event-capture-ratio–based coefficients in Table 5.4 be used with Equation 5.2 instead of the volume capture ratio coefficients.

The emptying, or drain, time is chosen by the designer or dictated by local authorities. Longer emptying times produce somewhat better removal rates of suspended solids. However, longer drain times tend to produce less attractive facilities, ones that have little or no vegetation on the bottom. Facilities with long emptying times have "boggy" bottoms with marshy vegetation and can be difficult to maintain and clean.

Using Hydrograph Routing. For detention basins that serve areas larger than 1.0 km^2 (0.6 sq mile), the volume can be found using a reservoir routing method. Again, it is recommended that the maximized storm depth be used. It has to be first converted to a design hyetograph, however, to simulate a runoff hydrograph. How this is done will be dictated by the typical design storm temporal distribution in use within the region where the facility is located. It is suggested, however, that the maximized depth be redistributed into a 2-hour design storm hyetograph.

The goal of reservoir routing is to balance inflow rates against outflow rates to find the needed volume. This is accomplished by solving Equation 5.9 with numerical methods or using one of the many available computer programs written for this purpose (see Chapter 3). Referring to Figure 5.11, Equation 5.10 states that the needed storage volume is a time integral of the difference between inflow and outflow hydrographs from the beginning of

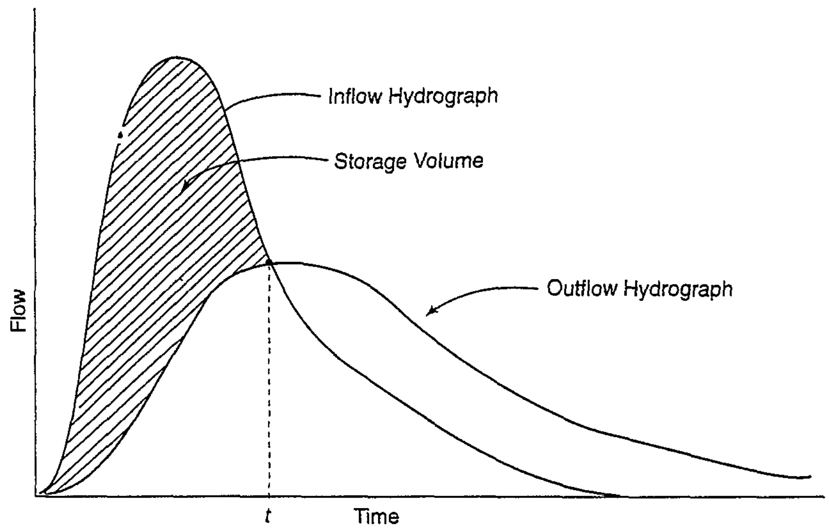


Figure 5.11 Routing a hydrograph through a detention basin.

storm runoff to the point in time where the outflow rate exceeds the inflow rate:

$$V_{max} = \int_0^t (Q_{in} - Q_{out})\, dt \qquad (5.10)$$

Where

V_{max} = storage volume,
t = time from beginning of runoff to a point of maximum storage,
Q_{in} = Q_{out} on hydrograph recession limb,
Q_{in} = inflow rate, and
Q_{out} = outflow rate.

CONFIGURING AN EXTENDED DETENTION BASIN. In configuring an extended detention basin, try to make these facilities an integral part of the community. Consider multiple uses, aesthetics, safety, and the way the facility will fit into the urban landscape. Also, maintainability is an important consideration. Although these basins provide passive treatment with no operational attention, continued successful performance will depend on good maintenance. Always provide adequate maintenance access.

Figure 5.12 shows an idealized layout for an extended detention basin. The individuality of each on-site or regional facility and its place within the urban community make it incumbent on the designer to seek out local input, identify site constraints, identify the community's concerns, and consider a wide array of possibilities during design.

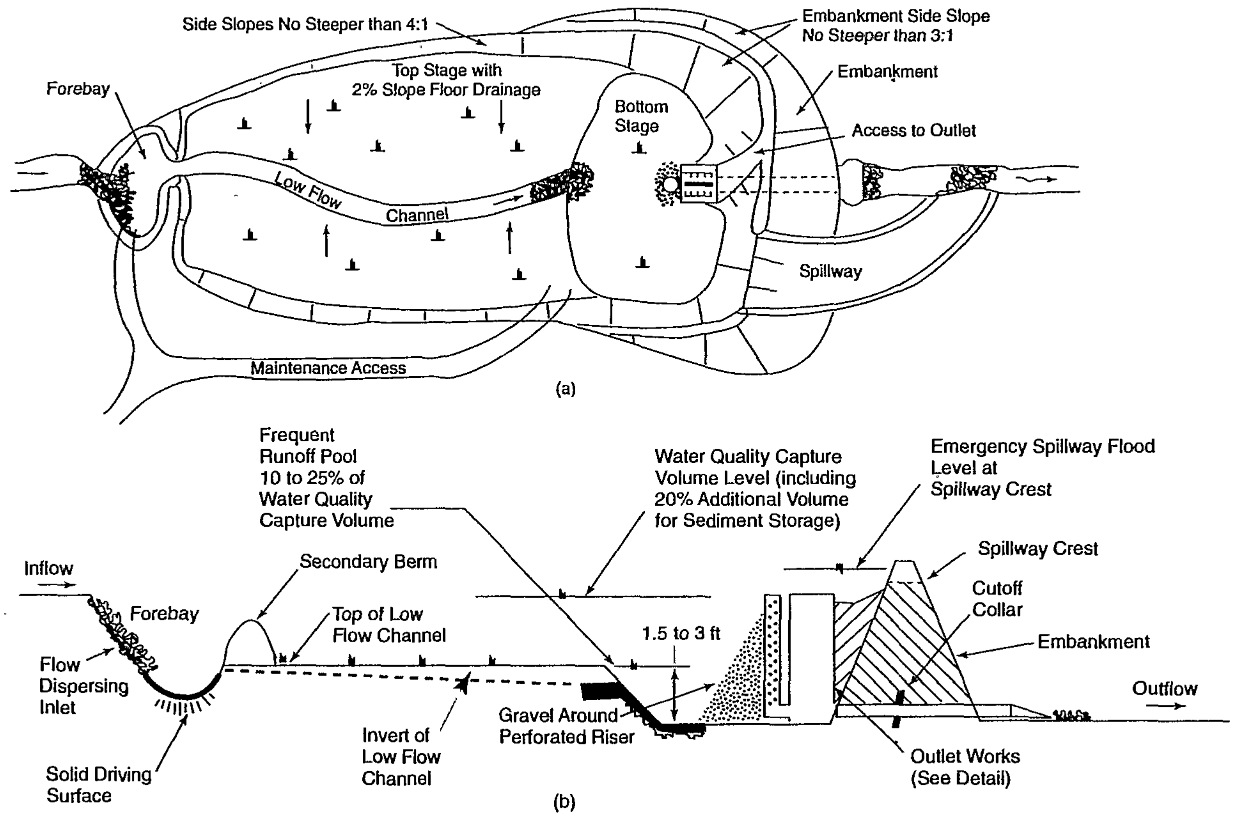


Figure 5.12 **An idealized extended detention basin: (a) plan (not to scale) and (b) section (not to scale) (ft × 0.304 8 = m) (UDFCD, 1992).**

Storage Volume. Provide a storage volume, sometimes called capture volume, equal to the maximized volume described earlier. Add 20% to this volume to provide for sediment accumulation. Randall *et al.* (1982) and Whipple and Hunter (1981) suggest that such detention basins be designed to promote sedimentation of small particles, namely smaller than 60 microns in size, which account for approximately 80% of the suspended sediment mass found in stormwater (Urbonas and Stahre, 1993).

Provide an outlet to empty less than 50% of the design volume in the first one-third of the design emptying period (that is, 12 to 16 hours). This ensures that small runoff events will be detained to remove small suspended solids. The particles, as they settle in a water column, concentrate at the lower levels of the temporary pond. It is this layer that drains through the bottom outlet of a detention basin. A long emptying time–thus the term extended detention–permits smaller particles to attach to the bottom of the basin and become trapped.

Flood Control Storage. Whenever feasible, try to incorporate the extended detention basin within a larger flood control facility. The designer may want to consider combining water quality and flood control functions in a single detention basin.

Basin Geometry. The basin should gradually expand from the inlet and contract toward the outlet to reduce short circuiting. Provide a length-to-width ratio of two or greater, preferably up to a ratio of four.

Two-Stage Design. Whenever feasible, provide a two-stage basin. The lower portion has a micropool that fills often. This reduces the periods of standing water and sediment deposition in the remainder of the basin. The top stage should be 0.6 to 1.8 m (2 to 6 ft) deep, its bottom sloping at approximately 2% toward a low-flow channel. The bottom pool can be 0.5 to 0.9 m (1.5 to 3 ft) deeper and should be able to store 15 to 25% of the capture volume. These recommendations do not necessarily apply to large, regional extended detention basins.

Basin Side Slopes. Basin side slopes need to be stable under saturated soil conditions. They also need to be sufficiently gentle to limit rill erosion, facilitate maintenance, and address the safety issue of individuals falling in when the basin is full of water. Side slopes of 4:1 and flatter provide well for these concerns.

Forebay. Design the basin to encourage sediment deposition to occur near the point of inflow. A forebay with a volume equal to approximately 10% of the total design volume can help with the maintenance of the basin, and the service life of the remainder of the basin can be extended. Equip it with a stabilized access and a concrete or soil cement lined bottom to prevent mechanical equipment from sinking to the bottom.

Basin Inlet. Most erosion and sediment deposition occurs near the inlet. An ideal inflow structure will convey stormwater to the basin while preventing erosion of the basin's bottom and banks, reducing resuspension of previously deposited sediment and facilitating deposition of heaviest sediment near the inlet. With several compromises, many of these design goals can be nearly achieved. Inflow structures can be drop manholes, rundown chutes with an energy dissipator near the bottom, a baffle chute, a pipe with an impact basin, or one of the many other types of diffusing devices.

Low-Flow Channel. Provide a low-flow channel to convey trickle flows and the last of the captured volume to the outlet.

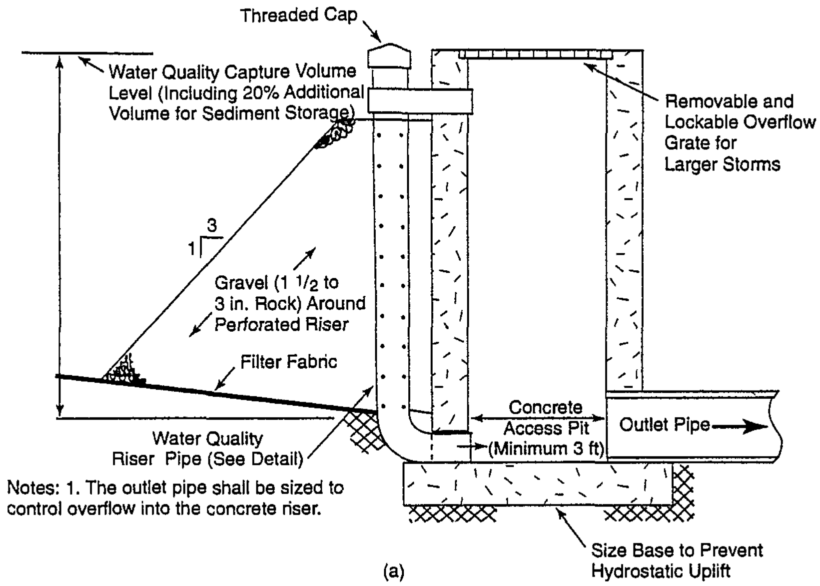
Outlet Design. Use an outlet capable of slowly releasing the design capture volume over the design emptying time. One example is a perforated riser, illustrated in Figure 5.13. Another arrangement of an outlet was suggested by Schueler *et al.* (1992), namely, a hooded perforated riser located in a small permanent pool (that is, a micropool).

Because extended detention basins are designed to encourage sediment deposition and urban stormwater has substantial quantities of settleable and floatable solids, basin outlets are prone to being clogged. This can make the design of reliable outlet structures for extended detention basins difficult. A clogged outlet will invalidate the hydraulic function of even the best design.

ASCE (1985), ASCE (1992), DeGroot (1982), Roesner *et al.* (1989), Schueler (1987), Schueler *et al.* (1992), Urbonas and Roesner (Eds.) (1986), and Urbonas and Stahre (1993) reported many reasons for outlet problems, which include clogging by trash and debris, silting in of the outlet, damage by vandalism, children plugging an outlet, and other factors that modify its discharge characteristics. Each outlet has to be designed with clogging, vandalism, maintenance, aesthetics, and safety in mind.

Trash Rack. If the outlet is not protected by a gravel pack, as shown in Figure 5.13, provide some form of a trash rack. Never wrap a perforated outlet in a geotextile filter cloth that will seal quickly. Figure 5.14 is a chart that provides simple, empirically based guidance for minimum sizes of trash racks for detention outlets.

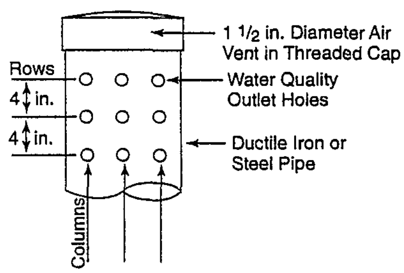
Dam Embankment. Design and build the dam embankment so that it will not fail during storms larger than the water quality design storm. Provide an emergency spillway or design the embankment to withstand overtopping commensurate with the size of the embankment, the volume of water that can be stored behind it, and the potential of downstream damages or loss of life if the embankment fails. Emergency spillway designs vary widely with local regulations. Embankments for small on-site basins should be protected from at least the 100-year flood, while the larger facilities should be evaluated for the probable maximum flood. Always consult the state's dam regulatory agency.



Notes: 1. The outlet pipe shall be sized to control overflow into the concrete riser.

(a)

Notes 1. Minimum number of holes = 8.
2. Minimum hole diameter = 1/8 in. diameter.



Maximum Number of Perforated Columns				
Riser Diameter, in.	Hole Diameter, in.			
	1/4 in.	1/2 in.	3/4 in.	1 in.
4	8	8	±	±
6	12	12	9	±
8	16	16	12	8
10	20	20	14	10
12	24	24	18	12

Hole Diameter, in.	Area of Hole, sq in.
1/8	0.013
1/4	0.049
3/8	0.110
1/2	0.196
5/8	0.307
3/4	0.442
7/8	0.601
1	0.785

(b)

Figure 5.13 An example of a perforated riser outlet: (a) outlet works (not to scale) and (b) water quality riser pipe (not to scale) (ft × 0.304 8 = m; in. × 25.4 = mm) (UDFCD, 1992).

Embankment slopes should be no steeper than 3:1, preferably 4:1 or flatter. They also need to be planted with turf-forming grasses. Embankment soils should be compacted to 95% of their maximum density at optimum moisture.

Vegetation. A basin's vegetation provides erosion control and enhances sediment entrapment. The basin can be planted with native grasses or with ir-

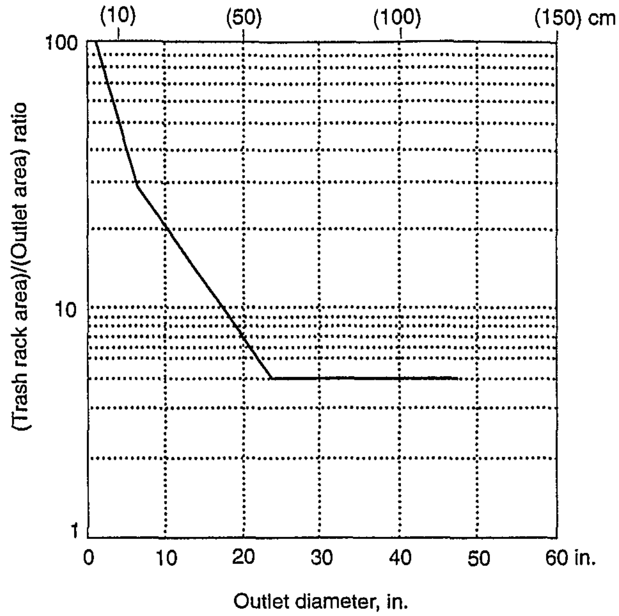


Figure 5.14 **Minimum size of a trash rack versus outlet diameter (note: trash rack area is the net area of all openings between bars, rock packing, and so on) (in. × 25.4 = mm) (UDFCD, 1992).**

rigated turf, depending on the local setting, basin design, and its intended other uses (such as recreation). Sediment deposition, along with frequent and prolonged periods of inundation, make it difficult to maintain healthy grass cover on the basin's bottom. Options for an alternative bottom liner include a marshy wetland bottom, bog, layer of gravel, riparian shrub, bare soil, low-weed species, or other type that can survive the conditions found on the bottom of the basin.

Maintenance Access. Provide for vehicular maintenance access to the forebay and the outlet areas with grades that do not exceed 8 to 10% and have a stable surface of gravel-stabilized turf, a layer of rock, or concrete pavement.

Multiple Uses. Whenever desirable and feasible, incorporate the water quality basin within a larger flood control facility. Also, whenever possible, provide for other uses such as active or passive recreation, wildlife habitat, or wetland. The use of a multiple-stage basin design described earlier can help accommodate multiple uses. The area within an extended detention basin is not well suited for active recreation such as playing fields. These are best located above an extended detention basin's pool level.

Aesthetics. Aesthetics are what the public uses to judge how "successful" or "useful" a detention basin is within the community. Although there are examples of unattractive basins, most new facilities are tastefully integrated to the neighborhood. Aesthetics are important. Using a landscape architect to assist with the design should be considered.

Safety. For larger on-site basins and regional facilities, safety has to also include the structural integrity of the water impounding embankment. As discussed earlier, the embankment should be protected from catastrophic failure. In the U.S., dam failure is almost always judged as an absolute liability of its owner. Always consider this principle of common law when designing detention facilities.

When the facility is in operation, safety concerns need to focus on flow velocities, water depths, and keeping the public from being exposed to high-hazard areas. During dry weather periods, safety is enhanced by reducing the use of high vertical walls and steep side slopes. Outlets and inflow structures and adjacent areas require special attention, and ASCE (1985) suggests the use of thorny shrubs and trash/safety racks at all outlet orifices, pipes, and weirs.

SUMMARY AND CONCLUSIONS. Extended detention basins are viable and effective treatment facilities. When properly designed, reductions of approximately 70% are possible in the total suspended sediment load and of constituents associated with these sediments. Regional facilities often offer economies of scale and greater reliability in capturing stormwater when they are used, while on-site facilities offer institutional and fiscal advantages of implementation as the land is urbanized.

RETENTION PONDS (WET)

A retention pond is a small artificial lake with emergent wetland vegetation around the perimeter, designed to remove pollutants from stormwater. This BMP is also sometimes called a "wet pond" or a "wet detention basin." This manual refers to it as a retention pond to distinguish it from the extended detention basin described in the previous section. A retention pond often is sized to remove nutrients and dissolved constituents, while any pool that may be associated with an extended detention basin is smaller and is provided for aesthetics, for example, to cover solids-settling areas.

Features of a retention pond are shown in Figure 5.15. The permanent pool provides a vessel for the settling of solids between storms and the removal of nutrients and dissolved pollutants. The wetland vegetation bench, called the littoral zone, provides aquatic habitat, enhances pollutant removal, and reduces the formation of algal mats. Figure 5.15 also shows an optional surcharge detention storage volume overlying the permanent pool. This can

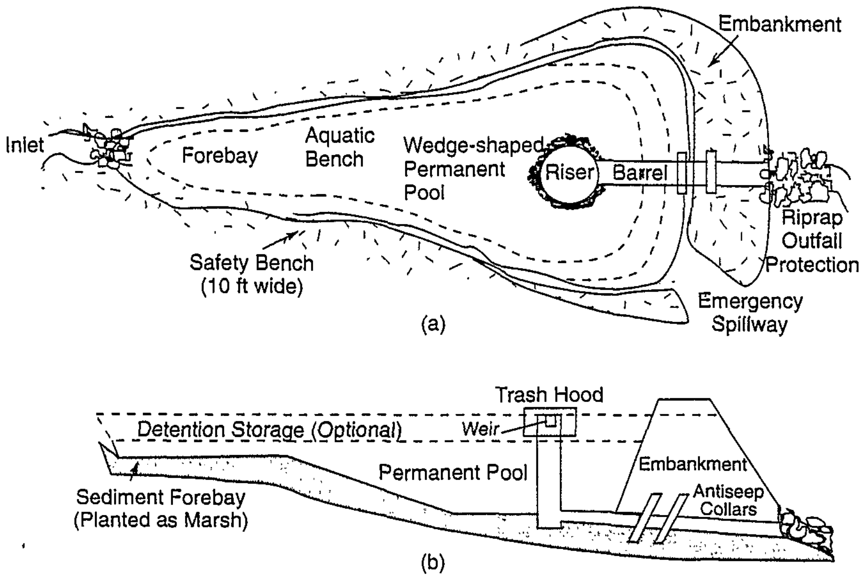


Figure 5.15 **Plan and profile of a retention basin: (a) top view and (b) side view (Schueler, 1987).**

be used for flood control. Some local jurisdictions require that this surcharge storage be designed as extended detention for added pollutant removal efficiency.

STORMWATER MANAGEMENT APPLICATIONS. Control of Nutrient Loadings. Retention ponds can be superior to extended detention basins for the control of nutrients in urban stormwater. While detention basins rely on solids-settling processes, retention ponds remove dissolved nutrients through several physical, chemical, and biological processes in the permanent pool. Table 5.13 shows a comparison of removal efficiencies of

Table 5.13 **Comparison of pollutant removal percentages by well-designed extended detention basins and retention ponds (U.S. EPA, 1983).**

Type of practice	Total suspended sediments	Nitrogen	Phosphorus	Lead	Zinc	Biochemical oxygen demand
Extended detention	70–80	0 (Diss) 20–30 (Total)	0 (Diss) 20–50 (Total)	70–80	40–50	20–40
Retention ponds	70–80	50–70 (Diss) 30–40 (Total)	50–70 (Diss) 50–60 (Total)	70–80	40–50	20–40

properly sized retention ponds and extended detention basins. In addition, petroleum hydrocarbon removals are similar to those of total suspended sediments. Retention ponds are most appropriate where nutrient loadings are of concern, especially in the following situations:

- Watersheds tributary to reservoirs and lakes—retention ponds in the watershed can help achieve eutrophication management goals in downstream reservoirs and lakes.
- Watersheds tributary to tidal embayments and estuaries—nutrient loadings into estuarine systems is a growing concern in coastal areas, including upland areas that drain into tidal waters. Retention ponds can help reduce the nutrient loads.

Removal of nutrients has a price: the permanent pool of a retention pond requires two to seven times more volume than an extended detention basin, depending on local meteorology. The larger volume requires larger structures and more land than detention basins, resulting in costs of facilities that are 50 to 150% more than for extended detention basins. If, however, the facility requires overlying storage for flood control peak-shaving, cost increases become smaller as the flood control volume and benefits get larger. Table 5.14, which summarizes design criteria for a regional stormwater management master plan for Fairfax County, Virginia (U.S.), exemplifies the relative difference in size for retention ponds and extended detention basins for this region of the U.S.

Table 5.14 Comparison of detention storage requirements in Fairfax County, Virginia: permanent pool of retention pond versus extended detention basin.[a]

Land use	Imperviousness, %	Retention pond, in.[b]	Extended detention,[c] in.[b]
Low-density single family	20	0.7	0.1
Medium-density single family	35	0.8	0.2
Multifamily residential	50	1.0	0.4
Industrial/office	70	1.2	0.5
Commercial	80–90	1.3	0.8
Forest/undeveloped	0	0.5	0.0

[a] Retention pond pool volume is based on an average hydraulic retention time of 2 weeks.
[b] In. × 25.40 = mm.
[c] Extended detention volume is based on the capture of first-flush runoff.

Aesthetics. Retention ponds offer a number of aesthetic advantages. They typically are more attractive than extended detention basins and are considered property value amenities in many areas. This is because sediment and debris accumulate within the permanent pool and are out of sight.

Other Siting Considerations. Retention ponds can be designed to require little hydraulic head to operate. While Figure 5.15 shows a dam at the downstream end of the pond, in flat terrain the permanent pool can be excavated below the ground surface, a common practice in the state of Florida (U.S.). Before excavating into the groundwater table, check with local regulatory authorities; however, if the pond is not sited over a gravel or karst formation, it should not adversely affect the quality of the groundwater, although such a possibility may exist in some cases. Most pollutants typically are removed from the groundwater in the first 0.4 to 0.9 m (18 to 36 in.) of soil downgradient of the pond.

Other issues to consider when choosing a retention pond include

- If the tributary catchment is large enough to have sufficient base flow to sustain a permanent pool;
- If the receiving waters immediately downstream are particularly sensitive to increased effluent water temperatures that can result from introduction of the pond;
- If existing wetlands at the site restrict the use of a permanent pool; and
- If water rights available for evapotranspiration are consumptive use in states with a prior appropriation water law system.

DESIGN METHODS. Two different methods are used for the design of permanent pools for a retention pond:

- Solids-settling design method relies on the solids-settling theory and assumes that all pollutant removal is because of sedimentation (Driscoll, 1983, and U.S. EPA, 1983).
- Lake eutrophication model design method provides for a level of eutrophication by accounting for the principal nutrient removal mechanisms (Hartigan, 1989, and Walker, 1987).

Solids-Settling Design Method. The solids-settling method is most appropriate for situations where the control of total suspended sediments and pollutants that attach themselves to the solids is the principal objective. The method relies on rainfall and runoff statistics, pond size, and settling velocities of suspended solid particle size distributions to calculate total suspended sediment removal. This method assumes an approximate plug flow system in the retention pond with all pollutant removal resulting from sedimentation.

Retention pond design curves based on the solids-settling method are shown in Figure 5.16 (U.S. EPA, 1986) for low-density, single-family resi-

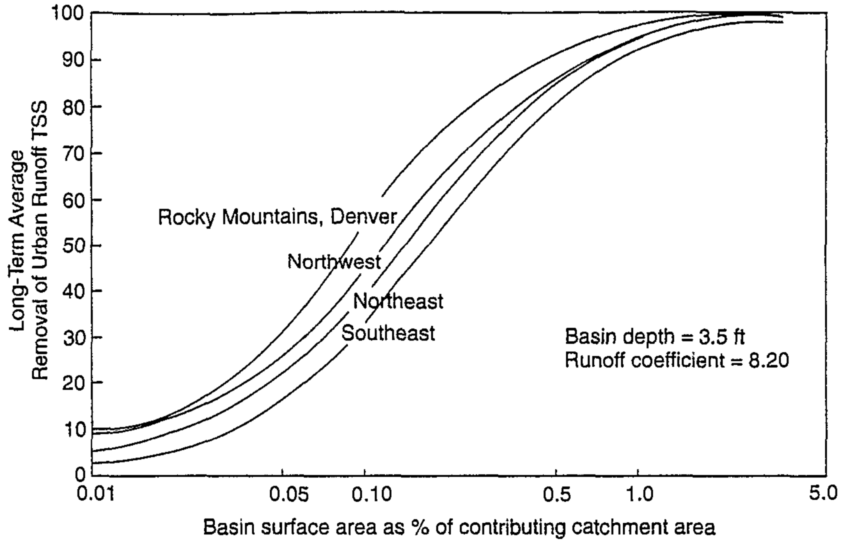


Figure 5.16 **Geographically based design curves for solids settling model (ft × 0.304 8 = m) (U.S. EPA, 1986).**

dential development (runoff coefficient, $RV = 0.2$). Separate design curves must be developed for other land-use patterns. These design curves relate average total suspended sediment removal to the size of the permanent pool. Here, the permanent pool size is expressed as the ratio of its surface area to the tributary catchment area and is based on a mean pool depth of approximately 1 m (3.5 ft). Average removal rates for other constituents may be estimated by multiplying the total suspended sediment removal rate by the average particulate fraction of the constituent of interest.

The total suspended sediment settling model was tested using data from nine retention ponds monitored during U.S. EPA's National Urban Runoff Program (NURP). Based on goodness-of-fit plots, it was concluded that the method did a reasonably good job of predicting removal rates at these nine NURP sites (Driscoll, 1983, and U.S. EPA, 1986).

A drawback to the performance curves shown in Figure 5.16 is that they were developed for only low-density residential land use (that is 20 to 30% imperviousness). However, comparison of this method with facilities designed using the maximized volume based on a 12-hour emptying time has shown nearly identical results, provided a surcharge extended detention volume is given. Thus, it is recommended that the permanent pool volume for the solids-settling method be the maximized volume based on a 12-hour drain time as described earlier in this chapter. It is also recommended that a surcharge extended detention volume be provided above the permanent pool, which is also equal to the maximized runoff volume. The outlet is then designed to draw down, or empty, this surcharge volume in 12 hours. This type of design significantly improves pollutant removal efficiency and virtually eliminates many of the short-circuiting problems often found in ponds without a surcharge extended detention volume above the permanent pool.

Lake Eutrophication Model Design Method. This method assumes that a retention pond is a small eutrophic lake that can be represented by empirical models used to evaluate lake eutrophication effects (Hartigan, 1989, and Walker, 1987). Using this design method, a retention pond can be sized to achieve a controlled rate of eutrophication and an associated removal rate for nutrients. Because retention ponds that achieve nutrient removal also remove other pollutants, typically it is not necessary for the design process to address constituents other than nutrients. Also, as noted earlier, large retention ponds may not be cost effective unless nutrient control is the principal water quality management objective.

The lake eutrophication design model is the phosphorus retention coefficient model developed by Walker (1985 and 1987). Like most input/output lake eutrophication models, this model is an empirical approach that treats the permanent pool as a completely mixed system and assumes that it is not necessary to consider the temporal variability associated with individual storm events. Unlike the solids-settling model, which accounts for temporal variability of individual storms, the Walker model is based on annual flows and loadings.

The model is applied in two parts:

$$K_2 = \frac{0.56 \cdot Q_S}{F \cdot (Q_S + 13.3)} \tag{5.11}$$

Where

K_2 = second-order decay rate, $m^3/mg \cdot a$;
Q_S = Z/T the mean overflow rate, m/a;
Z = mean pond depth, m;
T = average hydraulic retention time, years; and
F = inflow (ortho P)/(total P) ratio.

$$R = 1.0t \frac{1.0 - \sqrt{1.0 + (1.0 + 4N)}}{2N} \tag{5.12}$$

Where

R = total P retention coefficient (that is, BMP efficiency),
N = $K_2 \cdot P_T \cdot T$, and
P_T = inflow total P, μg/L.

Equations 5.11 and 5.12 were developed from a database for 60 U.S. Army Corps of Engineers' reservoirs and were verified for 20 other reservoirs. The model was applied by Walker (1987) to 10 NURP sites and 14 other retention pond systems and small lakes. The goodness-of-fit test yielded an $R^2 = 0.8$, indicating a good job of replicating monitored total P removals.

The permanent pool storage volume, V_B, is calculated for the desired average removal rate for P_t, which is a function of the average hydraulic retention time, T. The value of T (in years) is computed by dividing the permanent pool volume, V_B, by the product of the mean storm runoff, V_R, times the total number of runoff events per year, n, namely, $T = V_B/(V_R \cdot n)$. Field studies indicate that an optimum removal rate for T_P of approximately 50% occurs at T values of 2 to 3 weeks for pools with mean depths of 1.0 to 2.0 m (3 to 6 ft) (Hartigan, 1989). In the eastern U.S., this optimum range for T values corresponds to V_B/V_R ratios of 4 to 6. Ponds with values of T greater than 2 to 3 weeks have a greater risk of thermal stratification and anaerobic bottom waters, resulting in an increased risk of significant export of nutrients from bottom sediments.

State and regional stormwater management regulations and guidelines often address design criteria for the permanent pool storage volume in terms of either average hydraulic retention time, T, V_B/V_R, or minimum total suspended sediment removal rate. For example, the U.S. state of Florida (Florida DER, 1988) requires an average hydraulic retention time of 14 days, equivalent to V_B/V_R of 4; the Urban Drainage and Flood Control District's BMP criteria manual in the Denver, Colorado, area (U.S.) (UDFCD, 1992) specifies that the permanent pool storage volume should be 1.0 to 1.5 times the "water quality capture volume," which is equivalent to V_B/V_R on the order of 1.5 to 2.5. A municipal BMP handbook published by the California State Water Resources Control Board (Camp Dresser & McKee *et al.,* 1993) recommends that retention pond permanent pools be sized for a V_B/V_R of 3. The U.S. state of North Carolina's stormwater disposal regulations for coastal areas and water supply watersheds specify that the permanent pool should be sized to achieve a total suspended sediment removal rate of 85%, which is equivalent to a V_B/V_R in the range of 3 to 4 when no surcharge extended detention is provided. With surcharge extended detention, 85% removal of total suspended sediments has been achieved with a V_B/V_R of 2 or less.

CONFIGURING A RETENTION POND. Depth of Permanent Pool. Mean depth of the permanent pool is calculated by dividing the storage volume by the surface area. The mean depth should be shallow enough to ensure aerobic conditions and reduce the risk of thermal stratification but deep enough to ensure that algal blooms are not excessive and reduce resuspension of settled pollutants during significant storm events. The minimum depth of the open water area should be greater than the depth of sunlight penetration to prevent emergent plant growth in this area, namely, on the order of 2 to 2.5 m (6 to 8 ft).

A mean depth of approximately 1 to 3 m (3 to 10 ft) should produce a pond with sufficient surface area to promote algae photosynthesis and should maintain an acceptable environment within the permanent pool for the average hydraulic retention times recommended above, although separate analyses should be performed for each locale. If the pond has more than 0.8 ha (2 ac) of water surface, mean depths of 2 m (6.5 ft) will protect it against wind-generated resuspension of sediments. The mean depths of the more effective retention ponds monitored by the NURP study typically fall within this range. A water depth of approximately 1.8 m (6 ft) over the major portion of the pond will also increase winter survival of fish (Schueler, 1987).

A maximum depth of 3 to 4 m (10 to 13 ft) should reduce the risk of thermal stratification (Mills *et al.*, 1982). However, in the U.S. state of Florida, pools up to 9.2 m (30 ft) deep have been successful when excavated in high groundwater areas; this is probably because of improved circulation at the bottom of the pond as a result of groundwater moving through it.

Side Slopes along Shoreline and Vegetation. Side slopes along the shoreline of the retention pond should be 4H:1V or flatter to facilitate maintenance (such as mowing) and reduce public risk of slipping and falling into the water. In addition, a littoral zone should be established around the perimeter of the permanent pool to promote the growth of emergent vegetation along the shoreline and deter individuals from wading (see Figure 5.15). The emergent vegetation around the perimeter serves several other functions: it reduces erosion, enhances the removal of dissolved nutrients in urban stormwater discharges, may reduce the formation of floating algal mats, and provides habitat for aquatic life and wetland wildlife. This bench for emergent wetland vegetation should be at least 3 m (10 ft) wide with a water depth of 0.15 to 0.45 m (0.5 to 1.5 ft). The total area of the aquatic bench should be 25 to 50% of the permanent pool's water surface area. Local agricultural agencies or commercial nurseries should be consulted about guidelines for using wetland vegetation within shallow sections of the permanent pool.

Extended Detention Zone above the Permanent Pool. Some state or local regulations require detention of a specified runoff volume as surcharge above the permanent pool. Storage in the surcharge zone is released during a specified period through an outlet structure. This surcharge detention requirement is intended to reduce short circuiting and enhance settling of total suspended sediments. Settling-solids analysis shows that retention ponds sized for nutrient removal with a minimum detention time, T, of 2 weeks and a minimum V_B/V_R of 4 achieve total suspended sediment removal rates of 80 to 90%. Addition of an extended detention zone above the permanent pool is unlikely to produce measurable increases in the removal of total suspended sediments. Still, a surcharge extended detention volume is recommended whenever the V_B/V_R is less than 2.5. Whenever one is used or required, it is suggested that the maximized event-based volume with a 12-hour drain time be used.

Minimum and Maximum Tributary Catchment Areas. The minimum drainage area should permit sufficient base flow to prevent excessive retention times or severe drawdown of the permanent pool during dry seasons.

Unless regional experience is available for determining the minimum drainage area required in a particular location, it is recommended that a water balance calculation be performed using local runoff, evapotranspiration, exfiltration, and base flow data to ensure that the base flow is adequate to keep the pond full during the dry season.

The maximum tributary catchment area should be set to reduce the exposure of upstream channels to erosive stormwater flows, reduce effects on perennial streams and wetlands, and reduce public safety hazards associated with dam height. Again, regional experience will be useful in providing guidelines. For example, in the southeastern U.S., some stormwater master plans have restricted the maximum tributary catchments to 40 to 120 ha (100 to 300 ac) depending on the amount of imperviousness in the watershed, with highly impervious catchments restricted to the lower end of this range and vice versa. On the other hand, experience in semiarid areas has shown that even a small area of new land development can cause downstream erosion and that drainageway stabilization is needed between the new development and the pond for relatively small catchments.

Construction of Retention Ponds in Wetland Areas. One potential constraint on the use of retention ponds as regional BMPs is federal regulations that restrict the filling of wetland areas and the Section 404 permit program regulating any wetland or retention pond constructed for stormwater management. Although retention pond BMPs typically are designed to enhance pollutant removal by incorporating wetland areas along the perimeter, regulatory agencies may restrict their use if a significant amount of native wetlands will be submerged within the permanent pool. In addition, restorative maintenance of the created wetland areas, which includes removal of silt, may require a Section 404 permit. If work is performed without such a permit, the owner can be subject to federal and state enforcement action and fines. Thus, it is important to check with the local offices of the federal regulatory agencies, such as the U.S. Army Corps of Engineers and state regulators, about the need for such permits. A written response should always be obtained before proceeding with any restorative maintenance work.

Potential wetlands constraints must be addressed on a case-by-case basis during final design of each retention pond facility. If field inspections indicate that a significant wetlands area will be affected at a particular site, the following options can be pursued during final design:

- Investigate moving the embankment and permanent pool upstream of the major wetland area.
- If the above option is unfeasible, a wetland mitigation plan can be developed as a part of the retention pond design.
- If neither of the above options result in a design acceptable to regulatory agencies, consider using an extended detention basin instead. Eliminating the permanent pool can often reduce adverse effects on

native wetlands, but their direct oversight by regulatory agencies may not be avoided.

Basin Geometry. Relatively large length-to-width ratios can help reduce short circuiting, enhance sedimentation, and help prevent vertical stratification within the permanent pool. A minimum length-to-width ratio of 2:1 (3:1 preferred) is recommended for the permanent pool. The permanent pool should expand gradually from the basin inlet and contract gradually toward the outlet, maximizing the travel time from the inlet to the outlet. Baffles or islands within the pool can increase the flow path length and reduce short circuiting.

Soil Permeability. Highly permeable soils may not be acceptable for retention ponds because of excessive drawdown during dry periods. Where permeable soils are encountered, exfiltration rates can be minimized by scarifying and compacting a 0.3-m (12-in.) layer of the bottom soil of the pond, incorporating clay to the soil, or providing an artificial liner. Excavating the permanent pool into the groundwater table can also ensure its permanency, but seasonal fluctuations in the groundwater table need to be taken into account.

Forebay. To reduce the frequency of major cleanout activities within the pool area, a sediment forebay with a hardened bottom should be constructed near the inlet to trap coarse sediment particles. The forebay storage capacity should be approximately 10% of the permanent pool storage. Access for mechanized equipment should be provided to facilitate removal of sediment. The forebay can be separated from the remainder of the permanent pool by one of several means: a lateral sill with wetland vegetation, two ponds in series, differential pool depth, rock-filled gabions, a retaining wall, or a horizontal rock filter placed laterally across the permanent pool.

Inlet and Outlet Structures. The inlet design should dissipate flow energy and diffuse the inflow plume where it enters the forebay or permanent pool. Examples of inlet designs include drop manholes, energy dissipators at the bottom of paved rundown, a lateral bench with wetland vegetation, and the placement of large rock deflectors.

An outlet for a retention pond typically consists of a riser with a hood or trash rack to prevent clogging and an adequate antivortex device for basins serving large drainage areas. Some typical outlet structures are illustrated in Figure 5.17. Antiseep collars should be installed along outlet conduits passing through or under the dam embankment. If the pond is a part of a larger peak-shaving detention basin, the outlet should be designed for the desired flood control performance. An emergency spillway must be provided and designed using accepted engineering practices to protect the basin's embankment. Be certain that the pond embankment and spillway are designed in accordance with federal, state, and local dam safety criteria.

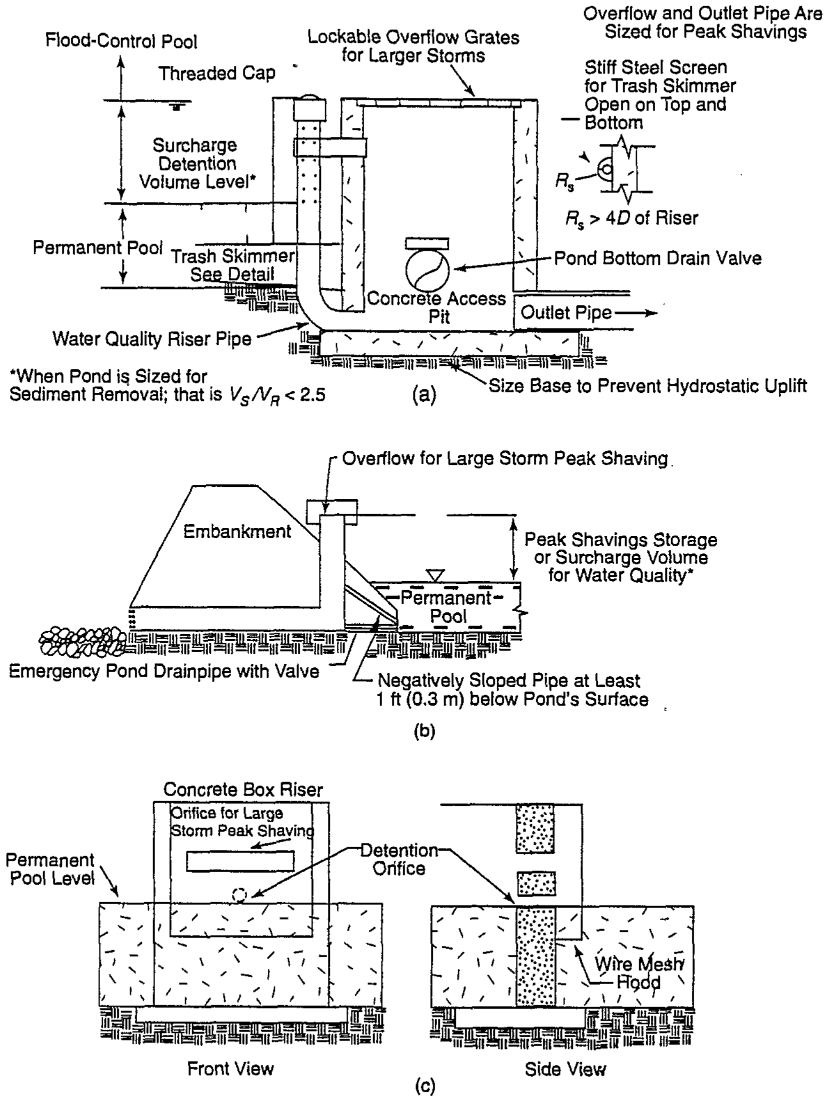


Figure 5.17 **Typical outlet structures: (a) outlet works with surcharge detention for water quality, (b) negatively sloped pipe outlet with riser, and (c) multiple orifice outlet (Schueler, 1987, and UDFCD, 1992).**

The channel that receives the discharge from the basin's outlet should be protected from erosive discharge velocities. Options include riprap lining of the channel or the provision of stilling basins, check dams, rock deflectors, or other devices to reduce outfall discharge velocities to nonerosive levels.

CONSTRUCTED WETLANDS

The use of constructed wetlands is popular for treating stormwater. Reported removal efficiencies vary. Strecker *et al.* (1992) summarized the performance of several wetlands in the U.S. for treatment of urban runoff; they found that suspended solids removals averaged 87%, with a range of 40 to 96%.

A significant deterrent to the comparison of removal efficiencies between wetlands is the lack of a standard set of design criteria. What is reported here is a general guidance based on information available in the literature.

DESIGN. General Considerations. Specific site conditions are important to the proper design of a wetland. Key site characteristics include soils, hydroperiod, and plant species and density. Depth to the confining layer or groundwater is important to ensure that the wetland does not dry up during extended periods of no rainfall. In addition, a constant source of surface water is recommended; stagnant water in the wetlands causes the underlying soil to become anaerobic, releasing ammonia, phosphorus, and heavy metals to the overlying water for washout during the next runoff event. Stagnant water also results in mosquito problems. Finally, the depth and duration of maximum submergence are important because an excess of either will kill the vegetation.

Hydraulic Design. The following hydraulic design criteria are recommended for wetlands:

- Maintain dry weather flow depths that vary through the wetland between 0.1 and 1.2 m (0.5 to 4 ft), depending on the types of vegetation planted, with the outlet structure designed so that the wetland can be periodically drawn down completely to dry the sediments (provides for natural oxidation of built-up organics);
- Size the wet weather storage volume using the methodology for extended detention basins but with a maximum surcharge depth above the dry weather flow depth of 0.6 m (2 ft) and a drawdown time of 24 hours; this will reduce stress on herbaceous wetland plants. The 0.6-m depth limitation will determine the surface area required for the wetland.
- Design inlet structures to achieve sheet flow across the wetland to the maximum extent possible.
- Design the outlet structure to control the water surface and protect it from plugging by floatables common in wetlands (see Inlet and Outlet Structures in this chapter).
- If open water is to be included in the wetland, it should be less than 50% of the total wetland area; the depth of the open water should follow the rules for the maximum permanent pool depth in retention ponds.

Configuration of the Wetland. The siting and configuration of the created wetland somewhat depend on adjacent land uses, the magnitude of contributing surface runoff, and the type of collection system (that is, shallow ditches or underground piping). Variations in topography and plant types will create more suitable habitat for wildlife. If the proposed site is large enough, some upland areas (peninsulas or islands) are preferable. Upland buffers increase the habitat value of a created wetland.

Figure 5.18 shows an idealized wetland basin designed to enhance stormwater quality. Urbonas and Stahre (1993) propose that the ideal shape is similar to an oval, with the outlet and inlet at opposite ends. If an oval shape is not possible, use any other elongated shape that separates the inlet and outlet as much as possible. The primary goals are to increase the contact time of the inflow with the wetland surfaces and ensure that the inflow does not short-circuit the facility. An elongated basin shape helps to achieve these goals. It is suggested that the length-to-width ratio of the wetland surface be no less than 3 (that is, $L/W > 3$); a 2:1 ratio is recommended by Livingston (1989).

The forebay shown in Figure 5.18 helps settle out the largest sediment particles before the flow passes over the areas covered with emergent vegetation. It also helps to spread the inflow uniformly over the entire wetland. The forebay should also have a baffle near the inlet as illustrated to break up the inflow jet and facilitate spreading of the inflow over the entire surface area of the wetland.

An overflow outlet, not dissimilar to a riser used in a retention pond, is placed within a deepened portion near the outlet end of the basin. This deepened basin helps keep the outflow zone free of emergent vegetation and makes the outlet less likely to clog. Wetlands serving small tributary watersheds will require small outlets to ensure that the drain time of the design capture volume is no fewer than 20 hours. However, designing small outlets that do not clog is difficult, if not impossible. For this case, a set of V-notch weirs or a sawtooth weir may be more appropriate for the outflow control device.

Vegetation. Suitable plants for created wetlands vary between different ecoregions. However, the wetland plants chosen for created wetlands should incorporate the following attributes:

- Tolerance to wide ranges of water elevations, salinity (salt content), temperature, and pH;
- A mixture of perennials and annuals;
- Moderate amounts of leaf production; and
- Proven removal efficiencies, for example, of *Scriptus* species.

Wetland plants are now commercially available in some municipalities from local nurseries who can provide additional information on tolerances and growth rates.

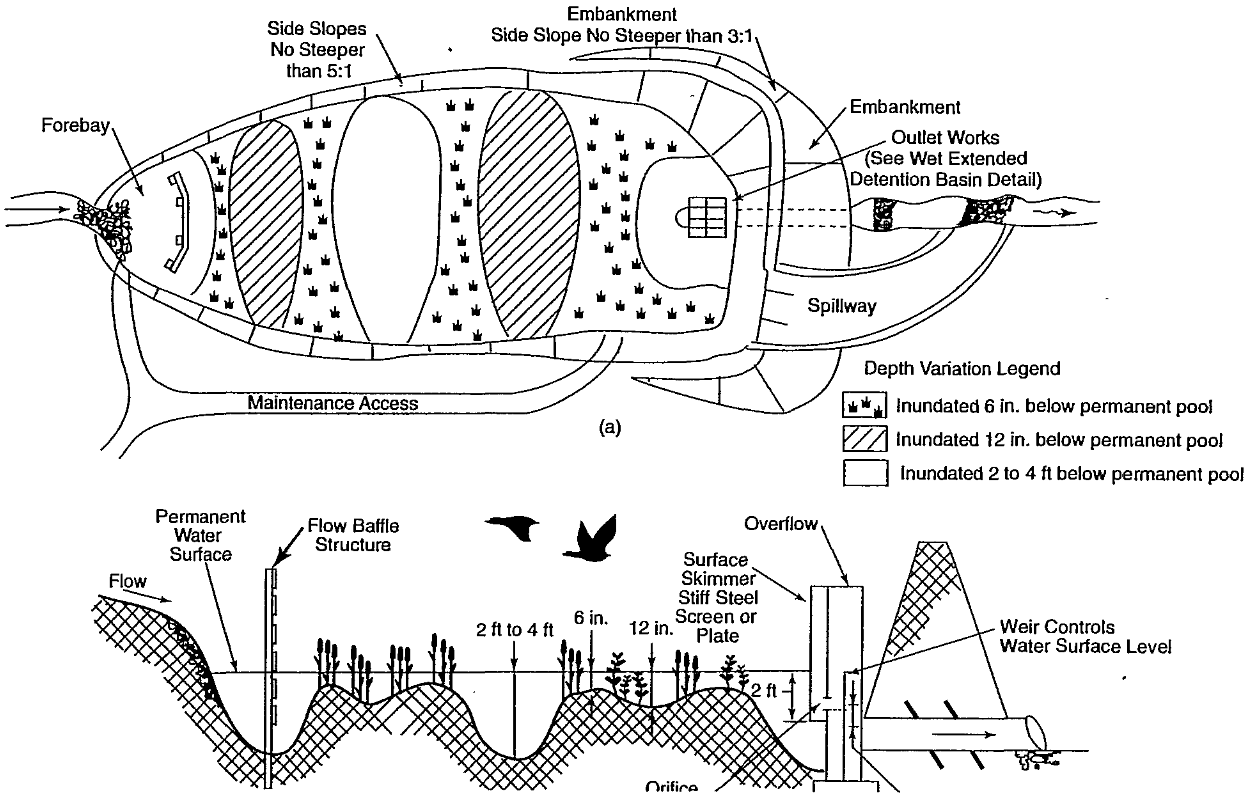


Figure 5.18 **Plan and profile of a wetland basin: (a) plan (not to scale) and (b) profile (not to scale) (ft × 0.304 8 = m; in. × 25.4 = mm).**

CONSTRUCTION. Construction management of the wetland is critical. Elevations and contouring of the constructed wetlands are the most important aspect of created wetlands—especially with respect to the groundwater. The confining layers of clay will vary from place to place within a specific area. If the clay layer is breached, clay should be replaced and the elevations of that location should be changed in the design.

Proper staging and sequencing will provide areas for dewatering during construction to reduce effects to adjacent waters. Rim ditches are particularly beneficial to avoid excessive pumping. When the created wetland is adjacent to an existing wetland, a temporary berm is needed until final grade has been achieved.

The use of organic soils is necessary to provide moisture-retaining abilities during drier periods and nutrients. If at all possible, soils (muck) from displaced wetlands should be stockpiled and used in the created wetland. Care should be taken to ensure wetland soils with nuisance species are not used. The displaced muck will provide root propagules, seed sources, micro- and mieofauna, and other invertebrates. Topsoil or peat can be substituted in the place of wetland muck. The muck/organic layer should be 0.1 to 0.3 m (6 to 12 in.) deep. Depths greater than 0.3 m (12 in.) tend to create difficulties in spreading the muck and planting.

If possible, it is best to control the hydration of the newly constructed wetland. The installation of plant material is most efficiently accomplished in saturated conditions, but standing water can cause poorly installed plants to float. Flash-board risers and adjustable gates can aid in controlling water levels during construction. However, if water control is not possible, wetland plants should be acclimated to inundation in the nursery before shipping to the site.

Keeping the soils saturated for 1 week after the muck/mulch has been spread will encourage seeds and propagules to sprout. If the wetland creation area is flooded with 0.15 m (6 in.) of water, by the second week this flooding will selectively remove upland species. The remaining water can be allowed to fill to design level after 3 weeks (Tesket and Hinckley, 1977).

MONITORING. Monitoring the created wetland will ensure proper coverage of the planted zones by desirable species. Monitoring should be done quarterly for the first year, semiannually for the second and third years, and (when necessary) annually for the fourth and fifth years.

Monitoring the wetland for the following information will help prevent future problems:

- Percent survivorship of planted species—subsamples can be used to provide quantitative results in larger wetlands,
- Percent cover of planted species and recruited desirable plants,
- Percent cover of nuisance species,
- Wildlife use, and
- Qualitative assessments of water quality.

Replanting as necessary to achieve the 85% survival rate at the end of each year is beneficial. It is critical to assess the created wetland for nuisance species. If the nuisance coverage is greater than 10%, maintenance through removal may be necessary.

MAINTENANCE. Maintenance includes three primary areas: replanting, nuisance species removal, and excavation of sediment sumps. Adjustments in plant type may be needed to accommodate differences in elevations. Typically, this is easier than regrading an established area. If water levels are lower than desired, adjustment of the control structure can increase survival.

Removal of nuisance species will increase the function and value of the constructed wetland. Harvesting wetland plants can be considered for nutrient removal but can resuspend trapped sediments. This resuspension, with habitat disturbance, is probably less beneficial than the actual nutrient removal.

MEDIA FILTRATION

Figure 5.19 shows a conceptual rendering of a media filtration facility widely used in the U.S. city of Austin, Texas. It consists of a settling basin followed by a filter. Field research indicates the sand filter has a suspended solids removal efficiency similar to that of retention ponds and extended detention.

The most typical filter is sand, but some use a peat and sand mixture because peat has the adsorptive ability to remove organics and dissolved contaminants. Clogging problems have been reported with the peat mixture (Tomasak *et al.*, 1987), but this may be because of the type of peat used (Galli, 1990). Limited research also indicates that compost made from leaves can be effective at removing dissolved phosphorus, metals, oil, and grease (Stewart, 1989), but field data show inconsistent performance.

Presettlement is essential to avoid rapid clogging of the filter. The device should not be on line during construction in the tributary watershed. Filters should be designed to have overflow or bypass for extreme events to protect against flooding because of backups if filter plugging occurs. It should be noted, however, that providing the bypass allows a clogged filter to appear to be operating effectively. The only way to ensure that the filter is not plugged is faithful periodic inspection providing a design that clearly indicates when the filter is no longer draining, such as excessive surface ponding or excessive bypasses by runoff.

THE AUSTIN, TEXAS, FILTER. The most extensive experience to date is with surface facilities of the type shown conceptually in Figure 5.19. This type of facility has been used on catchments of up to 20 ha (50 ac) in Austin, Texas, where it originated. Austin provides for two designs—one with full sedimentation and the other with partial sedimentation.

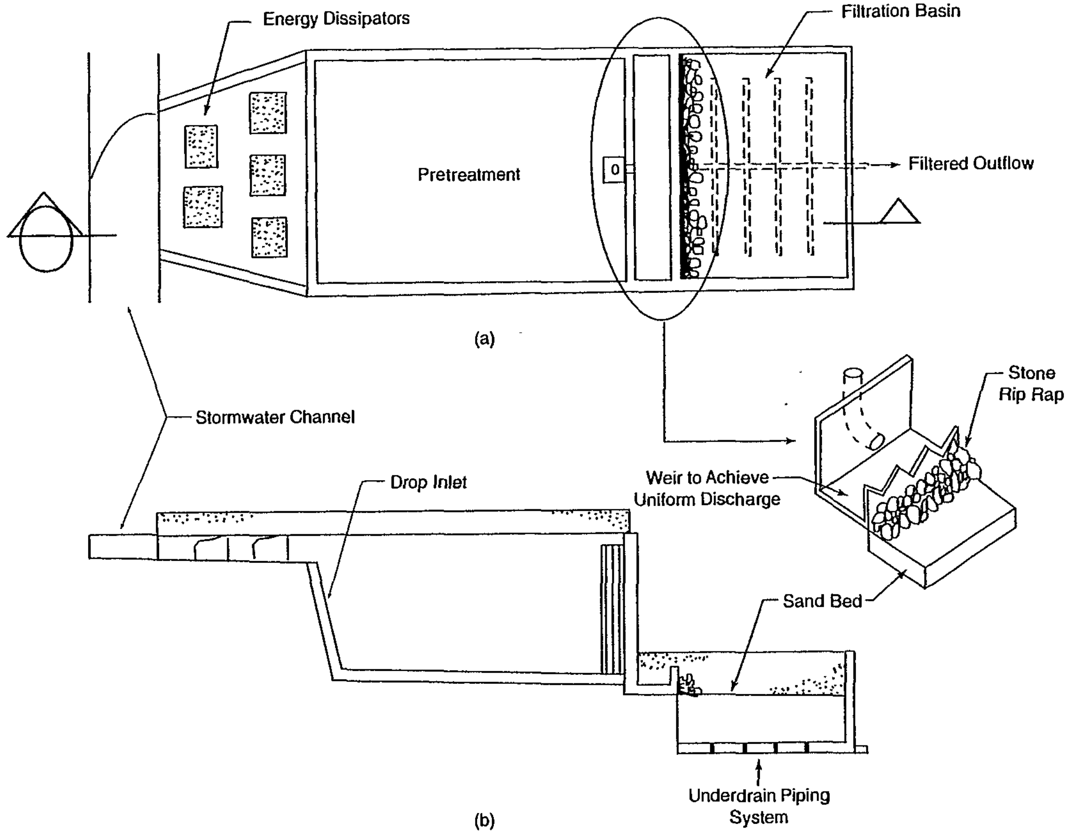


Figure 5.19 **Sand filter with a presettlement basin: (a) plan view and (b) elevation.**

The full sedimentation configuration includes a sedimentation basin designed to hold the entire water quality volume (that is, equivalent to the 40-hour drain time maximized volume) and to release this volume to the filter over a 40-hour drawdown period. This system should be used unless topographical constraints make this design unfeasible.

The partial sedimentation configuration requires less depth than the full sedimentation system and may be applicable where topographical constraints exist. In this system, a smaller sedimentation chamber is located upstream of the filtration basin and is designed to remove the heavier sediment and trash litter only. It requires more intensive maintenance than the full sedimentation system. The volume of the sediment chamber should be no less than 20% of the water quality volume used for the full sedimentation design. The design must ensure that the sediment chamber discharges the flow evenly to the filtration basin. Rock gabions composed of 300- to 450-mm (12- to 18-in.) diameter rocks can be used for this purpose. The outflow side of the sediment chamber should incorporate features to prevent gouging of the sand media (for example, concrete splash pad or riprap).

Determining the Surface Area of the Filter. This procedure is based on the design guidance provided in Austin, Texas. The design provides that a design water quality volume, namely the maximized volume, is processed through the filter without overtopping or bypassing the facility. The filter is sized as follows:

- Average hydraulic head on the filter is approximately 0.9 m (3 ft).
- For the full sedimentation design: 40-hour drawdown rate of the water quality volume and coefficient of permeability $K = 1.1$ m/d (3.5 ft/d).
- For the partial sedimentation design: 8-hour drawdown rate of the water quality volume and coefficient of permeability $K = 0.6$ m/d (2 ft/d).
- Clean concrete aggregate sand 0.02 to 0.04 in. in diameter (ASHTO C-33).

The above criteria result in the following equation:

$$A_F = \frac{A_T \cdot P_O}{12 \cdot K \cdot T_D} \tag{5.13}$$

Where

A_F = filter area, m^2 (sq ft);
A_T = area of the tributary catchment, m^2 (sq ft);
P_o = runoff volume equal to the maximized volume, mm (in.);
K = coefficient of permeability, m/d (ft/d); and
T_D = drawdown time of the maximized volume (40 hours for full sedimentation and 8 hours for partial sedimentation).

As an example, assume a 0.37-ha (40 000-sq ft) commercial catchment in the U.S. city of Dallas, Texas, with a runoff coefficient $C = 0.70$. Size a filter for the full sedimentation and the partial sedimentation conditions. Using Equation 5.2, the maximized runoff volume for this catchment is

P_O = 18.5 mm (0.73 in.) for the full sedimentation condition; and

P_O = 13.2 mm (0.55 in.) for the partial sedimentation condition.

Thus, for the full sedimentation condition, Equation 5.13 results in

$$A_F = \frac{(40\ 000)(0.73)}{12 \cdot (3.5) \cdot (40/24)} = 39 \text{ m}^2 \text{ (417 sq ft)}$$

and for the partial sedimentation condition, it becomes

$$A_F = \frac{(40\ 000)(0.55)}{12 \cdot (2.0) \cdot (8/24)} = 255 \text{ m}^2 \text{ (2 750 sq ft)}$$

Both filters will pass the maximized storm runoff volume or smaller without overtopping or bypassing any runoff, provided the filter is not excessively clogged. However, the full sedimentation design will have an extended detention basin upstream of the filter equal to 18.5 mm (0.73 watershed in.) of runoff, while the partial sedimentation design will have a basin with a volume equal to 20% of this volume. The design of choice will be governed by site constraints, maintenance considerations, and the owner's choices of which arrangement best fits the commercial site.

Configuring a Sand Filter. In addition to the coarse sediment and trash interception provided by the upstream detention storage, consider the following:

- Provide a trash rack at the outlet of the sedimentation basin,
- Provide access for maintenance equipment,
- Provide freeboard or a safe bypass when basin is full,
- Provide a sediment trap at the inlet to reduce resuspension,
- Use a flow spreader,
- Use one of two alternative sand bend designs (see Figure 5.20),
- Use a minimum sand bed thickness of 0.4 m (18 in.), and
- Provide underdrains under the sand.

LINEAR FILTERS—DELAWARE. An underground "linear" filter (see Figure 5.21) used in Delaware (U.S.) is suggested by Shaver (1991) for catchments of up to 2 ha (5 ac). This underground system uses a vault with a permanent pool of water as the pretreatment device. Shaver (1991) recommends that the volume of both the sedimentation and the filter chambers be approximately 38 m^3/ha (540 cu ft per contributing ac) and that the surface area of each chamber be 25 m^3/ha (360 sq ft per contributing ac). Configure the filter as follows:

- Depth of sand (0.4 m, or 18 in.).

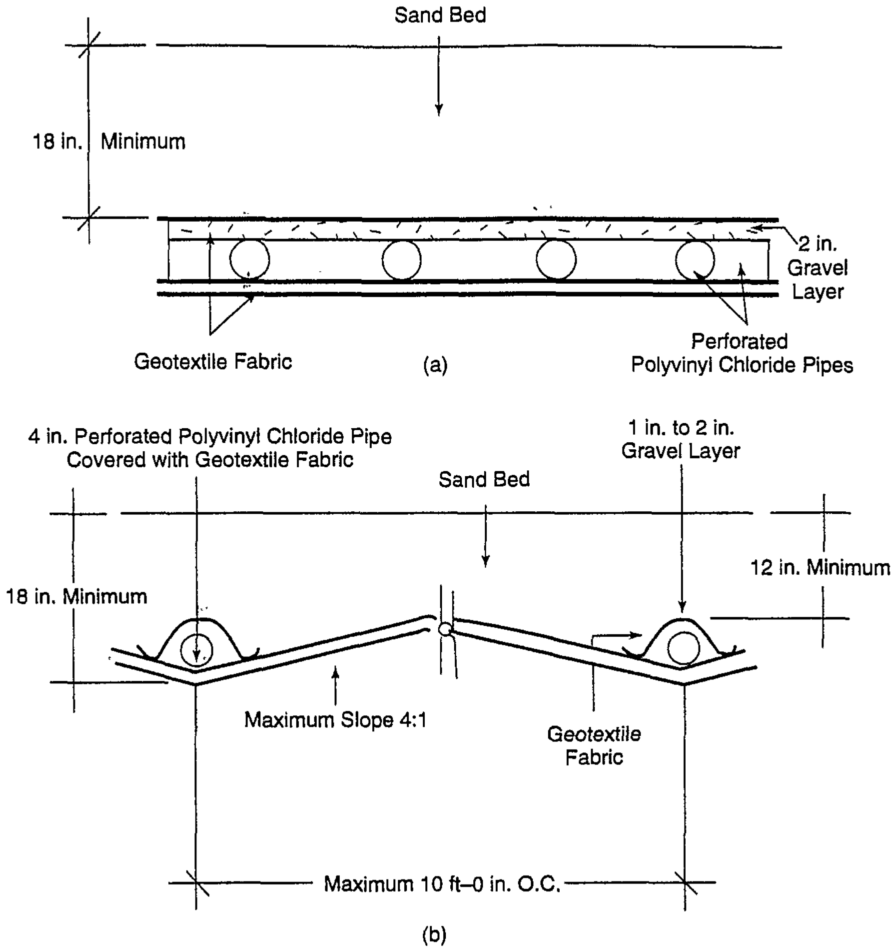


Figure 5.20 **Sand bed filtration configurations: (a) sand bed profile (with gravel layer) and (b) sand bed profile (trench design) (ft × 0.304 8 = m; in. × 25.40 = mm) (City of Austin, 1989).**

- Diameter of the outlet pipe should be 0.1 m (6 in.) or less (use multiple outlets if necessary).
- Position the filter relative to the pavement to evenly distribute the flow as it enters the sedimentation chamber. Pavement and inlet design and construction are, therefore, critical.

UNDERGROUND VAULT—WASHINGTON, D.C. A similar type of linear filter, illustrated in Figure 5.22, has been used in the Washington, D.C., area (U.S.). It is suggested that this particular design be viewed cautiously for the following reasons. First, the initial settling chamber is undersized for effective sedimentation, causing the filter to clog quickly. Second,

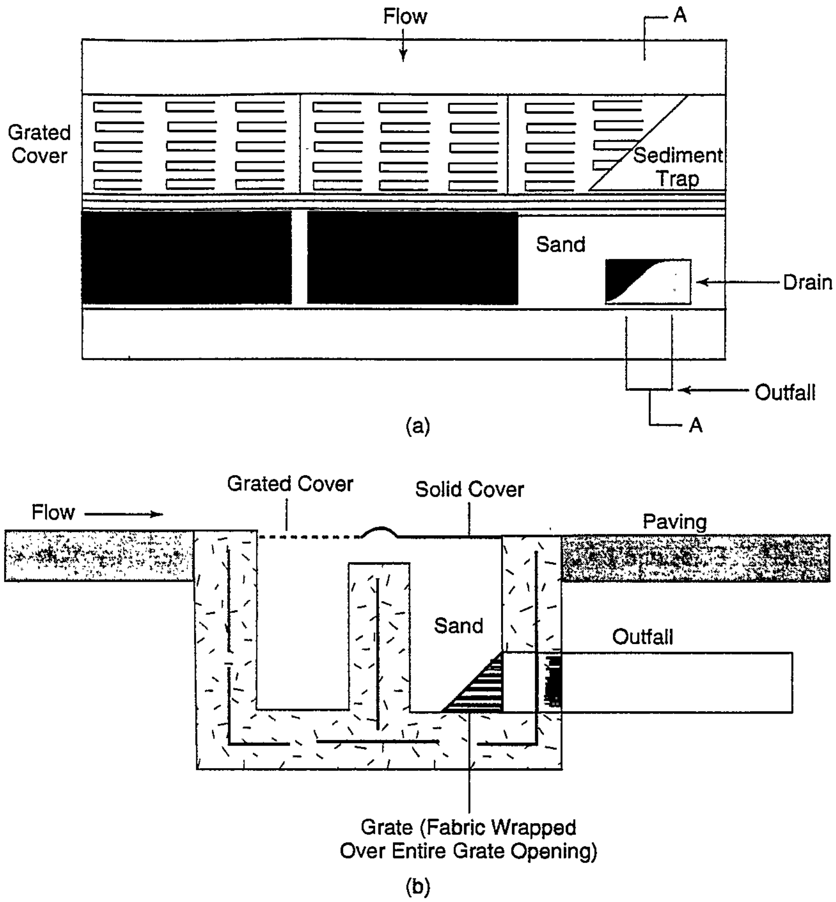


Figure 5.21 **Linear filter: (a) plan view and (b) section A-A (Shaver, 1995).**

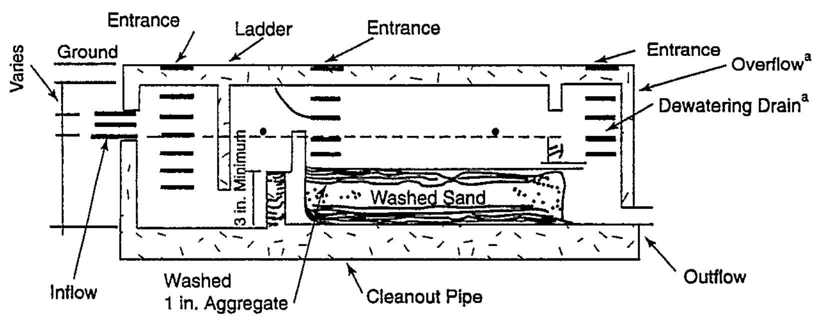


Figure 5.22 **Underground vault filter ([a]an ungated dewatering drain and overflow are not recommended) (in. × 25.40 = mm).**

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when the filter clogs, the flow will simply overtop the overflow weir and flow directly to the outlet, with no indication that the filter is plugged. If this filter type is to be used, it should be sized using the Delaware linear filter criteria, including the presettlement chamber. It is also strongly recommended that the overflow weir and dewatering drain in the filter chamber be blocked and that the entrance manhole covers over the sedimentation chamber and the outflow chamber be replaced with grates. Then, if the filter clogs, the water will back up in the vault, overflow out of the inlet grate over the sedimentation compartment, and back into the outfall chamber. This will be a clear visual indication that the filter is plugged.

MAINTENANCE. Inspect semiannually and after major storms. Sediment and all floatables should be removed: from the settling basin when 100 mm (4 in.) accumulates; from the filter when 2.5 mm (0.1 in.) or more accumulates; or when there is standing water over the filter 40 hours after the storm. Field experience in Austin, Texas (U.S.), indicates the filter surfaces must be cleaned about twice each year by raking off the dried sediment. If there are open space areas in the tributary catchment that are erosive, or if construction is occurring, more frequent cleaning will be necessary. Consult Shaver (1991) and Truong (1989) for additional design and maintenance criteria.

OIL AND WATER SEPARATORS

Oil and water separators are designed to remove petroleum compounds, grease, and grit. They will also remove other floatable debris. Two types of oil and water separators—conventional gravity separators and the coalescing plate interceptor (CPI)—are used at all bulk petroleum storage and refinery facilities. The lack of oil characteristics and the apparently low concentrations of oil in most stormwater result in considerable performance uncertainty.

APPLICATION. This treatment control is applicable when the concentrations of oil- and grease-related compounds are abnormally high and source control does not provide effective control. The typical business types of concern are gasoline stations and truck, car, and equipment maintenance and washing enterprises and other commercial and industrial facilities that generate high levels of oil products in runoff wastes. Public facilities for which separators may be considered include marine ports, airfields, fleet vehicle maintenance and washing facilities, and mass transit park-and-ride lots.

PERFORMANCE. Conventional separators are capable of removing oil droplets with diameters equal to or greater than 150 microns. A CPI separator should be used if smaller droplets must be removed. When the droplet size is of sufficient size, oil and grease concentrations can be reduced to 10 mg/L or less (Lettenmaier and Richey, 1985).

Separator sizing is based on the rise velocity of an oil droplet, using oil density and droplet size to calculate rise velocity or using direct measurement of rise velocities. With the exception of stormwater from oil refineries, there are no relevant design data describing the characteristics of petroleum products in urban stormwater. A portion of the petroleum products are attached to fine suspended solids and, therefore, are removed by settling not flotation. Consequently, the performance of oil–water separators for urban stormwater runoff is uncertain.

DESIGN. The basic configurations of the two types of separators are illustrated in Figure 5.23. With small installations, a conventional gravity separator has the general appearance of a septic tank but is longer with respect to its width. Larger facilities have the appearance of a municipal wastewater primary sedimentation tank. The CPI separator contains closely spaced plates that enhance the removal efficiency and consequently requires less space than a conventional separator. The angle of the plates to the horizontal ranges from 0 (horizontal) to 60 deg, although 45 to 60 deg is typical. The perpendicular distance between the plates typically ranges from 19 to 25 mm (0.75 to 1.0 in.). The stormwater will flow either across the plates or down through the plates, depending on the plate configuration.

SIZING. The sizing of a separator is based on the calculation of the rise velocity of the oil droplets using Equation 5.14 (modified from API, 1990):

$$V_P = \frac{5.76 \cdot (d_p - d_c) \cdot d^2}{n} \cdot 10^{-15} \tag{5.14}$$

Where

V_p = rise velocity, m/s (ft/sec);
d_p = density of the oil, kg/m^3 (lb/cu ft);
d_c = density of the water, kg/m^3 (lb/cu ft);
d = diameter of the droplet to be removed, m (ft); and
n = absolute viscosity of the water, kg/m^2 (lb/sq ft).

An appropriate water temperature value for selecting water density and viscosity is the expected temperature of the stormwater during the winter period. There are no data on the specific gravity of petroleum products in urban stormwater, but values between 0.85 and 0.95 typically are used. Also, distribution of droplet sizes must be known to select the appropriate droplet diameter for a stated efficiency goal. However, there is little information on the size distribution of oil droplets in urban stormwater. An oil droplet size and

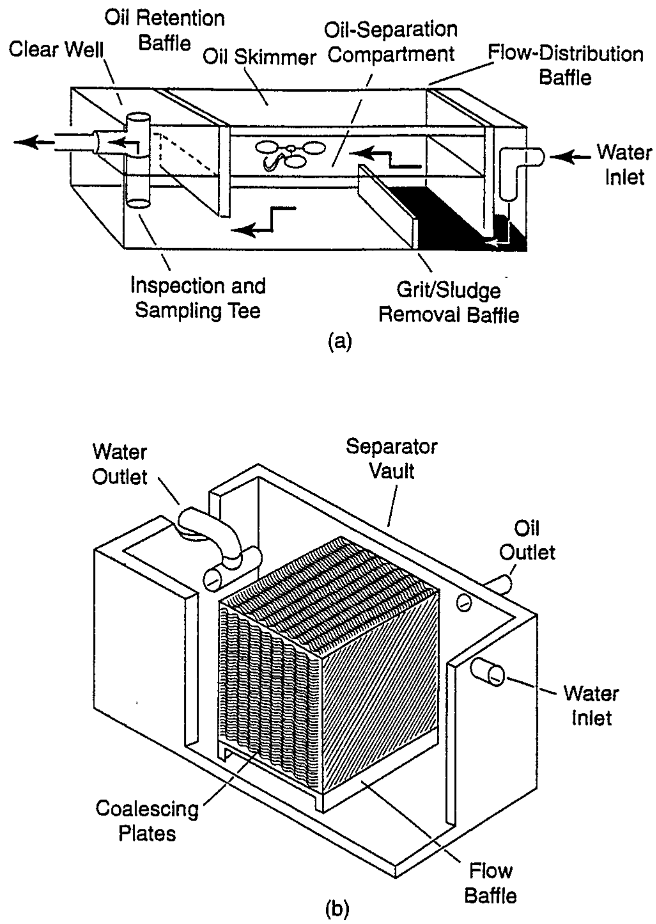

Figure 5.23 **(a) Conventional and (b) coalescing plate separators.**

volume distribution for stormwater from a petroleum products storage facility is depicted in Figure 5.24. Because a design influent concentration must be assumed, there will be considerable uncertainty because it will vary widely within and between storms.

If the effluent goal is 20 mg/L and the design influent concentration is 50 mg/L, a removal efficiency of 60% is required. Using Figure 5.24, this efficiency can be achieved by removing all droplets with diameters 90 microns or larger. Using a water temperature of 10°C (a water density of 0.999) and an oil density of 0.898, the rise velocity for a 90-micron droplet is 1.2 m/h (0.001 1 ft/sec).

It is typically believed that conventional separators are not effective at removing droplets smaller than 150 microns (API, 1990). Theoretically, a conventional separator can be sized to remove a smaller droplet, but the facility may be so large that the CPI separator may be more cost effective.

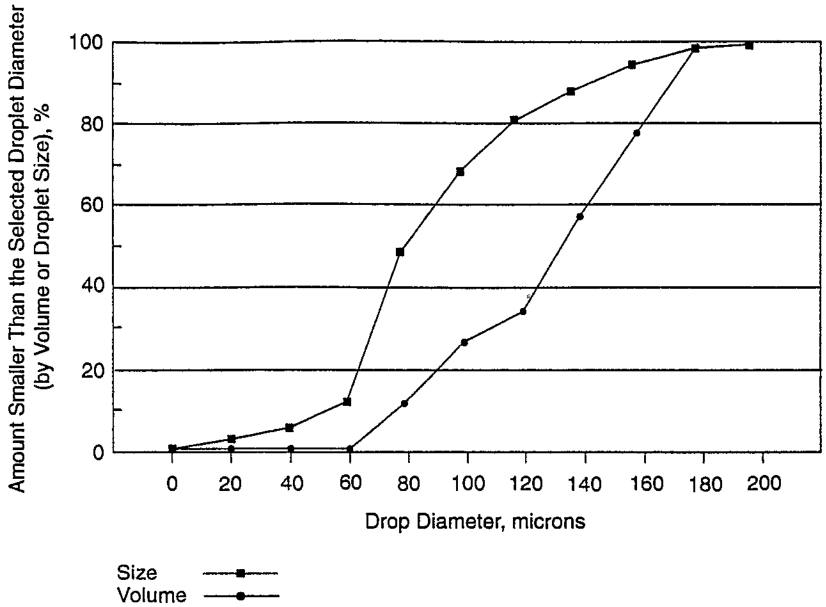

Figure 5.24 **Oil droplet size distribution in stormwater from petroleum products storage facilities.**

Sizing Conventional Separators. To size a conventional separator, first compute the depth:

$$D = \sqrt{\frac{Q}{2V}} \tag{5.15}$$

Where

D = depth, which should be between 0.9 and 2.4 m (3 and 8 ft);
Q = design flow rate, m^3/s (cfs); and
V = allowable horizontal velocity, no more than 15 times the design oil rise rate but not greater than 55 m/h (0.05 ft/sec).

If the computed depth exceeds 2.4 m (8 ft), design additional parallel units such that, at the design flow rate, the maximum recommended depth of 2.4 m (8 ft) is not exceeded. Minimum depth is 0.9 m (3 ft).

The next steps are

- Calculate length, $L = I \cdot D/V_p$;
- Select width, W = 2 to 3 times the depth, but not to exceed 6 m (20 ft);
- Baffle height-to-depth ratio of 0.85 for top baffles and 0.15 for bottom baffles;
- Locate the distribution baffle at 0.10L from the entrance;

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- Add 0.3 m (1 ft) for freeboard; and
- Install an inlet flow control and a bypass for flows in excess of the design flow.

Sizing Separators. Manufacturers can provide packaged separator units for flows up to several cubic metres (cubic feet) per second. For larger flows, the engineer must size the plate pack and design the vault. Given the variability of separator technology among manufacturers with respect to plate size, spacing, and inclination, it is recommended that the design engineer consult vendors for a plate package that will meet the engineer's criteria.

The engineer can size the facility using the following procedure. First, identify the expected plate angle (vertical above horizontal), H, in degrees, and calculate the total plate area required, A, in square metres (square feet):

$$A = \frac{Q}{V_P \cdot \cos(H)} \qquad (5.16)$$

where the terms are the same as defined under Equations 5.14 and 5.15.

Coalescing plate interceptor separators are not 100% hydraulically efficient, ranging from 0.35 to 0.95 depending on the plate design. If the engineer wishes to incorporate this factor, divide the result from Equation 5.16 by the selected efficiency.

- Select spacing, S, between the plates, typically 19 to 38 mm (0.75 to 1.5 in.).
- Identify reasonable plate width, W, and length, L.
- Number of plates $N = A/(W \cdot L)$.
- Calculate plate volume, P_v, m^3 (cu ft).

$$P_V = \left[\frac{N \cdot S}{12} + L \cdot \cos(H)\right] \cdot [W \cdot L \cdot \sin(H)] \qquad (5.17)$$

- Add 0.3 m (1 ft) beneath the plates for sediment storage.
- Add 0.1 to 0.3 m (6 to 12 in.) above the plates for water clearance so that the oil accumulates above the plates.
- Add 0.3 m (12 in.) for freeboard.
- Add a forebay for floatables and distribution of flow if more than one plate unit is needed.
- Add an afterbay for collection of the effluent from the plate pack area.
- For larger units include a device to remove and store oil from the water surface.

Horizontal plates require the least plate volume to achieve a particular removal efficiency.

Settleable solids will accumulate on the plates, complicating maintenance procedures. Experience shows that, even with slanted plates, some solids will stick to the plates because of the oil and grease. If debris is expected such as sticks, plastics, and paper, then select a larger plate separation distance. As an alternative, install a trash rack or screens with smaller openings than the plate spacing. The plates may be damaged by the weight when removed for cleaning.

MAINTENANCE. Check monthly during the wet season and clean several times a year. Always clean before the start of the wet season. Properly dispose of the oil.

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Ocean Water
Regulatory & Monitoring Protocol

County of Los Angeles
Department of Health Services
Public Health Programs and Services
Environmental Health
Recreational Health Program
(Revised 5/5/99)

R0017597

PROGRAM DESCRIPTION

The Recreational Health Program is responsible for the ocean water contact sports area regulatory program. The program enforces laws and regulations regarding beach sanitation and water quality standards. Elements of the program include ocean water monitoring, posting of warning signs on beaches when State standards are not met and emergency response including beach closure when a sewage or chemical spill occurs.

REGULATORY PROGRAM

The California Health and Safety Code, Section 11580 and the California Code of Regulations, Title 17, Sections 7956-7962, authorize the local health officer to conduct ocean water bacteriological monitoring and take corrective action when standards are not met. The County of Los Angeles Department of Health Services (DHS) conducts a comprehensive regulatory program. A routine ocean water monitoring program is conducted through sample collection and bacterial analyses. Minimum standards prescribed by the State constitutes the basis for regulatory action.

Incident reports involving the discharge of sewage not meeting Waste Discharge Requirements established by the California Regional Water Quality Control Board are received and evaluated according to the policy outlined below. Reports of hazardous material discharges affecting the beach and surf zone waters are investigated by the appropriate agency. Information and reports received as a result of these investigations are received and evaluated.

In order to effectively discharge the duties of the health officer in regard to ocean water contact sports areas, a beach warning, beach closure and rain advisory policy have been developed and implemented.

BEACH WARNING, CLOSURE AND RAIN ADVISORY POLICY

BEACH WARNING: Regulatory action taken by the health officer posting " Beach Warning" signs in areas where a storm drain discharges to the ocean or where bacteria levels exceed State bacteriological single sample standards as set forth in the California Code of Regulations, Title 17. DHS will direct the Los Angeles County, Fire Department, Lifeguard Division, (LD) to post affected portions of the beach with "Beach Warning" signs. This information will be made available via a telephone hotline.

BEACH CLOSURE: Regulatory action taken by the health officer closing an affected area of beach. This action is taken when there is a known incident of sewage pollution or chemical contamination of ocean water. DHS will direct the Los Angeles County, Fire Department, Lifeguard Division, (LD) to close affected portions of the beach and post "Beach Closure" signs. The DHS Public Information Office will issue as soon as practicable a public advisory through the wire services explaining which beach areas are closed and why. In addition, this information will be made available via a telephone hotline.

HAZARDOUS MATERIALS DISCHARGE: Beaches impacted by the discharge of a verified hazardous material (visible material, strong odor, etc.).

ELEVATED BACTERIA LEVELS: Bacteria levels that exceed State bacteriological single sample standards as set forth in the California Code of Regulations, Title 17.

PUBLIC NOTIFICATION: The DHS Public Information Office will issue a public advisory as soon as practicable to the wire services whenever an advisory due to rain is issued or when a beach area is closed. In addition, this information will be made available via a telephone hotline.

BEACH RAINFALL ADVISORY: Action taken by the health officer when a significant rainstorm is predicted or as one occurs. The DHS Public Information Office will issue as soon as practicable a public advisory through the wire services explaining that storm drain flows may cause elevated bacterial counts for 72 hours and ocean water contact, especially in areas adjacent to storm drain flows, should be avoided. In addition, this information will be made available via a telephone hotline.

MONITORING PROGRAM

DHS routinely collects ocean water samples at 38 sampling locations from Ventura County, south to Redondo Beach Pier and on Catalina Island. The majority of sampling points are located at frequented beaches and in the vicinity of storm drains.

Samples are collected from ankle to knee-deep water, approximately 4 to 24 inches below the water surface in the surf zone.

Sample analyses are conducted by the Department of Health Service's laboratory for total coliform, fecal coliform and enterococcus bacteria. Bacterial analysis is made in accordance with procedures recommended by the latest edition of Standard Methods for Examination of Water and Wastewater.

Analyses are completed within 24-48 hours from the time samples are collected. Results are obtained from the laboratory via email. The laboratory will telephone results sooner if unusually high counts are detected.

Samples are collected every Monday. Samples from Catalina Island are collected every Tuesday between April 1st and October 31st. Holidays may require samples to be collected on alternate days due to laboratory scheduling requirements.

SUPPLEMENTAL MONITORING DATA FROM OTHER AGENCIES

The Los Angeles City, Bureau of Sanitation, Environmental Monitoring Division (EMD) laboratory provides the Recreational Health Program with daily bacteriological data for 20 shoreline stations with daily data for total coliform and fecal coliform. Tests for enterococcus bacteria are conducted five times a month. Data for Ballona Creek, selected storm drains and special sampling results are also included. Data is provided daily via email. Results are normally obtained within 24 - 48 hours except on weekends and holidays.

The Los Angeles County Sanitation District collects 8 shore samples from Malaga Cove to Outer Cabrillo Beach and conducts analyses for total coliform, fecal coliform and enterococcus bacteria. The Los Angeles County Sanitation District laboratory provides the Recreational Health Program with sampling results every Monday and Tuesday via fax.

DATA TABULATION

Samples results are reported, stored and analyzed using Microsoft Excel. Samples reported as "greater than" or "less than" are recorded as the number reported (e.g. >16,000 will be recorded as 16,000 and <10 as 10).

A summary report of samples collected by the Department of Health Services is prepared and distributed monthly using Microsoft Excel.

BACTERIOLOGICAL STANDARDS

Based on a single sample, the density of bacteria in water from each sampling station at a public beach or public water contact sports area shall not exceed:

10,000 total coliform bacteria per 100 ml or

400 fecal coliform bacteria per 100 ml or

104 enterococcus bacteria per 100 ml or

1,000 total coliform bacterial per 100 milliliters, if the ratio of fecal/total coliform bacteria exceeds 0.1.

SIGNS

There shall be three types of signs that are used to warn the public of hazardous conditions in ocean waters:

1. **BEACH CLOSURE SIGN** (aka "Yellow Sign") - This sign shall be posted when a beach

is closed due to a sewage spill or chemical contamination. The sign shall have the following verbiage in both English and Spanish:

Beach Closed - Sewage Contaminated Water - Contact May Cause Illness

The words "KEEP OUT" shall be in red letters and the remaining words in black letters on a yellow background. There shall be a graphic depiction of a swimmer in a red circle with a diagonal hash mark

2. **STORM DRAIN WARNING SIGN** (aka "White Sign") - This sign shall be posted at or in front of any flowing storm drain or creek discharging into the ocean. The sign shall have the following verbiage in both English and Spanish:

   WARNING - Storm Drain Water May Cause Illness

   The words "WARNING" shall be in red letters and the remaining words in black letters on a white background. There shall be a graphic depiction of a swimmer in a red circle with a diagonal hash mark and a yellow/black striping on the border.

3. **BEACH WARNING SIGN** (aka "Brown Sign") - This sign shall be posted at areas of beach where testing indicates that bacteria levels exceed State bacteriological single sample standards. The sign shall have the following verbiage in both English and Spanish:

   WARNING - Ocean Water Contact May Cause Illness - Bacteria Levels Exceed Health Standards

   The words "WARNING" shall be in red letters and the remaining words in black letters on a light brown background. There shall be a graphic depiction of a swimmer in a red circle with a diagonal hash mark and a red/black striping on the border.

PROCEDURES DURING SEWAGE SPILLS

A. All information and actions taken shall be recorded in the incidence log book maintained by the Recreational Health Program.
B. The following information should be obtained from the person reporting the spill:
   1. Location of spill.
   2. Whether sewage has entered or will enter ocean waters.
   3. Time the spill began and ended and the estimated number gallons involved.
   4. If flow is continuing, the estimated time of repair and present flow rate.
   5. Cause of the spill.
   6. Actions taken.
   7. Agencies involved in repairs and cleanup.
C. Affected areas of beach shall be closed as soon as possible regardless of bacteria levels.

D. Recreational Health Program staff assigned to driving beach emergency response vehicles may be reached by cellular telephone or pager. All affected Environmental Health programs should coordinate their activities.

E. When any beach or portion of beach is closed due to a sewage or chemical discharge, the notification list in Appendix I should be used.

F. GUIDELINES TO SAMPLING POINTS IN RELATION TO SIZE OF SEWAGE SPILL

Bacteriological water monitoring activities may be coordinated with other agencies, e.g., City of Los Angeles, Los Angeles County Department of Public Works, Los Angeles County Sanitation District.

Generally, in large spills, e.g. spills exceeding 500,000 gallons, enough time should be given for the spill to spread its maximum distance before assuming that negative bacteria results indicate safe levels.

The following is a suggested guideline for bacteriological sampling:

Less than 1,000 gallons	minimum of 3 samples within and at the limits of the closure zone
1,000 - 10,000 gallons	minimum of 5 samples within and at the limits of the closure zone
10,000 - 100,000 gallons	minimum of 7 samples within and at the limits of the closure zone
100,000 - 1 million gallons	minimum of 9 samples within and at the limits of the closure zone
1 - 2 million gallons	minimum of 11 samples within and at the limits of the closure zone
Over 2 million gallons	minimum of 13 samples within and at the limits of the closure zone

Circumstances and available data may dictate alternative courses of action.

PROCUDURES DURING ELEVATED BACTERIA LEVELS

A. All information and actions taken shall be recorded in the incidence log book maintained by the Recreational Health Program.

B. Elevated bacterial levels exist when any of the single sample standards are exceeded:

C. When a sampling station exhibits elevated bacterial levels, when practicable, a resample shall be taken between 24-48 hours after the initial sample. When resampling, a minimum of three samples shall be taken.

D. When there is an elevated bacterial level the following guidelines shall be followed:
   - All storm drains continually discharging or intermittently discharging during dry weather into the ocean shall be posted with a "Storm Drain Warning" sign at the point where the discharge meets the surf zone.
   - When a sampling station, in proximity to a storm drain, exceeds single State standards, "Beach Warning" signs shall be posted at 50 and 100 yards either side of the storm drain or where the point of discharge meets the surf zone. If not already posted, A "Storm Drain Warning" sign shall be posted directly in front of the storm drain or where the point of discharge meets the surf zone. Posting patterns and distances may vary depending on bacteria levels and local geographic conditions.
   - When a sampling station, not in proximity to a storm drain, exceeds single State standards, "Beach Warning" signs shall be posted at the sampling station and 50 yards either side of the sampling station. Posting patterns and distances may vary depending on bacteria levels and local geographic conditions.
   - Areas with a chronic history of elevated bacteria levels exceeding State standards, may be posted continuously with "Beach Warning" signs.

PROCEDURES DURING RAINFALL EVENTS

A. A rainfall event shall begin anytime there is greater than or equal to 0.1 inches of precipitation recorded by the National Weather Service at the Los Angeles Civic Center.

B. A rainfall event shall end 72 hours after cessation of all precipitation as recorded by the National Weather Service at the Los Angeles Civic Center.

C. A rainfall event may be declared if significant precipitation is recorded in other parts of Los Angeles County and not at the Los Angeles Civic Center.

E. When a rainfall event is declared the DHS Public Information Office will issue as soon as practicable a public advisory through the wire services explaining that storm drain flows may cause elevated bacterial counts for 72 hours and ocean water contact, especially in areas adjacent to storm drain flows, should be avoided. In addition, this information will be made available via a telephone hotline.

F. All flowing storm drains shall be posted during a rainfall event.

BEACH CLOSURE GUIDELINES IN THE EVENT OF A SEWAGE SPILL

Beaches affected by a known discharge of untreated or partially treated sewage not meeting the Waste Discharge Requirements established by the California Regional Water Quality Control Board.

Guidelines for closure are:

Less than 1,000 gallons = 100 yards - ¼ mile each side of discharge

1,000 to 10,000 gallons	=	¼ - ½ mile each side of discharge
10,000 to 100,000 gallons	=	¾ - 1 mile each side of discharge
100,000 to 1 million gallons	=	2 - 3 miles each side of discharge
1 to 2 million gallons	=	4 - 5 miles each side of discharge
More than 2 million gallons	=	minimum 5 miles each side of discharge

Samples will be collected at locations to be determined on the basis of reported volume of the spill, prevailing winds and currents, location of the discharge and the extent of the closure.

REOPENING BEACH AREAS

A. Beach areas that were closed due to a know release or spill of untreated or inadequately treated sewage shall be reopened when it has been determined that the source of the sewage release has been eliminated, the closure was for a minimum of 48 hours and all resampling results meet State standards.

B. Beach areas closed because of elevated bacteriological levels shall be reopened when all resampling results meet State standards

C. Beaches closed because of a hazardous materials discharge shall be reopened when the responsible County agency conducts an on-site inspection and the health officer determines that there is no significant risk to public health.

APPENDIX II

MONITORING LOCATIONS

Agency	No.	Monitoring Location
DHS	012	Leo Carrillo State Beach, 35000 Pacific Coast Hwy., Malibu. [in front of beach restrooms]
DHS	011	Nicholas Beach. [100 feet west of lifeguard tower]
DHS	010	Broad Beach, 31138 Broad Beach Rd., Malibu. [in front of public access stairs]
DHS	009	Trancas Beach, 30600 Pacific Coast Hwy., Malibu. [mouth of Trancas Creek]
DHS	008	Westward Beach, 6800 Westward Beach Rd., Malibu [in front of Monroe's restaurant]
DHS	007	Paradise Cove, 28128 Pacific Coast Hwy., Malibu [in front of the Sand Castle restaurant, 100 yds. west of the pier]
DHS	006	26610 Latigo Shore Drive., Malibu [in front of Latigo Bay Villa treatment plant]
DHS	005	Corral Beach, 26100 Pacific Coast Hwy., Malibu [at lifeguard station by bridge]
DHS	004	Malibu Point, Malibu Colony Dr., Malibu [50 yds. West of breech or at fence, east side]
DHS	003	Surfrider Beach, Malibu [50 yds. east of breech or in front of restrooms]
HYP	S1	Surfrider Beach, Malibu. [50 yds. east of breech]
DHS	002	Malibu Pier, Malibu [50 yards east of pier]
DHS	001	Big Rock Beach, 19900 Pacific Coast Hwy., Malibu [off point]
HYP	S2	Topanga Point, Malibu [in front of lifeguard station]
DHS	101	17200 Pacific Coast Hwy., Pacific Palisades. [1/4 mile east of Gladstone's restaurant and Sunset storm drain]
DHS	102	Bel Air Bay Club, 16801 Pacific Coast Hwy., Pacific Palisades. [at the chain link fence just east of the Bay Club]

HYP	S3	Puiga storm drain, Pacific Palisades. [50 yards east of storm drain]
DHS	103	Temescal storm drain, 15100 Pacific Coast Hwy., Pacific Palisades. [at the Will Rogers Beach lifeguard headquarters, 50 yards east of storm drain]]
HYP	S4	Santa Monica Canyon storm drain. Pacific Palisades.[50 yards east of storm drain]
DHS	104	San Vincente Blvd., extended, Santa Monica. [east side of Santa Monica Swim Club]
DHS	105	Montana Avenue extended, Santa Monica. [50 yards east of storm drain]
DHS	106	400 feet east of Wilshire Blvd., Santa Monica. [at tallest building]
HYP	S5	Santa Monica Pier, Santa Monica. [50 yards south of pier]
HYP	S6	Pico-Kenter storm drain, Santa Monica. [50 yards south of storm drain]
DHS	107	Strand Street extended, Santa Monica. [in front of restrooms]
DHS	108	Ashland storm drain, Santa Monica. [50 yards north of storm drain]
HYP	S7	Ashland storm drain, Santa Monica [50 yards south of storm drain]
DHS	109	Brooks Ave. extended, Los Angeles. [50 yards south of Brooks storm drain]
HYP	S8	Windward storm drain, Los Angeles. [50 yards north of storm drain]
DHS	110	Venice Pier, Venice. [50 yards south of pier]
DHS	111	Topsail Street extended, Venice.
DHS	112	Marina del Rey Beach, Marina del Rey. [extreme south end of swim area]
HYP	S9	Marina del Rey Beach. Marina del Rey. [at lifeguard tower]
DHS	113	Marina del Rey Beach, Marina del Rey. [extreme north end of swim area]
DHS	114	Jet ski launch. Basin H, Marina Del Rey.
HYP	S10	Ballona Creek, Playa del Rey. [50 yards south]
HYP	S11	Culver Blvd. extended, Playa del Rey. [north side of Culver storm drain]
DHS	115	World Way extended, Playa Del Rey. [.15 miles south of maintenance building, south of jetty]
HYP	S12	Imperial Highway storm drain, Playa Del Rey. [50 yards north of storm drain]

DHS	116	Opposite Hyperion plant, Playa Del Rey. [at the one mile outfall pipe (marked by sign on beach)]
DHS	117	Grand Avenue extended, El Segundo.
HYP	S13	40th Street extended, Manhattan Beach.
HYP	S14	Manhattan Beach Pier, Manhattan Beach. [50 yards south of pier]
DHS	118	26th Street extended, Hermosa Beach.
HYP	S15	Hermosa Beach Pier, Hermosa Beach. [50 yards south of pier]
DHS	119	Herondo Street extended, Redondo Beach. [50 yards north of Herondo storm drain]
HYP	S16	Redondo Pier, Redondo Beach. [50 yards south of pier]
DHS	120	Topaz Street extended, Redondo Beach. [north side of jetty]
HYP	S17	Avenue I extended, Redondo Beach. [50 yards south of storm drain]
HYP	S18	Arroyo Circle, extended, Malaga Cove, Palos Verdes Estates.
LACSD	MC	Malaga Cove, Palos Verdes Estates
LACSD	BC	Bluff Cove, Palos Verdes Estates
LACSD	S1	Long Point, Rancho Palos Verdes.
LACSD	S2	Abalone Cove, Rancho Palos Verdes.
LACSD	S3	Portuguese Bend, Rancho Palos Verdes.
LACSD	S5	White Point, San Pedro. [Western Avenue extended]
LACSD	S6	Wilder Addition Park, San Pedro.
LACSD	S7	Outer Cabrillo Beach, San Pedro.
TI	CB1	Inner Cabrillo Beach, San Pedro. [off of boat launch south side]
TI	CB2	Inner Cabrillo Beach, San Pedro. [in front of the lifeguard tower]
DHS	121	Avalon Beach [Adjacent to Storm Drain at South end of beach]
DHS	122	Avalon Beach [50 yds. South of Green Pleasure Pier]
DHS	123	Avalon Beach [Under the Green Pleasure Pier]
DHS	124	Avalon Beach [50 yds. North of Green Pleasure Pier]

DHS	125	Avalon Beach [Adjacent to Busy Bees Restaurant, South side]
DHS	126	Avalon Beach [Between Busy Bee Restaurant and Tuna Club]

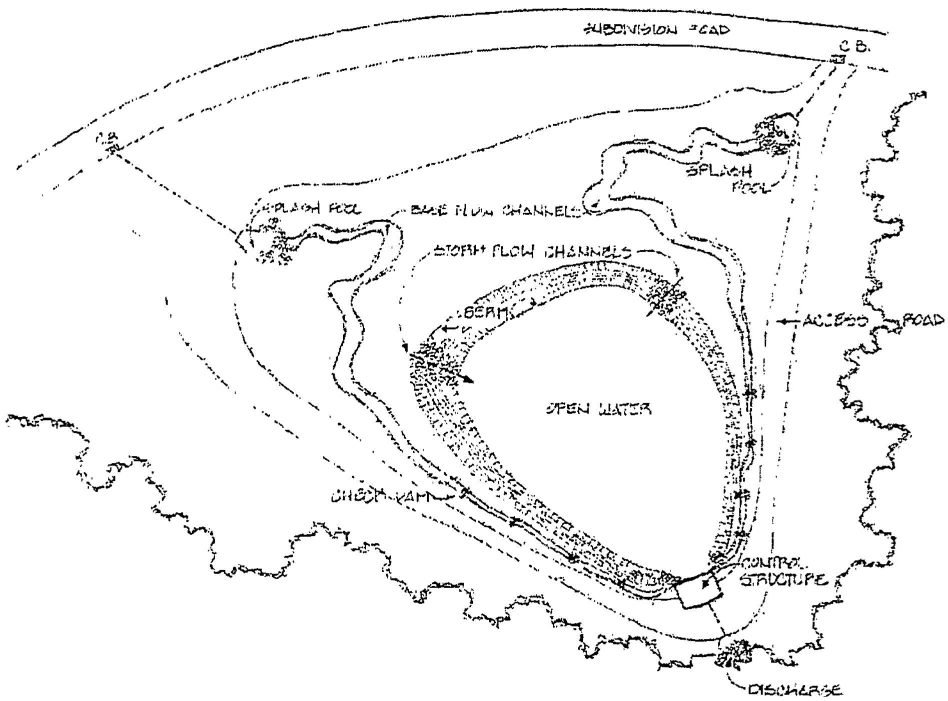
KEY

AGENCIES
DHS Department of Health Services
HYP Los Angeles City Bureau of Sanitation, Hyperion Laboratory
TI Los Angeles City Bureau of Sanitation, Terminal Island Laboratory
LACSD Los Angeles County Sanitation District

Appendix II revised (5/99)

United States Environmental Protection Agency
Office of Water (4303) Washington, DC 20460
EPA-821-R-99-012 August 1999

EPA Preliminary Data Summary of Urban Storm Water Best Management Practices



R0017609

United States Environmental Protection Agency
Office of Water Washington, D C.
EPA 832-F-99-024 September 1999

Storm Water Management Fact Sheet
Storm Water Contamination Assessment

DESCRIPTION

A Storm Water Contamination Assessment (SWCA) reviews a facility and/or a site to find materials or practices that may contaminate storm water. This assessment helps target the most important pollutant sources for correction or prevention.

A SWCA program is closely related to other BMPs, such as materials inventory, non-storm water discharges, record keeping, and visual inspections.

APPLICABILITY

An SWCA program is applicable to any industrial facility which contains areas, activities, or materials which may contribute pollutants to storm water runoff from the total site. An assessment for storm water purposes may also be applicable in situations where a formal site assessment for hazardous waste purposes is being performed.

ADVANTAGES AND DISADVANTAGES

A comprehensive SWCA program can eliminate pollution sources that can impair receiving water quality. However, there are limitations associated with a contamination assessment program, including:

- Assessments need to be performed by qualified personnel.
- Assessments are useful only if there is corporate commitment to reduce any contamination sources discovered.
- Assessments need to be periodically updated.

KEY PROGRAM COMPONENTS

A SWCA program should include:

- Assessing potential pollutant sources and associated high risk activities such as loading and unloading operations, outdoor storage activities, outdoor manufacturing or processing activities, dust- or particulate-generating activities, and on-site waste disposal practices.
- Determining which of these sources pose the greatest risks of polluting storm water runoff from the site.
- Selecting other cost-effective BMPs to prevent or control pollution from the high-risk sources at the site.

IMPLEMENTATION

In addition to identifying problems within the storm sewer system, it is even more important to prevent problems from developing at all, and to provide an environment in which future problems can be avoided. Thus, an effective storm water assessment program should include follow-up activities including:

- Educating the public about the consequences of misusing storm sewers.
- Pretreating industrial storm water or disconnecting commercial and industrial storm water entries into the storm drainage system.
- Tackling the problem of widespread septic system failure.

- Disconnecting direct sanitary sewerage connections from the storm sewer system.

- Rehabilitating storm or sanitary sewers to abate infiltration by contaminated water.

- Developing zoning and other ordinances.

In some communities that are assumed to have separate sanitary and storm sewer systems, the storm sewer system may actually act as a combined sewer system. In these cases, the community may consider designating the storm sewer system a combined sewer and treating the discharge.

A SWCA program and the related correction program need to be periodically updated, based on their effectiveness and on the introduction of new raw materials or changes in processes at the site.

Because the results and performance of a SWCA program depend on the severity of the risks uncovered and the corrective actions taken, it is difficult to quantify the water quality benefits of a risk assessment program. Clearly, however, a program that identifies potential pollution sources and corrects them will improve water quality.

COSTS

Costs for the initial assessment may be high. However, by pinpointing high risk areas, a risk assessment may reduce overall costs associated with a complete BMP implementation program. The costs associated with a risk assessment program for storm water are small when compared with those of an overall hazardous waste site assessment.

REFERENCES

1. Pitt, R., D. Barbe, D. Adrian, and R. Field, 1992. *Investigation of Inappropriate Pollutant Entries into Storm Drainage System - A User's Guide*, U.S. EPA, Edison, New Jersey.

2. U.S. EPA, 1981. *NPDES Best Management Practices Guidance Document.*

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United States Environmental Protection Agency
Office of Water Washington, D.C.
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September 1999

EPA

Storm Water Management Fact Sheet
Coverings

DESCRIPTION

Covering is the partial or total enclosure of raw materials, byproducts, finished products, containers, equipment, process operations, and material storage areas that, when exposed to rain and/or runoff, could contaminate storm water. Tarpaulins, plastic sheeting, roofs, buildings, and other enclosures are examples of temporary or permanent coverings that are effective in preventing storm water contamination. The most prominent advantage of covering is that it is inexpensive in comparison to other BMPs.

APPLICABILITY

A review of numerous NPDES group applications indicates that covering is a commonly implemented BMP. As more facilities identify potential sources of storm water contamination, the use of coverings will increase significantly due to their effectiveness from a performance and cost perspective.

Covering is appropriate for loading/unloading areas, raw material, byproduct, and final product outdoor storage areas, fueling and vehicle maintenance areas, and other high risk areas.

ADVANTAGES AND DISADVANTAGES

Covering is a simple and effective storm water management BMP. Its advantages relative to other storm water management BMPs include its comparative ease of implementation, its potential low cost, and its widespread applicability.

Disadvantages associated with covering as a BMP include:

- Temporary covering methods, such as plastic sheeting, can become torn or ripped, exposing the contaminant to precipitation and/or storm water runoff.
- Costs may prohibit the building of complete enclosures.
- Health or safety problems may develop with enclosures built over certain materials or activities.
- Coverings require frequent inspection.
- A structure with only a roof may not keep out all precipitation.

The impact from a covered area depends on the degree of complexity in the covering design. Simple plastic sheeting can possibly create a storm water diversion, and allow for disposal of uncontaminated water to a storm sewer. An appropriate structure with a permanent roof may be less effective, if the material inside is not sufficiently protected from contact with runoff. An enclosed structure may need to have internal drainage. However, if the stored material is considered hazardous, it must not be connected to the storm sewer. Depending on the site's NPDES permit, connection to a sanitary sewer may also be unsuitable. The internal drains would then need to be connected to some suitable containment area for later pretreatment and disposal.

IMPLEMENTATION

When implementing a program to cover materials to reduce their exposure to runoff, one must first choose the proper covering. When deciding on a covering, it is necessary to evaluate the integrity and durability of the covering, as well as its compatibility with the material or activity being covered.

Covering alone may not protect exposed materials from storm water contact. Placing material on an elevated impermeable surface or building curbing around the outside of the materials may be required to prevent contact with storm water runoff from adjacent areas. If the program calls for a material to be enclosed, the designer should consider materials access, handling, and transfer during the design of the enclosure. Materials that pose environmental and/or safety dangers because they are radioactive, pathogenic, flammable, explosive, or reactive, require special ventilation and temperature design considerations.

In addition to properly designing an enclosure or cover, practicing proper materials management within an enclosure or underneath a covered area is essential. For example, floor drainage within an enclosure should be properly designed and connected to a sanitary sewer. The local publicly owned treatment works should be consulted to determine if there are any pretreatment requirements, restrictions, or compatibility problems prior to discharge of the storm water.

Based on data currently available, it is difficult to quantify the mitigation of runoff contamination when covering is used. However, significant runoff water quality benefits are expected by simply reducing the contact between potential contaminants and precipitation or storm water runoff. One source has estimated that 80 percent of the environmental damage from de-icing chemicals is caused by inadequate storage facilities.

Inspecting coverings must be part of an overall preventive maintenance program. Maintenance involves frequent inspection of the covering for rips, holes, and general wear.

COSTS

Covering costs vary in proportion to the degree of protection desired, and the required life span. The most inexpensive covering is plastic sheeting, but it is not suitable where a high degree of protection is desired for a long period. An enclosed building is the most expensive type of covering when materials for the structure, lighting, and ventilation are considered, but it offers the highest degree of protection for the longest period.

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2. U.S. EPA, 1992. *Summary Guidance: Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practice.* EPA 833-R92-002, U.S. EPA, Washington, DC.

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United States Environmental Protection Agency
Office of Water Washington, D.C.
832-F-99-005
September 1999

EPA

Storm Water Management Fact Sheet
Record Keeping

DESCRIPTION

Keeping records of spills, leaks, and other discharges can help a facility run more efficiently and cleanly. Records of past spills contain useful information for improving Best Management Practices (BMPs) to prevent future spills. Typical items that should be recorded include the results of routine inspections, and reported spills, leaks, or other discharges.

Records should include:

- The date, exact place, and time of material inventories, site inspections, sampling observations, etc.
- Names of inspector(s) and sampler(s).
- Analytical information, including the date(s) and time(s) analyses were performed or initiated, the analysts' names, analytical techniques or methods used, analytical results, and quality assurance/quality control results of such analyses.
- The date, time, exact location, and a complete characterization of significant observations, including spills or leaks.
- Notes indicating the reasons for any exceptions to standard record keeping procedures.
- All calibration and maintenance records of instruments used in storm water monitoring.
- All original strip chart recordings for continuous monitoring equipment.
- Records of any non storm water discharges.

Figure 1 shows a sample worksheet for tracking spills and leaks.

Record keeping is usually coordinated with internal reporting and other BMPs, and is often integrated into the development of a facility's Storm Water Pollution Prevention Plan (SWPPP) as part of the facility's NPDES storm water discharge permit.

APPLICABILITY

Records keeping is a basic business practice and is applicable to all facilities. If a separate record keeping system for tracking BMPs, monitoring results, etc., is not currently in place at a facility, existing record keeping structures can be easily adapted to incorporate this data. An ideal tool for implementation is the record keeping procedures laid out in an SWPPP.

ADVANTAGES AND DISADVANTAGES

Record keeping is a simple, easily implemented, and cost effective management tool. Complete, well-organized records can help ensure proper maintenance of facilities and equipment and can aid in determining the causes of spills and leaks; thus, record keeping can protect water quality by helping to prevent future leaks and spills.

Limitations of a record keeping system may including the following:

- Records must be updated regularly.

- Personnel completing and maintaining records must be trained to update records correctly.

- The records need to be readily accessible.

- Records containing any confidential information must be secured.

IMPLEMENTATION

The key to maintaining records is continual updating. Ensure that new information, such as analytical results, is added to existing inspection records or spill reports as it becomes available. In addition, update records if there are changes to the number and location of discharge points, principal products, or raw material storage procedures. Maintain records for least five years from the date of sample observation, measurement, or spill report. Some simple techniques used to accurately document and report results include:

- Field notebooks.

- Timed and dated photographs.

- Videotapes.

- Drawings and maps.

- Computer spreadsheets and database programs.

COSTS

Costs are those associated with staff hours used to develop and implement a record keeping system, costs for analyzing samples, and company overhead costs. Figure 2 is a sample worksheet that can be used to determine annual record keeping costs. Table 1 is an example of a completed record keeping costs sheet.

REFERENCES

1. California Environmental Protection Agency, August 17, 1992. Staff Proposal for Modification to Water Quality Order No. 91-13 DWQ Waste Discharge Requirements for Dischargers of Storm Water Associated with Industrial Activities, Draft Wording, Monitoring Program and Reporting Requirements.

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LIST OF SIGNIFICANT SPILLS AND LEAKS	Worksheet Completed by: ______________________ Title: ______________________ Date: ______________________

Directions: Record below all significant spills and significant leaks of toxic or hazardous pollutant that have occurred at the facility in the three years prior to the effective date of the permit.

Definitions: Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of reportable quantities.

1st Year Prior										
				Description				Response Procedure		
Date (mo/day/yr)	Spill	Leak	Location (as indicated on site map)	Type of Material	Quantity	Source, If Known	Reason	Amount of Material Recovered	Material No Longer Exposed to Storm Water (True / False)	Preventive Measure Taken
2nd Year Prior										
				Description				Response Procedure		
Date (mo/day/yr)	Spill	Leak	Location (as indicated on site map)	Type of Material	Quantity	Source, If Known	Reason	Amount of Material Recovered	Material No Longer Exposed to Storm Water (True / False)	Preventive Measure Taken
3rd Year Prior										
				Description				Response Procedure		
Date (mo/day/yr)	Spill	Leak	Location (as indicated on site map)	Type of Material	Quantity	Source, If Known	Reason	Amount of Material Recovered	Material No Longer Exposed to Storm Water (True / False)	Preventive Measure Taken

Source: U.S. EPA, 1992.

FIGURE 1 SAMPLE WORKSHEET FOR TRACKING SPILLS AND LEAKS

Title	Quantity		Average Hourly Rate ($)		Overhead Multiplier		Estimated Yearly Hours on SW Training		Estimated Annual Cost($)
______	______	x	________	x	_______	x	__________	=	_______ (A)
______	______	x	________	x	_______	x	__________	=	_______ (B)
______	______	x	________	x	_______	x	__________	=	_______ (C)
______	______	x	________	x	_______	x	__________	=	_______ (D)

Total Estimated Annual Reporting Cost _______

(Sum of A+B+C+D)

Source: U.S. EPA, 1992.

FIGURE 2 SAMPLE ANNUAL RECORD KEEPING COST WORKSHEET

TABLE 1 EXAMPLE OF ANNUAL RECORD KEEPING COSTS

Title	Quantity		Average Hourly Rate ($)		Overhead* Multiplier		Estimated Yearly Hours on SW Training		Estimated Annual Cost ($)
Storm Water Engineer	1	x	15	x	2.0	x	20	=	600
Plant Management	5	x	20	x	2.0	x	10	=	2,000
Plant Employees	100	x	10	x	2.0	x	5	=	10,000
							Total Estimated Annual Cost:		$12,600

*Note: Defined as a multiplier (typically ranging between 1 and 3) that takes into account those costs associated with payroll expenses, etc

Source: U.S. EPA, 1992.

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R0017618

ADMINISTRATIVE RECORD-
STORM WATER MANAGEMENT
FOLDER: 2, ITEM # 40

URBAN STORM DRAINAGE

CRITERIA MANUAL

volume 3 - best management practices

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

Urban Drainage and Flood Control District
Denver, Colorado September, 1999

Drainage Criteria Manual (V.3)

Update

September 1, 1999

Urban Drainage and Flood Control District

R0017620

R0017621

Urban Storm Drainage Criteria Manual

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2.0 PURPOSE OF *MANUAL*

Volume 3 of the *Urban Storm Drainage Criteria Manual* (*USDCM*) is designed to provide guidance for local jurisdictions, developers, contractors, and industrial and commercial operations in selecting, designing, maintaining, and carrying out best management practices (BMPs) to improve stormwater runoff quality. This volume of the *USDCM* covers a variety of topics related to stormwater quality BMPs and contains the following:

- An introduction to stormwater runoff quality management that includes an overview of water quality impacts and explains the selection and use of nonstructural and structural BMPs
- A discussion on stormwater runoff quality and hydrology, urban runoff, and pollutant loadings
- Technical criteria for a number of structural BMPs that are recommended for use in developing residential and commercial areas in the Denver metropolitan area and other areas with similar climate and meteorology
- Technical guidance for a number of structural BMPs that may be used at light industrial and certain commercial establishments
- A description of various nonstructural BMPs and how they may be used and implemented
- Guidance in the selection and use of erosion control practices and general management of stormwater runoff during construction
- A collection of typical details for structural BMPs

The Bibliography section for this volume includes references for all chapters. Additional materials on the topics presented in the *Manual* may be found in studying the published papers and documents listed there.

This volume is primarily targeted at developing and redeveloping residential and commercial areas. The 1999 edition of the *Manual* goes beyond its earlier edition (UDFCD, 1992) first published in 1992 by addressing BMPs for light industrial, or other types of land uses, some of which are being permitted directly by the State of Colorado or the U.S. Environmental Protection Agency. This list is not meant to be comprehensive–as information about BMPs is evaluated and refined, or new standards are promulgated by the State, additional BMPs may be added to the *Manual*. As a result, Volume 3 is expected to grow and change as the technology of stormwater BMPs matures and is refined in the future.

3.0 OVERVIEW OF *MANUAL*

Volume 3 is intended to meet the needs of a variety of users. Figure P-1 graphically illustrates the components of a Comprehensive Municipal Stormwater Quality Management Program, namely: stormwater quality programs, parties responsible for implementation of or participation in a particular program, and BMPs that can be used to satisfy the corresponding program requirements. Figure P-2 expands on Figure P-1 by detailing the BMPs that can be considered during the implementation of the various programs. These two figures give the user an overview of the contents of the *Manual.* Both the *Manual* and Figure P-1 move from general toward specific, starting with an overview chapter on Stormwater Quality Management (left portion of Figure P-1), moving through planning sections addressing New Development BMPs, Industrial and Commercial BMPs, and Construction BMPs, and then providing detailed design and implementation guidance in the Structural BMPs, Nonstructural BMPs, and Construction BMPs chapters (outlined in Figure P-2).

The *Manual* will be used by individuals associated with the development of residential property and the development or operation of industrial and commercial sites. Material included in the *Manual* will assist these individuals in determining the most applicable BMPs for each situation. The *Manual* will also benefit municipalities that address stormwater quality through land development and municipal operations. Table P-1 lists the chapters in the *Manual* relevant for various parties.

TABLE P-1
Relevant Chapters

User	Program	Volume 3 Sections
Developers/Owners	Construction, New Development, Industrial (for industrial sites)	Stormwater Quality Management, BMP Planning for New Development, Structural BMPs, Construction Site Program, Industrial and Commercial BMPs (for industrial sites)
Development Engineers	Construction, New Development	Stormwater Quality Management, BMP Planning for New Development, Structural BMPs, Construction BMPs
Contractors	Construction	Stormwater Quality Management, Construction BMPs
Municipal Staff	Public Education and Involvement, Illicit Discharges, Construction Sites, New Development, Industrial Sites	Stormwater Quality Management, BMP Planning for New Development, Structural BMPs, Industrial and Commercial BMPs, Nonstructural BMPs, Construction BMPs

4.0 LIST OF ABBREVIATIONS

>	greater than
<	less than
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BOD	Biochemical Oxygen Demand
BMPs	Best Management Practices
cfs	cubic feet per second
COD	Chemical Oxygen Demand
CRS	Colorado Revised Statutes
CSO	Combined Sewer Overflow
DCIA	Directly Connected Impervious Areas
DO	dissolved oxygen
DRCOG	Denver Regional Council of Governments
DRURP	Denver Regional Urban Runoff Program
EMCs	event mean concentrations
EPA	Environmental Protection Agency
fsp	feet per second
ft	feet
FHWA	Federal Highway Administration
H:V	horizontal to vertical ratio of a slope
i	impervious ratio of a catchment
I_a	percent imperviousness of catchment
I_{wq}	percent imperviousness of catchment
mg/L	milligrams per liter
µg/L	micrograms per liter
MS4	Municipal Separate Storm Sewer System
MSDS	Material Safety Data Sheets
MWCOG	Metropolitan Washington Council of Governments
N/A	not available
NPDES	National Pollution Discharge Elimination System
NTIS	National Technical Information Service
NURP	Nationwide Urban Runoff Program
NVDPC	Northern Virginia District Planning Commission
pH	measure of acidity
ppm	parts per million

SCS	Soil Conservation Service
SEWRPC	Southeastern Wisconsin Regional Planning Commission
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UDFCD	The Urban Drainage and Flood Control District
USDCM	*Urban Storm Drainage Criteria Manual*
USGS	United States Geological Survey
WQCV	Water Quality Capture Volume

Abbreviations of Structural BMPs in *the Manual*

GB	Grass Buffer
GS	Grass Swale – Sedimentation Facility
MBP	Modular Block Porous Pavement
PPD	Porous Pavement Detention
PLD	Porous Landscape Detention – Sedimentation Facility
EXB	Extended Detention Basin – Sedimentation Facility
SFB	Sand Filter Extended Detention Basin
CWB	Constructed Wetlands Basin – Sedimentation Facility
RP	Retention Pond – Sedimentation Facility
CWC	Constructed Wetland Channel – Sedimentation Facility

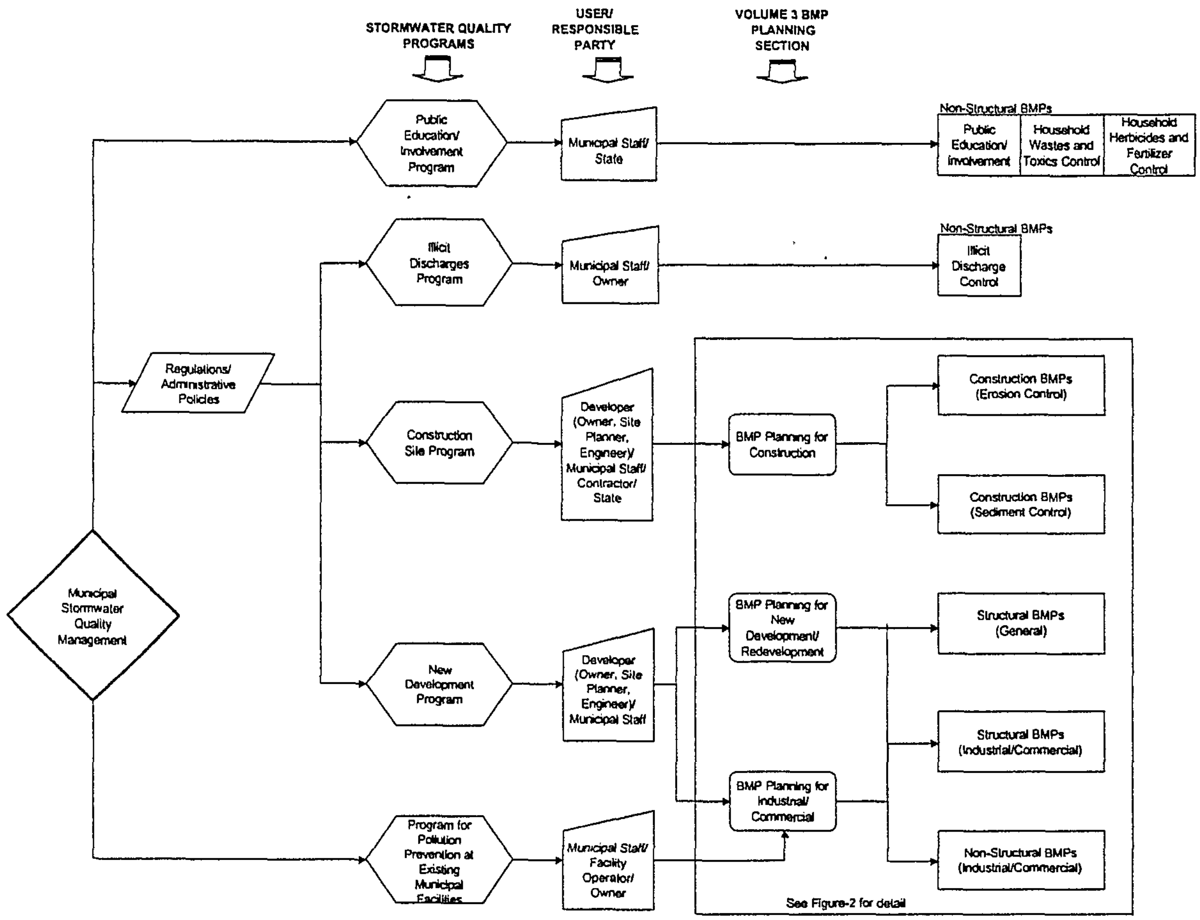

Figure P-1. User Flow Diagram of Municipal Stormwater Quality Management.

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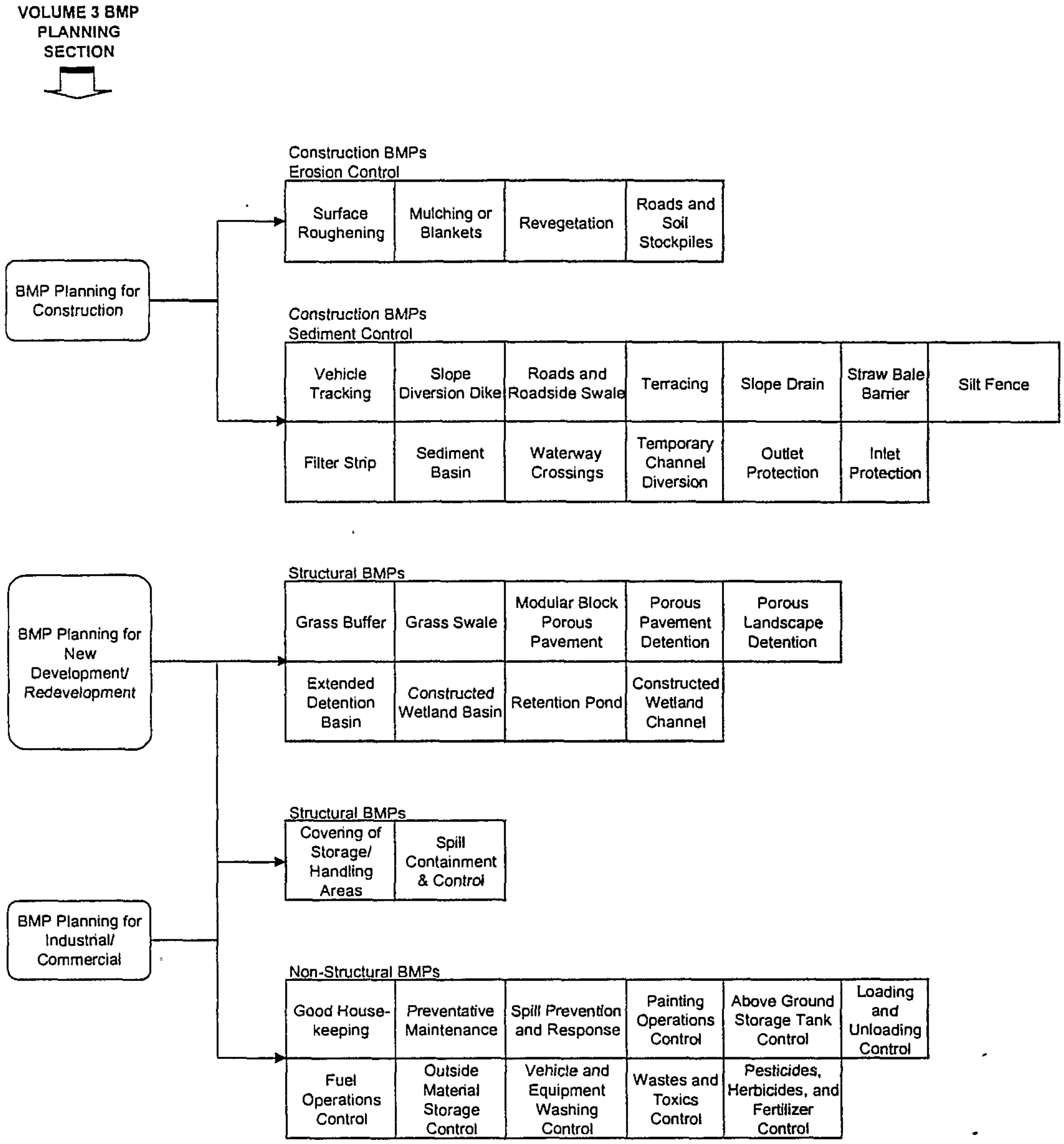

Figure P-2. Volume 3 BMP Planning Flow Diagram

STORMWATER QUALITY MANAGEMENT

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1.0 STORMWATER RUNOFF QUALITY MANAGEMENT

Most of the publics concerns with stormwater are usually related to flooding, not water quality. People complain when their basements flood or roads become impassable and the public suffers when severe catastrophic floods cause widespread damage to property and loss of life. Very few people are aware of the water quality impacts that stormwater has on our rivers, streams, or lakes. Stormwater runoff quality can have significant impacts on the receiving waters that affect not only the aquatic ecosystem, but also the quality of life in a community by the nature of the streams that run through it or the lakes within its boundaries.

1.1 Environmental Impacts of Runoff

Many people are familiar with the environmental impacts from municipal and industrial wastewater discharges. Few are aware of the existence of a stormwater drainage sewer system much less the impact that it may create to the environment. Studies have shown that runoff from urban and industrial areas can contain significant quantities of the same general types of constituents that are found in wastewater and industrial discharges.

The impacts of stormwater on streams fit into four categories. These include stream hydrology, stream morphology, water quality and aquatic ecology. The extent of impact is related to the climate, land use, and the measures implemented to address the impacts.

Briefly, the impacts on streams are:

1. Stream Hydrology: Urban development affects the environment through changes in the size and frequency of storm runoff events, changes in base flows of the stream and changes in stream flow velocities during storms results in decrease in travel time for runoff. Peak discharges in a stream can increase from urbanization due to decrease in infiltration of rainfall into the ground, loss of buffering vegetation and resultant reduced evapotranspiration. This results in more surface runoff and larger loads of various constituents found in stormwater.

2. Stream Morphology: When the hydrology of the stream changes, it results in changes to the physical characteristic of the stream. Such changes include streambed degradation, stream widening, and streambank erosion. As the stream profile degrades and the stream tries to widen to accommodate higher flows, instream bank erosions increase along with increases in sediment loads. These changes in the stream bed also result in change to the habitat of aquatic life.

3. Stream Quality: Water quality is impacted through urbanization as a result of erosion during construction, changes in stream morphology, and washing off of accumulated deposits on the urban landscape. Water quality problems include turbid water, nutrient enrichment, bacterial

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contamination, organic matter loads, metals, salts, temperature increases and increased trash and debris.

Table SQ-1 lists the common constituents in stormwater runoff and their impacts.

TABLE SQ-1
Urban Runoff Pollutants

Constituents	Sources	Effects
Sediments— TSS, Turbidity, dissolved solids	Construction sites Urban/agricultural runoff Landfills, septic fields	Habitat changes, stream turbidity, recreation and aesthetic loss, contaminant transport, bank erosion
Nutrients— Nitrate, Nitrite, Ammonia, Organic Nitrogen, Phosphate, Total Phosphorus	Lawn/Agricultural runoff, Landfills, Septic fields, Atmospheric deposition, erosion	Algae blooms, Ammonia Toxicity, Nitrate Toxicity
Pathogens— Total and Fecal Coliforms, Fecal Streptococci Viruses, E.Coli, Enteroccus	Urban/Agricultural Runoff Septic Systems, illicit sanitary connections, domestic/wild animals	Ear/Intestinal infections, Shellfish bed closure, Recreation/aesthetic loss
Organic Enrichment— BOD, COD, TOC and DO	Urban/Agricultural Runoff, Landfills septic systems	Dissolved oxygen depletion, odors, fish kills
Toxic Pollutants— Metals, Organics	Urban/Agricultural Runoff, Pesticides/Herbicides, Underground storage tanks, Hazardous Waste Sites, landfills, illegal disposals, industrial discharges	Toxicity to humans and aquatic life, bioaccumulation in the foodchain
Salts— sodium chloride	Urban runoff snowmelt	Contamination of drinking water, harmful to salt intolerant plants

Source: Handbook: Urban Runoff Pollution Prevention and Control Planning, 1993.

Stormwater runoff into lakes can have some unique effects. These include:

1. Lakes respond more to the mass of a constituent and flow volume. The response time to storm events is measured in days or weeks unlike streams which show effects within hours or days.

2. A notable visible impact of stormwater on lakes consists of floating refuse and shore damage.

3. A significant water quality impact on lakes that is related to stormwater runoff is nutrient enrichment. This can result in the undesirable growth of algae and aquatic plants.

4. Lakes do not flush contaminants as quickly as streams, and act as sinks for nutrients, metals, and sediments. This means that lakes can take longer to recover if contaminated.

Table SQ-2 lists the potential sources of stormwater runoff and the types of pollutants expected from a variety of human activities.

1.2 NPDES Permit Regulations

In 1972, Congress passed what is currently referred to as the Clean Water Act (CWA). The Act established the National Pollutant Discharge Elimination System (NPDES) program. Until recently, efforts under the NPDES program have focused on non-stormwater discharges from industries and municipal wastewater treatment plants. In the last several years, the EPA has expanded the NPDES program to cover stormwater discharges.

1.2.1 Phase I Stormwater Regulations. As effective controls have been implemented on non-stormwater discharges, it has become more evident that diffuse sources can create impacts on water quality. In 1987, the CWA was revised to address stormwater discharges. The CWA defined municipal and industrial stormwater runoff discharges as "point source"and called for a two phase permitting strategy. Phase I affected:

- Any discharge of stormwater that was permitted under the NPDES program prior to February 4, 1987.
- Discharges associated with industrial activity.
- Any discharge from a large or medium municipal separate storm sewer system (MS4). A large system serves a population greater than 250,000. A medium system serves a population between 100,000 and 250,000.
- Those discharges that the permitting authority determines contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the U.S.

Regulations which addressed permit application requirements for these affected facilities were published on November 16, 1990. These regulations have resulted in thousands of industries and a number of municipalities covered by stormwater permits. The municipalities in Colorado which have been impacted by the Phase I requirements include:

- Arapahoe County (including Arapahoe County Water and Wastewater Authority, East Cherry Creek Valley Water and Sanitation District and Inverness Water and Sanitation District as Co-Permittees)
- City of Aurora

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TABLE SQ-2
Activities and Associated Pollutants

Category	Nutrients	pH	Sediment	Organic Enrichment	Pathogens	Toxic Organics	Toxic Metals	Oil and Grease	Salts (TDS)	Hydrologic Alterations	Thermal Alterations	Pesticides
<u>Agriculture</u>												
Cropland	X		X									X
Pastureland	X		X	X	X							
Animal Holding Areas	X		X	X	X							
Animal Waste Storage	X		X	X	X							
Hayland	X			X	X							
Wash and Processing Water	X	X	X	X	X			X				X
Waste Application Areas	X		X	X	X		X					
<u>Construction</u>												
Highways, Bridges, Roads			X		X	X		X	X	X	X	
Land Development			X		X			X		X	X	
<u>Urban Land</u>												
Stormwater sewers, combined sewers, surface runoff-pavement	X		X	X	X	X	X	X	X	X	X	X
Surface runoff-turf areas	X				X			X				
Infiltration walls and basins	X				X	X		X	X			
<u>Land Disposal</u>												
Wastes, sludge, septage	X	X	X	X	X	X	X	X	X			
Landfills	X	X	X	X	X	X	X	X	X	X	X	X
In situ wastewater systems	X											
Hazardous Waste Areas	X	X			X	X	X	X	X			X

TABLE SQ-2 (CONTINUED)
Activities and Associated Pollutants

Category	Nutrients	pH	Sediment	Organic Enrichment	Pathogens	Toxic Organics	Toxic Metals	Oil and Grease	Salts (TDS)	Hydrologic Alterations	Thermal Alterations	Pesticides
<u>Hydrologic Modification</u>												
Earthfills, Channelization			X							X		
Dam Construction/Reconstruction	X	X	X	X						X	X	
<u>Other Sources</u>												
Atmospheric Deposition	X	X				X	X					
Underground Storage Tanks						X	X	X				X
Illegal disposal/dumping, release of contaminants from in-place deposits	X	X	X	X	X	X	X	X	X			X
Highway/Bridge maintenance			X			X	X	X	X			X
Auto Salvage						X	X	X				
Washing and Processing Areas	X	X	X	X	X	X	X	X	X		X	X
Snow dumping areas	X		X	X	X	X	X	X	X			
Utility ROWs			X							X	X	X
Gasoline Station						X	X	X				
In-place sediments	X	X	X	X	X	X	X	X	X	X		
Sewer leaks, domestic/wild birds and mammals	X			X	X							
Natural vegetation (leaves, fallen trees)	X		X	X	X							

Source: Handbook: Urban Runoff Pollution Prevention and Control Planning, 1993.

- Colorado Department of Transportation
- City of Colorado Springs
- City and County of Denver
- City of Lakewood

General permits were issued to cover industries impacted by the regulation. They include heavy industries, light industries, mining, and recycling facilities. Existing permits were amended to include stormwater requirements. Industrial general permits require development of a stormwater management plan (SWMP). The plan must include:

1. A description of the activity.
2. Maps showing facility layout and drainage patterns.
3. Description of Potential Pollutant Sources/Material Inventory.
4. Stormwater Management Controls such as risk identification and assessment, prevention maintenance, good housekeeping, spill response procedures, and other appropriate structural and non-structural BMPs.
5. An inspection program.
6. Employee training program.

It is anticipated that the *Manual* will assist industries in fulfilling their regulatory requirements by providing lists of BMPs that can be implemented on site, and general procedures for evaluation of sites.

Unlike industries that have been covered by general permits, MS4 permits have been developed on a case-by-case basis. While each is somewhat unique, they all require that certain programs be in place. These programs are:

1. A Commercial/ Residential Management Program. This program includes the following areas:
   a. Maintenance of structural controls.
   b. A New Development Program that requires permanent water quality elements.
   c. Public street maintenance procedures to be in place to reduce water quality impacts from snow and ice handling practices, herbicide/pesticide uses, and other debris.
   d. Review of new flood control structures for inclusion of water quality elements and evaluation of existing facilities for retrofitting opportunities.

e. Program to address water quality concerns associated with the application of pesticides, herbicides and fertilizers by public and private applicators.

2. Illicit Discharge Management Program. This program generally includes the following areas:

   a. A program for the prevention of illicit discharges and illegal disposal. The program must include detection and removal of illicit discharges.

   b. Implementation of an ongoing field screening program. This involves sampling of dry weather flows from the MS4 outfalls.

   c. Investigation of illicit discharges.

   d. A program for responding to spills into the MS4.

   e. Educational activities to promote public reporting of illicit discharges and improper disposal as well as promote proper management and disposal of toxic materials.

   f. A program that controls sanitary sewer seepage into the MS4.

3. Industrial Facilities Program. The purpose of this program is to have the municipality control the industrial stormwater discharges into its system to assure that there is no impact on the MS4 from an industry.

4. Construction Sites Program. This program involves ensuring that adequate measures are taken to control runoff from construction sites that pose water quality concerns.

5. Municipal Facility Runoff Control Program. This program requires that measures comparable to those required for industrial activities be implemented at municipal facilities.

6. Wet Weather Monitoring Program. The purpose of this program is to monitor trends in water quality.

The MS4 has some latitude in how these programs are implemented. The *Manual* can be used to assist MS4s in development of these programs. Many of the elements of a commercial and residential Program can be found in the Structural and Nonstructural Best Management Sections. An outline of an illicit discharge program is included in the Nonstructural Chapter. The elements of the construction program can be found in the Construction Program chapter. The Industrial and Commercial Best Management Practice chapter can provide assistance to municipalities in the development of Municipal Facility Runoff Control Plans.

1.2.2 Phase II Stormwater Regulations. When the amendment to CWA was passed in 1987, the intent under the stormwater program was to require MS4s that were under 100,000 in population to apply for an NPDES permit no later than October 1992. This date was later changed to October 1, 1994. However, at the time the 1999 edition of this Volume 3 was published, regulations were not finalized that address permit application requirements and applicable permit conditions for these systems. On January 9, 1998, EPA published draft rules for the Phase II program. These draft regulations center on three major items. These are:

1. Reduction in the size of construction sites required to obtain an NPDES stormwater permit from 5 acres to one acre.
2. A expansion of the exemption from permitting for industrial facilities which have all sources covered.
3. Expansion of the MS4 permits to communities with populations under 100,000.

The proposed regulations extend the municipal stormwater program to small municipalities that are:

1. Within urbanized areas (except tribally owned systems serving less than 1,000 or others where requirements are waived by the State or EPA).
2. Designated via criteria not yet developed by the State or EPA.
3. Contributing significant loadings to a regulated MS4.

For Colorado, this means that approximately 50 additional communities could potentially fall under this program. The regulation proposes covering these Phase II communities under a general permit rather than individual permits. The proposed programs that will be required in the general permit include:

a. Public Education and Outreach on Stormwater Impacts–This would require the distribution of educational materials to the public or other equivalent outreach efforts.

b. Public Involvement/Participation–This element involves public notification and inclusion of the public in the development and implementation of the municipalities' stormwater management program.

c. Illicit Discharge Detection and Elimination–This involves some identification of pollutant sources, and the control and detection of illicit discharges.

d. Construction Site Program–This requires the development, implementation, and enforcement of a program for controlling runoff from construction sites that are equal to or greater than one acre.

e. Post-Construction Stormwater Management in New Development and Redevelopment–This would require the development and implementation of a program to address stormwater runoff from development and redevelopment sites equal to or greater than one acre.

f. Pollution Prevention/Good Housekeeping for Municipal Operations–As proposed, this involves the development and implementation of an operation and maintenance program to reduce the pollutant runoff from municipal sites such as parks and open spaces, fleet maintenance facilities, building oversight, and stormwater system maintenance facilities.

The Phase II regulation is scheduled to be finalized by October 1999. This date was agreed to as a result of a suit brought against EPA by the Natural Resources Defense Council (NRDC). As stated previously, the *Manual* will assist these municipalities with their program development.

1.2.3 Non-Stormwater Discharges. It is sometimes difficult to determine which discharges fall under the stormwater program and which require a traditional NPDES permit. It is clear that discharges from municipal wastewater treatment plants or industrial processes require an NPDES permit, but others are less obvious. A stormwater discharge is one which is a direct result of stormwater (rainfall or snow melt) and stops shortly after the event ends. Everything other than stormwater discharges require a permit if it enters state waters. The Colorado Water Quality Control Act defines "state waters" as any and all surface and subsurface waters which are contained in or flow through this state, but does not include waters in sewers systems, waters in treatment works or disposal systems, waters in potable water distribution systems, and all water withdrawn for use until use and treatment have been completed. However, State regulations do not allow a discharge into a ditch or man-made conveyance for the purpose of evading the requirement to obtain a permit, per CRS 25-8-501(1). Litigation has shown that the definition of state waters is interpreted very broadly.

Table SQ-3 lists common discharges that are not covered by industrial or MS4 stormwater permits. The table includes a description of the activity and suggestions of how to prevent the need for a permit. All these discharges could be permitted.

TABLE SQ-3
Non-Stormwater Discharges

Discharge	Description	Suggested Measures
Vehicle Washing (Non-residential)	• Spraying a vehicle to rinse off grime/dirt and allowing to flow into the MS4 or state waters. This is whether or not soaps or solvents are used. • Does not affect residents washing their vehicles.	• Do washing at third party facilities which are permitted • Ensure that waters are captured and not allowed offsite • With appropriate approval send to a sanitary sewer • Obtain a NPDES Permit
Rinsing of trucks carrying materials such as concrete trucks	• Involves the washing of concrete or other materials from the mixing or tank portions of a vehicle	• With appropriate approval, dispose into the sanitary sewer (not concrete trucks) • Ensure that all waters are captured and not allowed offsite • Obtain a NPDES Permit

TABLE SQ-3
Non-Stormwater Discharges

Discharge	Description	Suggested Measures
Swimming Pool/Spa Draining (Non-residential)	• Involves the emptying of the contents of a swimming pool or hot tub • Private residential discharges are not affected	• Use water for irrigation purposes • With appropriate approval, dispose into the sanitary sewer • Obtain a NPDES Permit
Hydrostatic Testing	• Involves the addition of water to a tank or pipeline to ensure water tightness and strength of joints	• Ensure that waters are captured and not allowed offsite • With appropriate approval, dispose into a sanitary sewer • Obtain a NPDES Permit

The NPDES stormwater regulations allow for certain non-stormwater discharges to be released under a municipal permit. Table SQ-4 lists these discharges.

TABLE SQ-4
Allowable Non-Stormwater Discharges

The following non-stormwater discharges or flows are not considered illicit or illegal unless they are identified by the municipality or the State as sources of pollutants.

- Landscape irrigation.
- Diverted stream flows.
- Rising ground waters.
- Uncontaminated ground water infiltration to separate storm sewers.
- Discharges from potable water sources.
- Foundation drains.
- Air conditioning condensation.
- Irrigation water.
- Natural springs.
- Water from crawl space pumps.
- Footing drains.
- Lawn watering.
- Individual residential car washing.
- Flows from riparian habitats and wetlands.
- Emergency fire fighting activities.
- Irrigation return flow.

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TABLE SQ-4
Allowable Non-Stormwater Discharges (continued)

Non-stormwater discharges allowed under the municipal stormwater permits, provided appropriate control measures are implemented to minimize impacts of these sources, include:

- Individual residential swimming pool and hot tub discharges.
- Individual residential street washing.
- Water-line flushing.
- Water line flushing (excludes flushing of disinfection water for new pipes).
- Municipally owned and dechlorinated swimming pool discharges.
- Street wash water.

Other sources of allowable dry weather flow include:

- Discharges of process wastewater as long as authorized under separate CDPS permits.

In order to address many small discharges, the Colorado Water Quality Control Division developed the minimal discharge general permit. This permit covers the following types of discharges:

- Facilities discharging wastewater from washing the exteriors of trucks, cars, airplanes, boats, driveways, parking lots, and roads.
- Facilities discharging wastewater from the washing of bleachers, elevated seating and grandstands, such as those found at outdoor sporting or entertainment events.
- Commercial facilities discharging wastewater from draining, cleaning, and filter backwash of swimming pools, spas, hot tubs, and similar structures including water slides and water theme amusement parks.
- Commercial facilities discharging wastewater from the washing of temporary stables, traveling petting zoos, or any other facility that discharges wash water associated with animal wastes.
- Facilities discharging wastewater from commercial mobile cleaning vehicles such as steam cleaning, carpet cleaning and pressure washing (including building washing).
- Facilities discharging groundwater from foundation, basement, or underground structure dewatering.
- Facilities discharging non-contact cooling or heating water.
- Facilities discharging hydrostatic test water from the testing of new or used pipes, tanks or other similar vessels.
- Facilities discharging water such as facilities that employ super chlorination (50 to 500 mg/L) of water for the disinfection of these facilities and wish to discharge effluent.
- Commercial facilities discharging wastewater from washing of root crops such as potatoes, sugar beets, onions, and other fruit/vegetable agricultural produce.

The general permit allows for quick coverage of these types of discharges. Compliance is required with state water quality standards and effluent guidelines. Monitoring and reporting of the quality of the discharge is also required.

1.3 Summary

The *Manual* has been structured to provide industries, municipalities, contractors and developers with information which can be used to control water quality impacts from stormwater and comply with applicable regulatory requirements.

2.0 STORMWATER QUALITY CHARACTERISTICS AND SOURCES

2.1 General

Urban runoff contains many types and forms of constituents-some occurring in higher concentrations than found in runoff before development and some that are not naturally present in surface runoff from undeveloped land. Runoff from undeveloped watersheds contains sediment particles, oxygen-demanding compounds, nutrients, metals, and other constituents. Once developed, constituent loads increase because surface runoff volumes increase and the sources of many of these pollutants also increase. Also, additional sources of constituents may exist in a catchment and find their way into runoff. They may include the following:

- Metals, lubricating compounds, solvents, and other constituents originating from vehicles, machinery, and industrial and commercial activities
- Pesticides, herbicides, and fertilizers
- Household solvents, paints, roofing materials, and other such materials
- Pet litter, garbage, and other debris
- Suspended solids washed off impermeable surfaces
- Increased soil erosion during construction activities

A phenomenon termed *first flush* has been discussed for a number of years resulting in mixed conclusions. The first flush represents the higher levels of initial concentrations of constituents that are washed off from a surface at the very beginning of a rainfall event. Some reports include a first flush because of atmospheric fallout that accumulates before a storm occurs. Other reports conclude that there is no first flush, or an insignificant first flush of pollutants in separate, namely, not combined sewer stormwater runoff. However, by designing facilities to capture in total and treat the majority of runoff events, whether a first flush exists or not becomes irrelevant. At the same time, if it does exist for larger runoff events, such designs will then also capture their "first flush"of runoff.

2.2 Typical Constituent Concentrations in Urban Runoff

Urban stormwater runoff data for the Denver metropolitan area was collected under an Environmental Protection Agency (EPA)-funded effort as part of their Nationwide Urban Runoff Program in 1980 and 1981. A similar stormwater monitoring program, funded by the District and the cities of Denver, Aurora, and Lakewood, was carried out in 1992 and 1993. The results from these two monitoring programs are summarized in a report by Doerfer and Urbonas, "Stormwater Quality Characterization in the Denver Metropolitan Area,"dated 1993 in terms of average event mean concentrations. Table SQ-5 summarizes these EMCs for 13 constituents from industrial, residential, commercial, and undeveloped land uses. It is important to recognize however that the data were highly variable and that these EMCs should not be expected from every storm runoff event.

TABLE SQ-5
Land-Use Average Event Mean Concentrations of Stormwater Runoff in the Denver Metropolitan Area

Constituent	Units	Industrial	Commercial	Residential	Undeveloped
Total Suspended Solids	(mg/L)	399	225	240	400
Total Dissolved Solids	(mg/L)	58	129	119	678
Biochemical Oxygen Demand	(mg/L)	29	33	17	4
Chemical Oxygen Demand	(mg/L)	232	173	95	72
Total Nitrogen	(mg/L)	2.7	3.3	3.4	3.4
Total Kjeldahl Nitrogen	(mg/L)	1.8	2.3	2.7	2.9
Nitrate plus Nitrite	(mg/L)	0.91	0.96	0.65	0.50
Total Phosphorus	(mg/L)	0.43	0.42	0.65	0.40
Dissolved Phosphorus	(mg/L)	0.20	0.15	0.22	0.10
Cadmium, Total Recoverable	(μg/L)	3	1	n/d	n/d
Copper, Total Recoverable	(μg/L)	84	43	29	40
Lead, Total Recoverable	(μg/L)	130	59	53	100
Zinc, Total Recoverable	(μg/L)	520	240	180	100

n/d = below detection limit

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3.0 OVERVIEW OF BEST MANAGEMENT PRACTICES

3.1 Nonstructural and Structural BMPs

Urban stormwater runoff contains materials from various different land use types, such as residential, commercial and industrial sites. Urban stormwater runoff has been documented to contain a variety of constituents. When certain constituents are present in sufficient quantities, the potential exists for adverse effects on receiving waters.

Studies such as the Nationwide Urban Runoff Program (EPA, 1983) and the Denver Regional Urban Runoff Program (DRCOG, 1983) have documented concentrations of various constituents in urban stormwater. To reduce the concentrations and the loads of these constituents that reach the receiving waters, various BMPs have been suggested. These BMPs fall into the following two primary categories:

- Nonstructural-Including the subcategories of pollution prevention BMPs and source control BMPs
- Structural-Including facilities constructed to passively treat urban stormwater runoff before it enters the receiving waters. In fact, they are stormwater quality treatment devices.

The most cost-effective nonstructural BMPs are to prevent the disposal of constituents that may be potential pollutants on the urban landscape and to minimize the migration of constituents offsite from the point where they are being used, stored, or otherwise being exposed tostormwater. Measures that can prevent deposition of constituents are described in terms such as "Good Housekeeping,"Preventive Maintenance,"Spill Prevention"and others. A theme that runs through all of these is the need to educate the public on the impacts of its actions on the environment. Nonstructural source controls include administrative programs, preventing and controlling erosion during construction, street sweeping, modified street maintenance practices, employee-training and material handling practices. Nonstructural controls used to isolate pollutants from stormwater include covering potential pollutant areas such as service center gasoline pump islands. Source control BMPs are sometimes termed as "good housekeeping" measures because a clean site will produce lessstormwater contamination than will a dirty one. These and other nonstructural BMPs are further addressed in the nonstructural section of this volume.

Structural BMPs are facilities used to reduce runoff and/or remove constituents from runoff. Examples of structural BMPs include water quality detention (both dry basins and wet ponds), wetlands, porous pavement, and the use of vegetated zones. These BMPs may treat small volumes of stormwater on development sites or serve larger regional drainage areas.

3.2 Pollutant Removal Mechanisms

Although runoff may contain many individual pollutants, pollutants are grouped into two general categories in the *Manual*: particulate and soluble. Even though the exact boundary between the two does

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not need to be defined at this level of design, the boundary lies somewhere around the equivalent particle diameter of 0.4 micron (for example, very fine clays). In many cases, constituents (such as metals and oxygen demand compounds) become adsorbed or attached to particulate matter. Therefore, if the particulate matter is removed, so are the adsorbed or attached constituents.

One, or a combination of up to four basic pollutant removal or immobilization mechanisms, are used by the suggested BMPs to treat stormwater runoff for water quality enhancement. The following is a brief overview of each mechanism:

1. Sedimentation: Particulate matter is, in part, settled out of urban runoff. Smaller particles under 60 microns in size (fine silts and clays) (Stahre and Urbonas, 1990) can account for approximately 80 percent of the metals in stormwater attached or adsorbed along with other contaminants and can require long periods of time to settle out of suspension. Fortunately, extended detention allows smaller particles to agglomerate into larger ones (Randall et al, 1982), and for some of the dissolved and liquid state pollutants to adsorb to suspended particles, thus removing a larger proportion of them through sedimentation. Sedimentation is the primary pollutant removal mechanism for most structural BMPs.

2. Filtering: Particulates are removed, in part, from water by filtration. Filtration removes particles by attachment to small-diameter collectors such as sand.

3. Infiltration: Pollutant loads in surface runoff are removed or reduced as surface runoff infiltrates or percolates into the ground. Particulates are removed at the ground surface by filtration, while soluble constituents can be adsorbed into the soil, at least in part, as the runoff percolates into the ground. Site-specific soil characteristics, such as permeability, cation exchange potential, and depth to groundwater or bedrock limit the number of sites where this mechanism can be used effectively.

4. Biological Uptake: Plants and microbes require soluble and dissolved constituents such as nutrients and minerals for growth. These constituents are ingested or taken up from the water column and concentrated through bacterial action, phytoplankton growth, and other bio-chemical processes. In some instances, plants could be harvested to remove the constituents permanently. In addition, certain biological activities can reduce toxicity of some pollutants and/or possible adverse effects on higher aquatic species. Unfortunately, not much is understood yet about how biological uptake or activity interacts with stormwater during the relatively brief periods it is in contact with the biological media in most BMPs, with the possible exception of retention ponds between storm events (Hartigan, 1989).

5. Straining: Grasses strain out particulates when sheet flow is directed to flow slowly over vegetated areas.

3.3 Structural BMP Effectiveness

Table SQ-6 indicates ranges of removal efficiencies reported in literature for a number of structural BMPs. Although combinations of nonstructural/structural BMPs can improve the overall water quality of the runoff, the effectiveness of several BMPs in their ability to reduce influent pollutant concentrations as a group are not directly additive. Table SQ-6 also shows a most probable range of removal efficiencies for structural BMPs recommended in Volume 3.

3.4 Stormwater Quality Management Strategy

3.4.1 Municipalities. The selection of the most appropriate BMP categories within a municipality is determined by whether development is in place or has yet to occur. In areas with existing development, relying on nonstructural BMPs is most cost-effective because retrofitting structural controls into a developed area can be very expensive; that is, $5,000 to $50,000 per acre of tributary watershed. Structural controls are more appropriate for new development and significant redevelopment, particularly when they are integrated into the initial planning and design of municipal infrastructure and private development.

Structural BMPs are most cost-effective when included in the planning stages of development. It is recommended that the structural BMPs presented in the *Manual* be integrated into stormwater management planning by public entities and into the site planning process by land developers. Structural BMPs can also be used, in a cost-effective manner, whenever redevelopment or significant improvement occurs within fully developed areas.

An effective strategy for reducing stormwater pollution loads is to use multiple BMPs, including nonstructural measures, source controls, and structural BMPs. A single practice and/or facility cannot generally provide significant reductions in stormwater pollutant loads because these pollutants come from many sources within a municipality. Also, multiple BMPs can provide complementary water quality enhancement to achieve desired results. A multilevel BMP approach, schematically depicted in Figure SQ-1, deals with the many pollutant and runoff sources throughout a watershed and shows that whenever feasible, combining the most effective BMPs in a series can be an effective strategy to reduce pollutant loads being transported to the receiving waters by stormwater.

3.4.2 Industrial and Commercial. The selection of the most appropriate BMP controls for an industrial or commercial operation is determined by the activities that take place outside where they are exposed to stormwater. Similar to municipal BMPs, the determination as to whether to use structural or nonstructural BMPs is a function of whether the facility is under design or if it is existing.

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TABLE SQ-6
BMP Pollutant Removal Ranges for Stormwater Runoff and Most Probable Range for BMPs Recommended in Volume 3

Ref: Bell et al. (1996), Colorado (1990), Harper & Herr (1992), Lakatos & McNemer (1987), Schueler (1987), Southwest (1995), Strecker et al. (1990), USGS (1986), US EPA (1983), Veenhuis et al. (1989), Whipple and Hunter (1981), Urbonas (1997)

Type of BMP	(1)	TSS	TP	TN	TZ	TPb	BOD	Bacteria
Grass Buffer	LRR:	10-50	0-30	0-10	0-10	N/A	N/A	N/A
	EPR	**10-20**	**0-10**	**0-10**	**0-10**	N/A	N/A	N/A
Grass Swale	LRR:	20-60	0-40	0-30	0-40	N/A	N/A	N/A
	EPR	**20-40**	**0-15**	**0-15**	**0-20**	N/A	N/A	N/A
Modular Block Porous Pavement	LRR:	80-95	65	75-85	98	80	80	N/A
	EPR	**70-90**	**40-55**	**10-20**	**40-80**	**60-70**	N/A	N/A
Porous Pavement Detention	LRR:	8-96	5-92	-130-85	10-98	60-80	60-80	N/A
	EPR	**70-90**	**40-55**	**10-20**	**40-80**	**60-70**	N/A	N/A
Porous Landscape Detention	LRR:	8-96	5-92	-100-85	10-98	60-90	60-80	N/A
	EPR	**70-90**	**40-55**	**20-55**	**50-80**	**60-80**	N/A	N/A
Extended Detention Basin	LRR:	50-70	10-20	10-20	30-60	75-90	N/A	50-90
	EPR	**55-75**	**45-55**	**10-20**	**30-60**	**55-80**	N/A	N/A
Constructed Wetland Basin	LRR:	40-94	-4-90	21	-29-82	27-94	18	N/A
	EPR	**50-60**	**40-80**	**20-50**	**30-60**	**40-80**	N/A	N/A
Retention Pond	LRR:	70-91	0-79	0-80	0-71	9-95	0-69	N/A
	EPR	**80-90**	**45-70**	**20-60**	**20-60**	**60-80**	N/A	N/A
Sand Filter Extended Detention	LRR:	8-96	5-92	-129-84	10-98	60-80	60-80	N/A
	EPR	**80-90**	**45-55**	**35-55**	**50-80**	**60-80**	**60-80**	N/A
Constructed Wetland Channel*	LRR:	20-60	0-40	0-30	0-40	N/A	N/A	N/A
	EPR	**30-50**	**20-40**	**10-30**	**20-40**	**20-40**	N/A	N/A

(1) LRR Literature reported range, **EPR**— expected probable range of annual performance by Volume 3 BMPs.
N/A Insufficient data to make an assessment.

*The **EPR** rates for a Constructed Wetland Channel assume the wetland surface area is equal or greater than 0.5% of the tributary total impervious area.

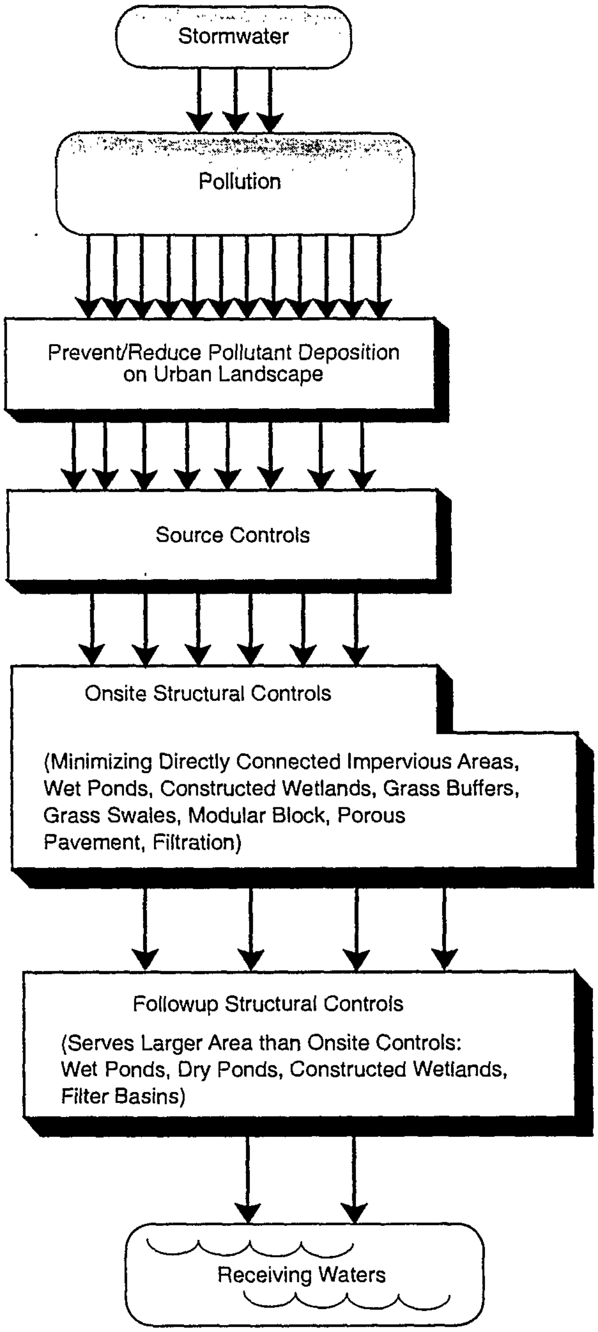

FIGURE SQ-1
Multi-level Stormwater Quality Management Strategy

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Structural controls, such as cover roofing, secondary containment, and detention facilities, can be readily integrated into the design of these facilities. It may be much more costly and less practical to put these controls into place after the facility is in operation.

An effective strategy for reducing stormwater pollution loads for industrial and commercial facilities is to focus on source controls using both structural and non-structural technologies. The multi-level stormwater strategy for municipalities is also of use for industrial and commercial sites.

3.5 Erosion Control During Construction

Control of construction activities is critical in stormwater quality management. During the relatively short period of time when land is converted from undeveloped to urban uses, a significant amount of sediment can erode from a construction site and be transported to adjacent properties and to receiving waters. If measures are not taken to reduce erosion and to capture sediment in runoff from construction sites, damage can occur to offsite areas and to aquatic habitats in the receiving water system.

Many methods are available to limit erosion and sediment losses from a construction site. One of the most effective is to prevent erosion from occurring. Oftentimes large areas are excavated or graded at one time in preparation for construction of site facilities and buildings. By limiting the amount of time that an area is disturbed through the use of phasing, soil erosion is reduced. Prevention, along with the application of erosion control practices to all areas disturbed during construction, can significantly reduce soil erosion. Finally, the proper installation and maintenance of sediment trapping devices at construction sites can ensure that soil erosion and sediment transport offsite is controlled to the maximum extent practicable.

There are many structural and nonstructural options available in the design of an erosion and sediment control plan. It is recommended, however, that the erosion and sediment control plan be developed consistent with the post-development stormwater management goals of the site. Opportunities often exist for converting temporary sediment control structures into permanent structural stormwater BMPs at the end of the construction phase. These options should be explored by the designer of an erosion control plan, final site BMPs, and their eventual owners.

Regardless of the specific details used in an erosion control plan, the goal is to implement erosion and sediment control as a standard practice at all construction sites, and to incorporate it as an integral part of any stormwater quality management strategy. To facilitate sound erosion and sediment control practices during construction, technical criteria were developed, along with a model ordinance for their implementation by local municipalities. These criteria and the model ordinance are contained in the *Construction Best Management Practices* chapter of Volume 3 of the *Manual.*

4.0 STORMWATER QUALITY HYDROLOGY

4.1 Overview

Urbanization affects stormwater runoff by increasing the following:

- The volumes and rates of surface runoff
- The concentrations and the types of pollutants found in stormwater
- The loads of pollutants carried and their transfer rates to receiving waters

Urbanization leads to a decrease in pervious land areas, an increase in impervious areas, and enhanced efficiency of surface runoff. The influx of commercial, residential, and industrial products into an urban area often brings new pollutants that result in concentrations of these pollutants in stormwater greater than before urbanization has occurred. Additional impervious areas can make pollutants more easy to wash off the surface and quicken their conveyance through the watershed. The cumulative effect is that urbanization results in much larger loads (with the possible exception of nutrients found in runoff coming from irrigated agricultural land), and in the delivery of certain pollutants, such as petroleum-based products not normally found in nonurban and nonindustrial runoff.

The rate of runoff and the extent of pollutant loads depend on the hydrologic conditions that lead to stormwater runoff. Some investigators hypothesize that pollutant loads being delivered by the urban stormwater system are affected by the period between storms (storm separation). They suggest that this period provides time for pollutants in the atmosphere and from other sources to build up on impervious areas. However, the Denver Regional Urban Runoff Program (DURP) studies (Mustard et al., 1985) conducted by the USGS did not support this hypothesis beyond a 2- to 5-day dry buildup period. This is not to say that the above-mentioned hypothesis is not true for other regions of United States.

4.2 Denver Area Precipitation Statistics

Studies of the precipitation for 36 years from the Denver Stapleton Rain Gage have revealed several pertinent hydrologic patterns. Analyses show that the average storm based on 6-hour separation period has an 11-hour duration and that the average time interval between storms (storm separation) is 11.5 days. However, the great majority of storms are less than 11 hours in duration. The limited number of storms with long rainfall periods within the data base tend to increase this average. Table SQ-7 summarizes the relationship between total storm depth and the annual number of storms. As the table shows, about 46 of a total of 75 storm events that occur on an annual average basis, or 61 percent, have less than 0.1 inches of precipitation. These storms produce practically no runoff. The table also shows that about 22 of the 30 remaining runoff-producing events, or 75 percent, total between 0.1 inches and 0.5 inches of depth. If runoff can be controlled from most of the storms that range 0.1 inches to 0.5 inches in precipitation, the overall treatment of stormwater runoff in the Denver region should be very effective.

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TABLE SQ-7
Number of Rainfall Events in the Denver Area

Total Rainfall Depth (inches)	Average Annual Number of Storm Events
0.0 to 0.1	46.
0.1 to 0.5	22.
0.5 to 1.0	4.7
1.0 to 1.5	1.5
1.5 to 2.0	0.60
2.0 to 3.0	0.30
3.0 to 4.0	0.19
4.0 to 5.0	0.028
>5.0	0
Total	**75.318**

4.3 Diminishing Returns with Increasing Size of Design Storms

The above analysis and other studies indicate that small-sized, frequently occurring storm events account for the predominate number of events that result in stormwater runoff from urban catchments. Consequently, these frequent storms also account for a significant portion of the annual pollutant loads. Capture and treatment of the stormwater from these small and frequently occurring storms is the recommended design approach for water quality enhancement, as opposed to flood control facility designs that focus on less frequent, larger events. Incorporating both sets of criteria into a single stormwater management facility is not only possible, but is encouraged.

The analysis of precipitation data collected from 1948 through 1984 (36 years) at the Denver Stapleton Rain Gage revealed a relationship between the percent imperviousness of a watershed and the capture volume needed to significantly reduce stormwater pollutants (Urbonas, Guo, and Tucker, 1990). Subsequent studies (Guo and Urbonas, 1996 and Urbonas, Roesner, and Guo, 1996) of precipitation resulted in a recommendation by the Water Environment Federation (1998) that stormwater quality treatment facilities (i.e., structural BMPs) be based on the capture and treatment of runoff resulting ranging in size from "mean" to "maximized" storms. These two extremes represent 70 to 90 percentile storms. As a result of these studies, water quality facilities for the front range of Colorado are recommended to capture and treat the 80th percentile runoff event. Capturing and properly treating this volume was estimated to remove between 80 and 90 percent of the annual TSS load, while doubling the capture volume was estimated to increase the removal rate by only 1 to 2 percent.

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While bigger may appear to be better in the case of stormwater quality, larger water quality detention basins can provide less holding time for the predominant number of smaller storms. Larger basins can result in less net reduction of pollutants than is obtained when using the recommended 80th percentile capture volume that can be obtained from Figure SQ-2. Storms larger than the 80th percentile events still receive some treatment when their capacity is exceeded by larger storms, but at a somewhat lower efficiency. Thus, the law of diminishing returns for cost-effective pollutant removal takes effect, not only because of the large number of small storms found in the total population of storms, but because the first flush of runoff for larger storm is also captured and that pollutant removal continues to occur for in-line capture basins when the runoff exceeds their design capacity.

4.4 Determining the Water Quality Capture Volume

4.4.1 Use of Directly Connected Impervious Area. The procedures described in the *Rainfall* and in the *Runoff* chapters of Volume 1 of the *USDCM* are intended for the design of drainages and flood facilities that prevent damage to property and help protect human life. These procedures show that the depth of rainfall produced from a design storm varies somewhat throughout the Denver region and that runoff is a function of total imperviousness. Water quality enhancement focuses more on the smaller events that deliver frequent flow pulses and pollutant loads to the receiving waters. The runoff volume for smaller events is especially sensitive to the impervious area that is hydraulically connected to the stormwater runoff system.

The impervious portion of a watershed determines the runoff volume that needs to be used for the design of water quality facilities, and the percentage of impervious surface therefore becomes important in the design of structural BMPs. The methodology for calculating basin imperviousness is presented in the *Runoff* chapter of Volume 1 of the *USDCM.* This procedure needs to be modified, however, when using the practice of *minimizing directly connected impervious areas*in combination with *extended detention basins, retention ponds, wetlands,* and other practices depended on a design water quality capture volume. Whenever applicable, the needed modifications are described in the appropriate chapters of this volume of the *USDCM.*

4.4.2 Water Quality Capture Volume (WQCV). All structural BMPs recommended in this volume of *USDCM* are based on the 80th percentile event. Specific guidance for finding the needed WQCV is provided in each BMP types'design section. This WQCV varies with the type of BMP used and is based on the time it takes to fully drain the brim-full WQCV. Figure SQ -2 summarizes the WQCV requirements as a function of the tributary catchments total imperviousness as a ratio of the total area of the catchment for 6-, 12-, 24-, and 40-hour drain times of the WQCV.

Figure SQ-2 is appropriate for use in Colorado's high plains near the foothills. For other portions of Colorado or of United States, the WQCV obtained from this figure can be adjusted using the following relationships:

$$WQCV_O = d_6 \frac{WQCV}{0.43}$$

in which,

$WQCV_O$	=	Water quality capture volume outside the Denver region
d_6	=	Depth of average runoff producing storm from Figure SQ-3 (watershed inches)

Once the WQCV in watershed inches is found from Figure SQ-2, then determine the required storage volume in acre-feet as follows:

$$Required\ storage = \left[\frac{WQCV}{12}\right](Area)$$

in which,

Required storage	=	Required storage volume in acre-feet
Area	=	The tributary catchment's area upstream in acres

The independent variable in Figure SQ-2 is the total imperviousness ratio (i.e., $i=I_{wq}/100$) of the tributary watershed (catchment). The chapter on *Runoff* in Volume 1 of the *USDCD* contains guidance for how to find the total imperviousness of a watershed and its use is recommended with one exception. Figure 2-1 in *Runoff* chapter of Volume 1 relate housing density to the impervious area percentage is no longer valid. Instead use Figures SQ-4, SQ-5 and SQ-6 to estimate the imperviousness of single family residential areas. Note that these figures require the knowledge of the average housing densities, types of housing, and their average square footage to find the imperviousness of these areas.

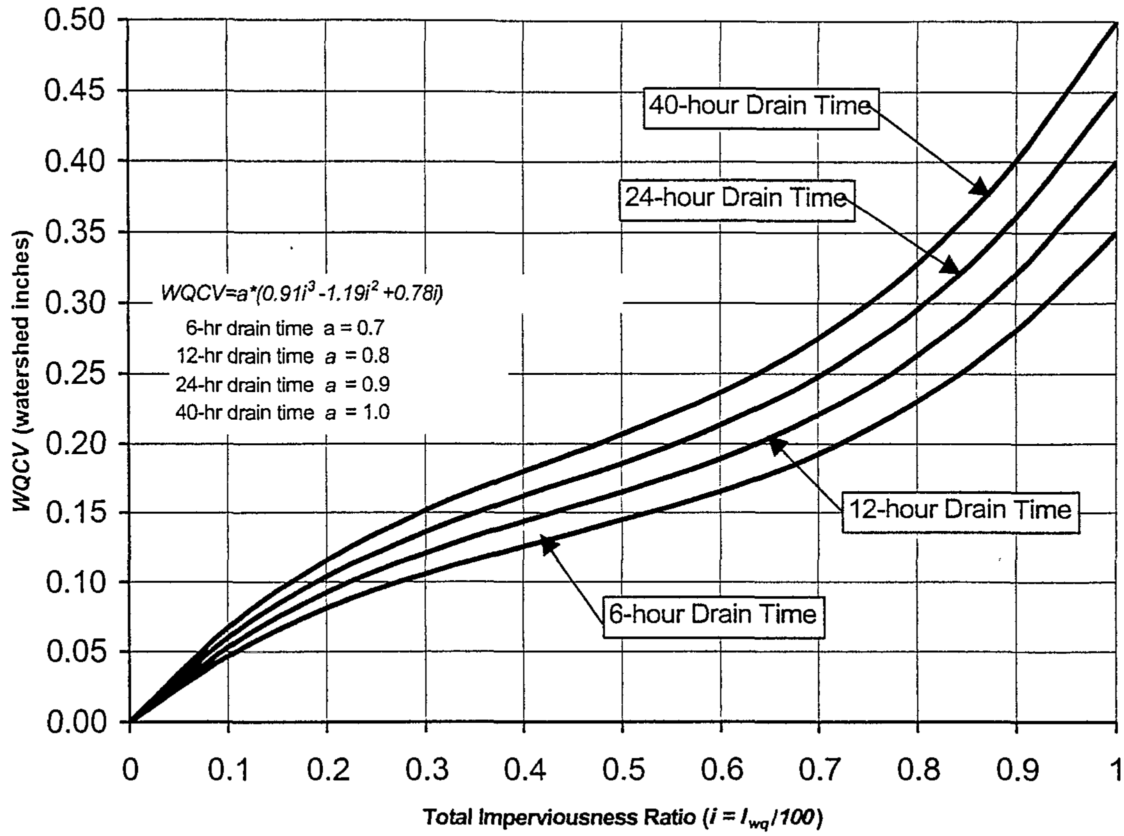

FIGURE SQ-2

Water Quality Capture Volume (WQCV), 80th Percentile Runoff Event

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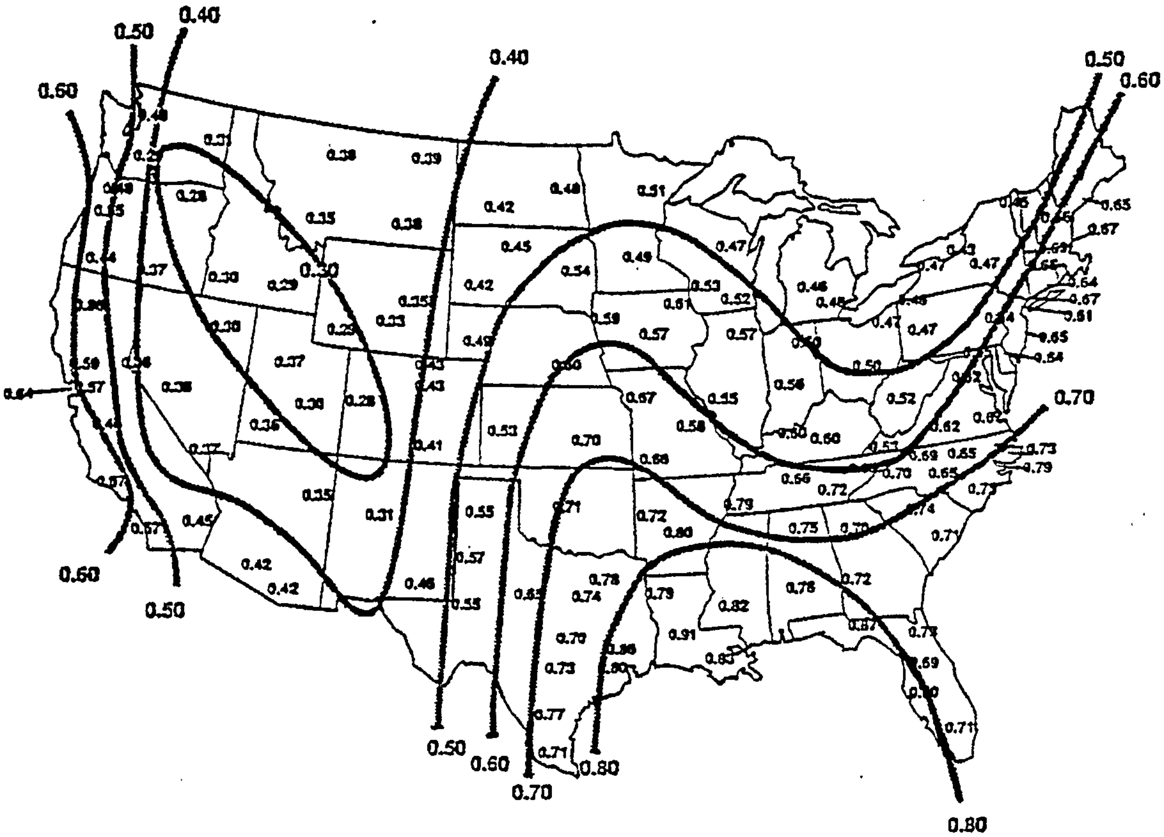

FIGURE SQ-3

Map of the Average Runoff Producing Storms Precipitation Depth in the United States, in inches.

(Ref.: Driscoll et.al., 1989)

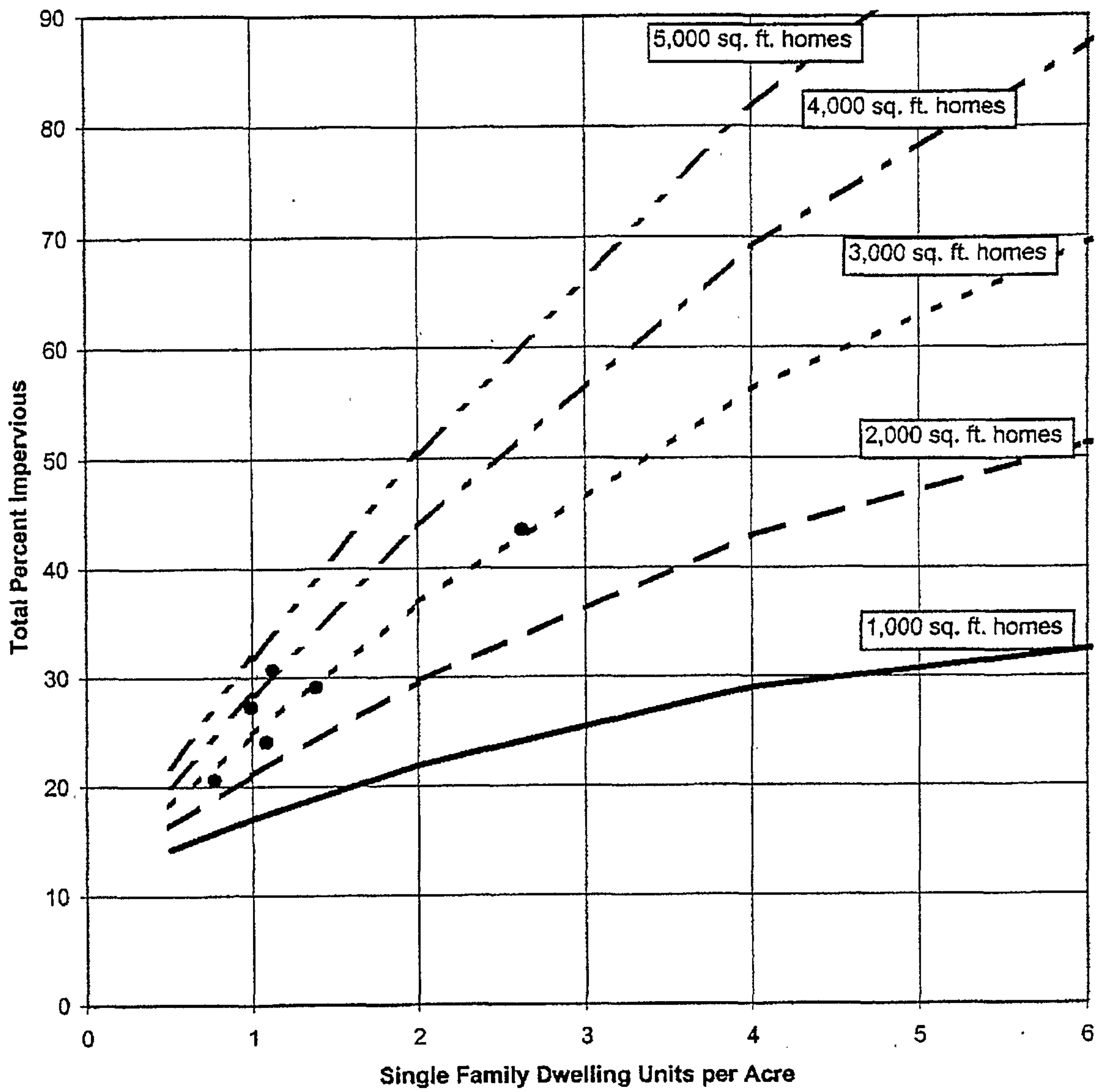

FIGURE SQ-4

Watershed Imperviousness, Single Family Residential Ranch Style Houses

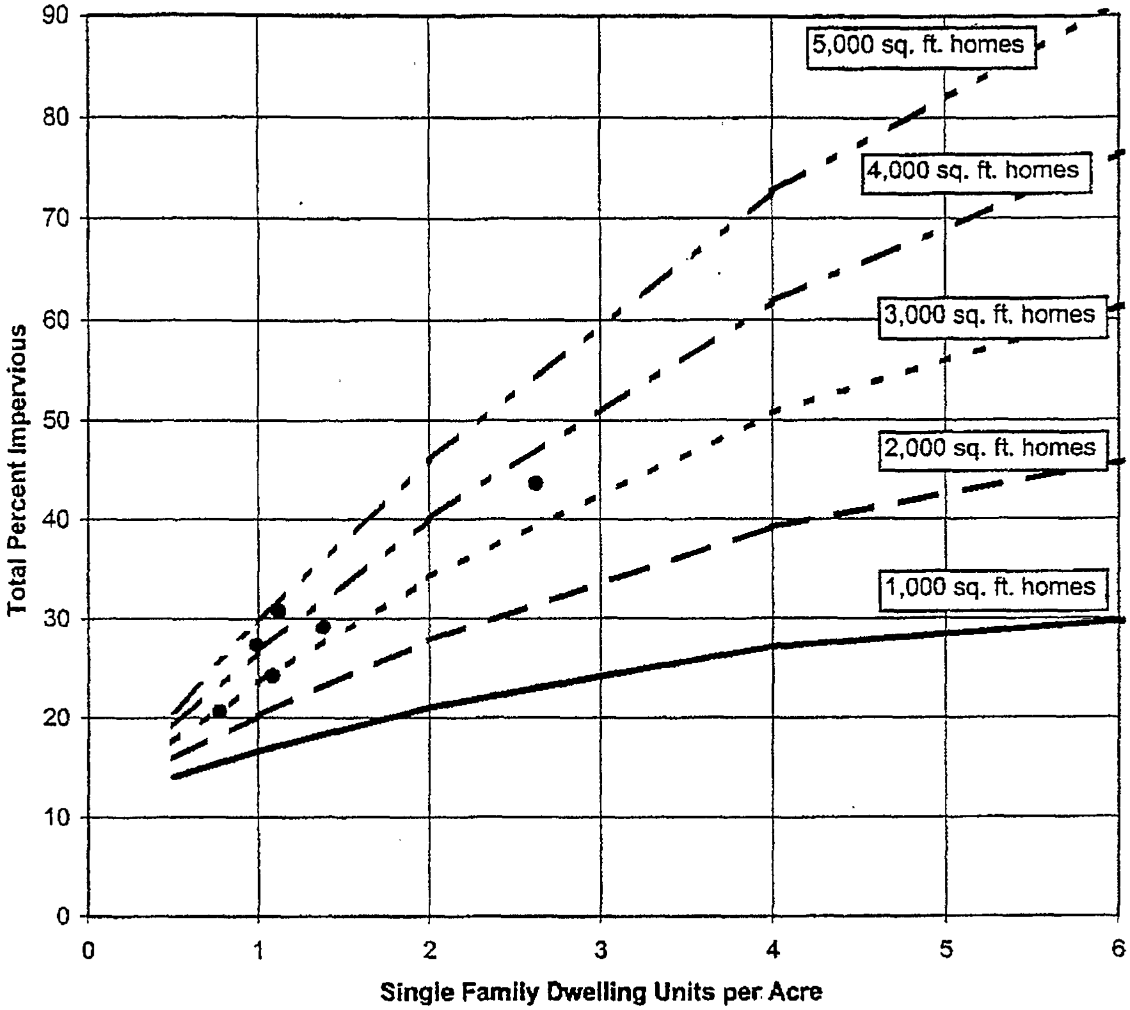

FIGURE SQ-5

Watershed Imperviousness, Single Family Residential Split-Level Houses

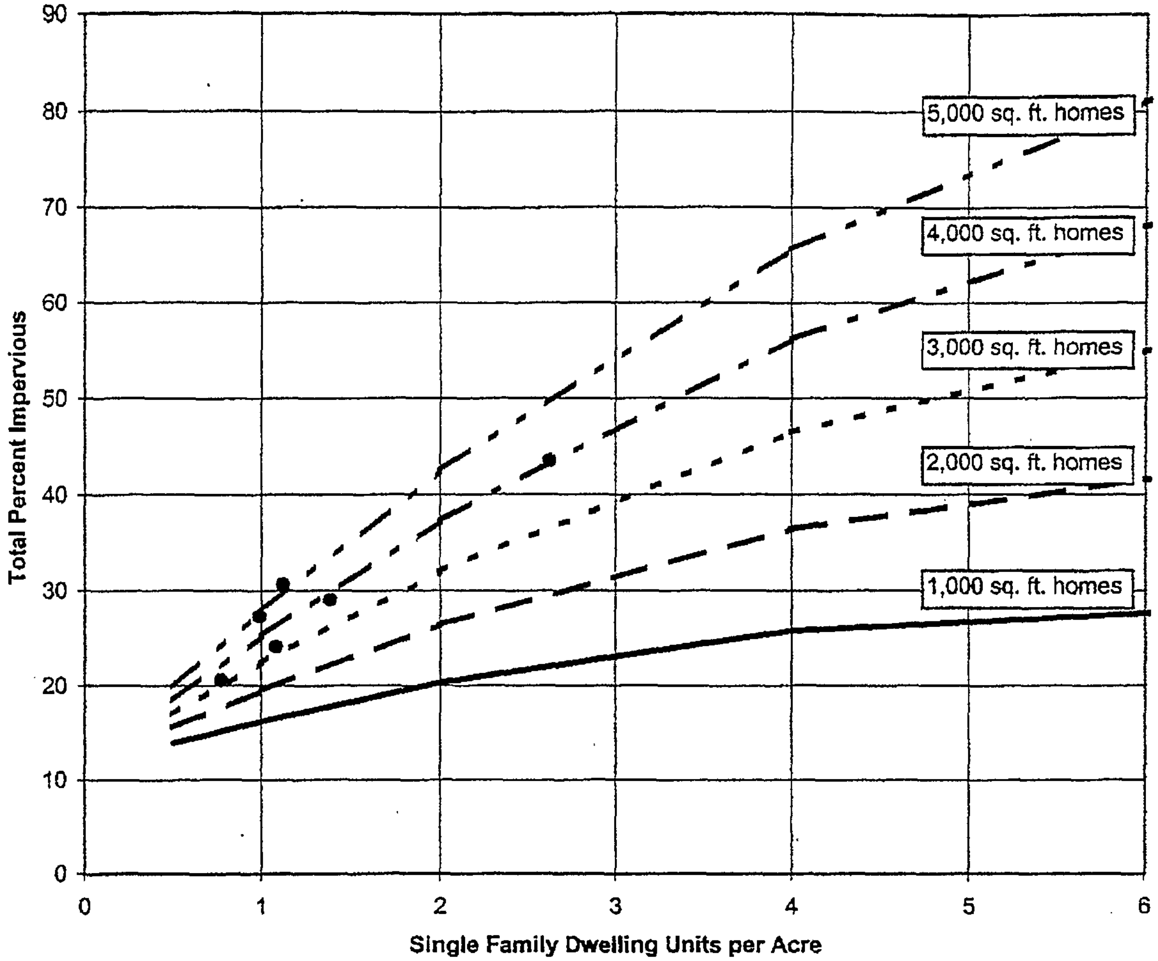

FIGURE SQ-6

Watershed Imperviousness, Single Family Residential Two-Story Houses

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BMP PLANNING FOR NEW DEVELOPMENT AND SIGNIFICANT REDEVELOPMENT

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1.0 BMP PLANNING FOR NEW DEVELOPMENT AND SIGNIFICANT REDEVELOPMENT

1.1 Overview

This chapter contains guidance for the selection and siting of structural best management practices (BMPs) for new development. The guidance is provided within the context of a four-step process that may be followed for new site developments and significant redevelopments.

Detailed descriptions, sizing and design criteria, and design procedures for these BMPs are provided in the chapter titled *Structural Best Management Practices.*

The selection of BMPs for a development site is intended to be made collaboratively as a result of coordination between the developer and the local jurisdiction. It is recommended that discussions regarding proposed BMPs occur early in each project between the developer's planner and engineer and municipal staff.

1.2 Four-Step Process

The following four-step process is recommended for selecting structural BMPs in newly developing and redeveloping urban areas:

- Step 1. Employ Runoff Reduction Practices. To reduce runoff peaks and volumes from urbanizing areas, employ a practice generally termed "minimizing directly connected impervious areas"(MDCIA). The principal behind MDCIA is twofold -- to reduce impervious areas and to route runoff from impervious surfaces over grassy areas to slow down runoff and promote infiltration. The benefits are less runoff, less stormwater pollution, and less cost for drainage infrastructure. There are several approaches to reduce the effective imperviousness of a development site:

  - Reduced Pavement Area. The use of smaller roadway cross sections is encouraged. Sometimes, creative site layout can reduce the extent of paved areas, thereby saving on initial capital cost of pavement and then saving on pavement maintenance, repair, and replacement over time.

  - Porous Pavement. The use of modular block porous pavement or reinforced turf in low-traffic zones such as parking areas and low use service drives such as fire lanes can significantly reduce site imperviousness. This practice can reduce the extent and size of the downstream storm sewers and detention.

  - Grass Buffers. Draining impervious areas over grass buffers slows down runoff and encourages infiltration, in effect reducing the impact of the impervious area.

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- Grass Swales. The use of grass swales instead of storm sewers, like grass buffers, slows down runoff and promotes infiltration, also reducing effective imperviousness. It also can reduce the size and cost of downstream storm sewers and detention.

Implementing these approaches on a new development site is discussed further in Subsection 1.3. This subsection provides a procedure for estimating a reduced imperviousness based on the use of grass buffers and swales. The latter three of the approaches for reducing imperviousness are structural BMPs and are described in detail in the following sections of the *Structural Best Management Practices* chapter:

Section	Structural BMP
1.0	Grass Buffer
2.0	Grass Swale
3.0	Modular Block Porous Pavement (or Stabilized-Grass Porous Pavement)

- Step 2. Provide Water Quality Capture Volume (WQCV). A fundamental requirement for any site addressing stormwater quality is to provide WQCV. One or more of six types of water quality basins, each draining slowly to provide for long-term settling of sediment particles, may be selected. Subsection 1.4 provides information on selecting and configuring one or more of these WQCV facilities at a site. These six BMPs are described in detail in the following sections of the *Structural Best Management Practices* chapter:

Section	Structural BMP
4.0	Porous Pavement Detention
5.0	Porous Landscape Detention
6.0	Extended Detention Basin
7.0	Sand Filter Extended Detention Basin
8.0	Constructed Wetland Basin
9.0	Retention Pond

- Step 3. Stabilize Drainageways. Drainageway, natural and manmade, erosion can be a major source of sediment and associated constituents, such as phosphorus. Natural drainageways are often subject to bed and bank erosion when urbanizing areas increase the frequency, rate, and volume of runoff. It is important that drainageways adjacent to or traversing development sites be stabilized. One of three basic methods of stabilization may be selected.

  - Constructed Grass, Riprap, or Concrete-Lined Channel This method of channel stabilization has been in practice for some time; it is described in Volume 2 of the *Urban Storm Drainage Criteria Manual* (*USDCM*). The water quality benefit associated with these channels is the

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reduction of severe bed and bank erosion that can occur in the absence of a stabilized channel. On the other hand, the hard-lined low flow channels that are often used do not offer much in the way of water quality enhancement or wetland habitat. The Urban Drainage and Flood Control District does not recommend the use of riprap or concrete lined flood conveyance channels, but does recommend the use of rock lined low-flow channels.

- Stabilized Natural Channel. This method of channel stabilization is also addressed in Volume 2 of the *USDCM*. However, in practice, many natural drainageways in and adjacent to new developments in the Denver area are frequently left in an undisturbed condition. While this may be positive in terms of retaining desirable riparian vegetation and habitat, urban development may cause the channel to become destabilized. When degradation occurs in these drainageways, significant erosion, loss of riparian and aquatic habitat, and elevated levels of sediment and associated pollutants can result. Therefore, it is recommended that some level of stream stabilization always be considered. Small grade control structures sized for a 5-year or larger runoff event are often an effective means of establishing a mild slope for the baseflow channel and arresting stream degradation. Severe bends or cut banks may also need to be stabilized. Such efforts to stabilize a natural waterway also preserves and promotes natural riparian vegetation which can provide paybacks in terms of enhanced aesthetics, habitat, and water quality.

One additional method of drainageway stabilization gives special attention to stormwater quality and is described in the following section of the *Structural Best Management Practices* chapter:

Section	Structural BMP
10.0	Constructed Wetland Channel.

- Step 4. Consider Need for Industrial and Commercial BMPs. If a new development or significant redevelopment activity is planned for an industrial or commercial site, the need for specialized BMPs must be considered. Several approaches are described in the following sections of the *Structural Best Management Practices* chapter:

Section	Structural BMP
11.0	Covering of Storage/Handling Areas
12.0	Spill Containment and Control

Guidance for planning of industrial and commercial BMPs is provided in the chapter titled *Industrial and Commercial Best Management Practices*. In addition, nonstructural practices applicable to industrial and commercial activities are described in the chapter on *Nonstructural Best Management Practices*.

1.3 Other BMPs

The structural BMPs identified above were selected after a comprehensive screening of known structural BMPs with representatives of a number of cities and counties in the Denver metropolitan area, Colorado Department of Transportation, Colorado Water Quality Control Division, industry, homebuilders, and a municipality located outside the Denver metropolitan area. Final selection by this group was based on the review of documentation on potential effectiveness in a semiarid climate, local applicability, maintenance considerations, and cost.

Several other BMPs were considered but were not included in Volume 3 at this time. These include manufactured devices such as water quality vaults and inlets, infiltration trenches, oil/grease separators, fabric inserts for inlets, and stream buffer setbacks. Some of these BMPs show promise but need further independent research to determine their pollutant removal effectiveness in a semiarid climate and to develop cost-effective design criteria to insure that they are properly designed, constructed, and maintained. As additional BMPs are field tested, and as supporting information becomes available, they may be added to the *Manual*.

1.4 Implementing Step 1. Employ Runoff Reduction Techniques

1.4.1 Benefits of Reducing Imperviousness. Reducing imperviousness offers the following benefits:

- Increased infiltration and decreased rate and volume of site runoff
- Decreased WQCV and, in turn decreased size of required WQCV facilities
- Decreased 2-year and 5-year peak runoff rates and volumes for downstream conveyance and detention facilities
- Reduced need for irrigation
- Less curb and gutter
- Smaller storm sewer systems
- Decreased pavement
- Decreased runoff rates and volumes further downstream in watershed, especially if MDCIA is used on a widespread basis

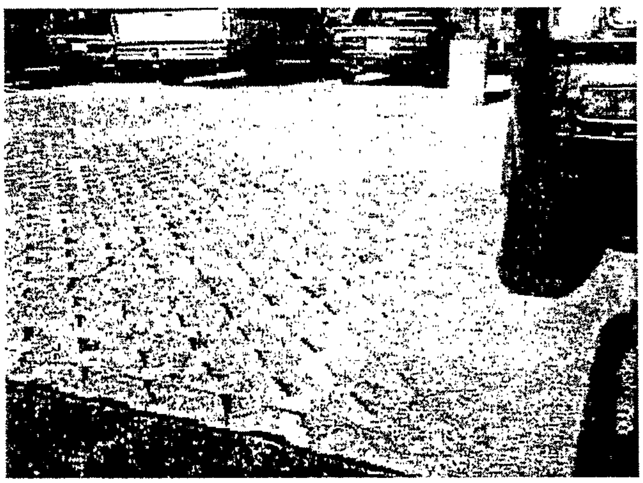
1.4.2 BMPs for Minimizing Effective Imperviousness. Described next are structural BMPs that minimize effective imperviousness.

Grass Buffer (GB)

Uniformly graded and densely vegetated area of turf grass. This BMP requires sheet flow to promote filtration, infiltration, and settling to reduce runoff pollutants.

Grass Swale (GS)

Densely vegetated drainageway with low-pitched side slopes that collects and slowly conveys runoff. Design of longitudinal slope and cross-section size forces the flow to be slow and shallow, thereby facilitating sedimentation while limiting erosion.



Modular Block Porous Pavement (MBP)

Modular block porous pavement consists of open void concrete slab units underlain with gravel. The surface voids are filled with sand. This BMP is intended to be used in low traffic areas to accommodate vehicles while facilitating stormwater infiltration near its source. A variation of this BMP is termed stabilized-grass porous pavement, consisting of plastic rings affixed to filter fabric underlain with gravel. The surface voids are filled with sand and grass sod/or seed.

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1.4.3 Applying MDCIA to a Site. Minimizing directly connected impervious area requires a basic change in land development design philosophy. This change seeks to reduce paved areas and directs stormwater runoff to landscaped areas, grass buffer strips, and grass-lined swales to slow down the rate of runoff, reduce runoff volumes, attenuate peak flows, and encourage filtering and infiltration of stormwater. Traditional land development practices do not focus on water quality enhancement. Instead, they promote runoff from rooftops, parking lots, driveways, and roads to quickly flow to a curb and gutter and to a formalized stormwater conveyance system. This practice concentrates runoff quickly, which results in a fast responding system and relatively large peak runoff rates during small storms.

Minimizing DCIAs can be made an integral part of landscape and drainage planning for any development. Roof collection systems can direct flow to landscaped areas, infiltration areas, grassed buffer strips, and to grass swales. Instead of using solid curbing, eliminate curbing or use slotted curbing along with stabilized grass shoulders and swales. Residential driveway runoff can be redirected from flowing directly into the street. Large parking lots can reduce DCIAs by using modular block or stabilized grass porous pavement in less used portions of the lot to encourage local infiltration or storage.

Site slopes should be capable of directing stormwater runoff by gravity in a sheet flow away from buildings, roads, and parking lots toward grass-covered or porous pavement covered areas. The runoff then needs to flow as a sheet over these porous surfaces before it reaches swales, storage, stormwater collection, and stormwater conveyance systems. As a result, in areas of high permeability soils (Hydrologic Soil Class A and B soils), the ground can provide for infiltration of large portions of surface runoff. Where less permeable soils are present, significant runoff losses can also be achieved, while the use of sand trenches with underdrains under grass swales can be used to prevent the nuisance of standing water.

Steep sites with average terrain slopes exceeding 4 percent may not lend themselves well to implementing some aspects of this BMP. Some of the difficulties can be dealt with by using terracing and retaining walls. Nevertheless, most sites with general terrain slopes flatter than 4 percent should be suitable for this BMP; the flatter the better.

Minimizing DCIAs can be implemented in varying degrees. Two general levels associated with minimizing DCIAs have been identified for the purpose of the *Manual* and are described below:

- Level 1. The primary intent is to direct the runoff generated by impervious surfaces to flow over grass-covered areas, and to provide sufficient travel time so as to encourage the removal of suspended solids before runoff leaves the site, enters a curb and gutter, or enters another stormwater collection system. Thus, at Level 1, *all* impervious surfaces are made to drain over grass buffer strips before reaching a stormwater conveyance system.

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- Level 2. As an adjunct to Level 1, this level replaces street curb and gutter systems with low-velocity grass-lined swales and pervious street shoulders. Conveyance systems and storm sewer inlets will still be needed to collect runoff at downstream intersections and crossings where stormwater flow rates exceed the capacity of the swales. Small culverts will be needed at street crossings and at individual driveways until inlets are provided to convey the flow to a storm sewer.

1.4.4 Calculating Effective Imperviousness. The first step in estimating the magnitude of runoff from a site is to first estimate the site's imperviousness. The total imperviousness of a site is the weighted average of individual areas of like imperviousness. For instance, according to Table 3-1 of Volume 1 of the USDCM, paved streets (and parking lots) have an imperviousness of 100-percent, drives and walks have an imperviousness of 96-percent, roofs have an imperviousness of 90-percent, and lawn areas have an imperviousness of 0-percent. The total imperviousness of a site can be determined taking an area-weighted average of the imperviousness of the street, walk, roof, and lawn areas.

Structural BMPs for minimizing imperviousness impact this calculation in two ways. First, the use of modular block porous pavement reduces the imperviousness associated with parking areas and drives built using modular block pavement from 100- and 96-percent, respectively, to 35-percent (assuming the use of underdrains). Second, the use of grass buffers and grass swales provides a reduction in imperviousness according to Figure ND-1. This figure represents the reduction in imperviousness associated with Level 1 and Level 2 MDCIA as discussed above. Grass buffers and/or grass swales are to be configured according to the design procedure documented in the *Structural Best Management Practices* chapter.

1.4.5 Application Examples. The following figures provide a number of illustrations of how the principle of MDCIA can be applied to development sites. Figure ND-2 shows an example of MDCIA for a residential and commercial site. Figure ND-3 shows an example for a multi-family residential site. Figure ND-4 shows typical application examples of modular block porous pavement.

The Total Percent of Watershed Imperviousness for the traditional residential layout in Figure ND-2 is approximately 47%. Using porous pavement and a grass swale, as shown at the bottom of the figure, reduces the Total Percent of Watershed Imperviousness to 34%. This shows that the inclusion of BMPs can significantly reduce total imperviousness. Additional BMP benefits are achieved when the user determines the Impervious Percent to Use with WQCV in Figure ND-1 because the MDCIA layout allows the use of the Level 2 MDCIA curve. The resulting Impervious Percent to Use with WQCV values for the traditional residential layout and the residential MDCIA layout are 47% and 20%, respectively.

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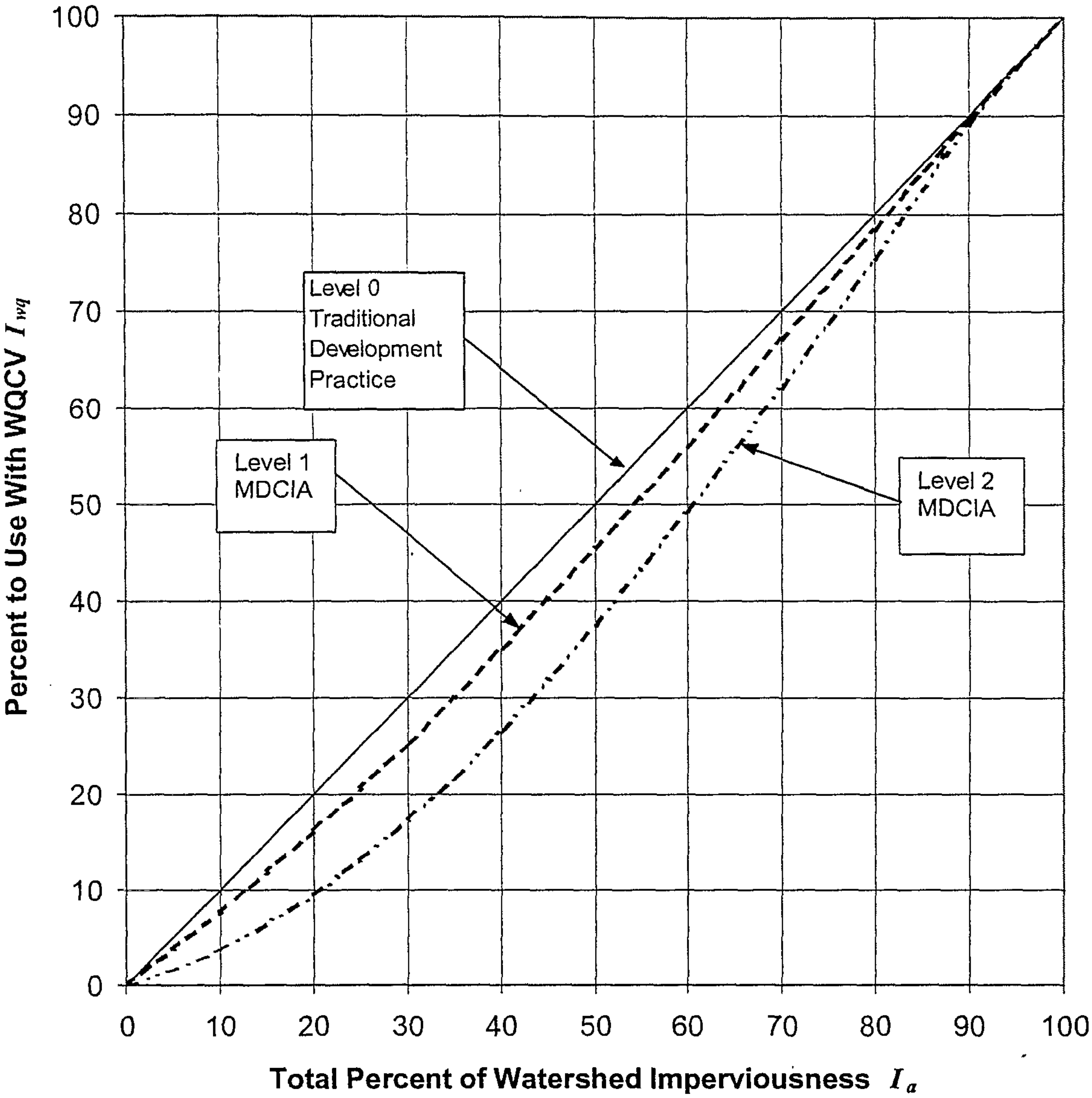

FIGURE ND-1

Imperviousness to Use With Water Quality Capture Volume (WQCV)

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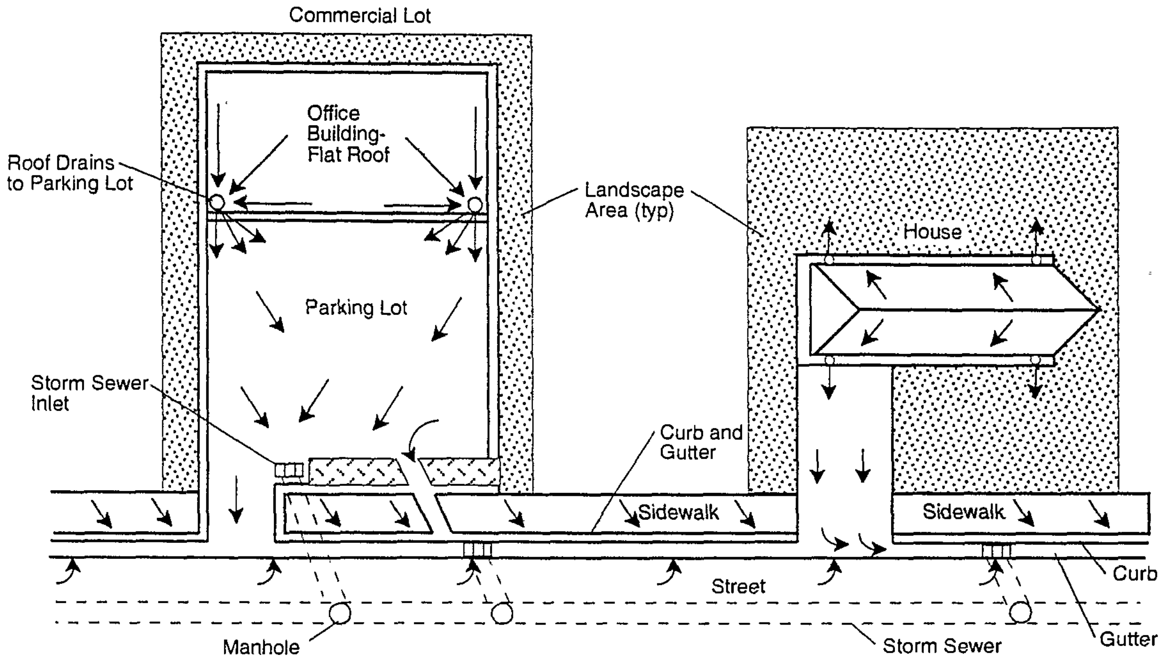
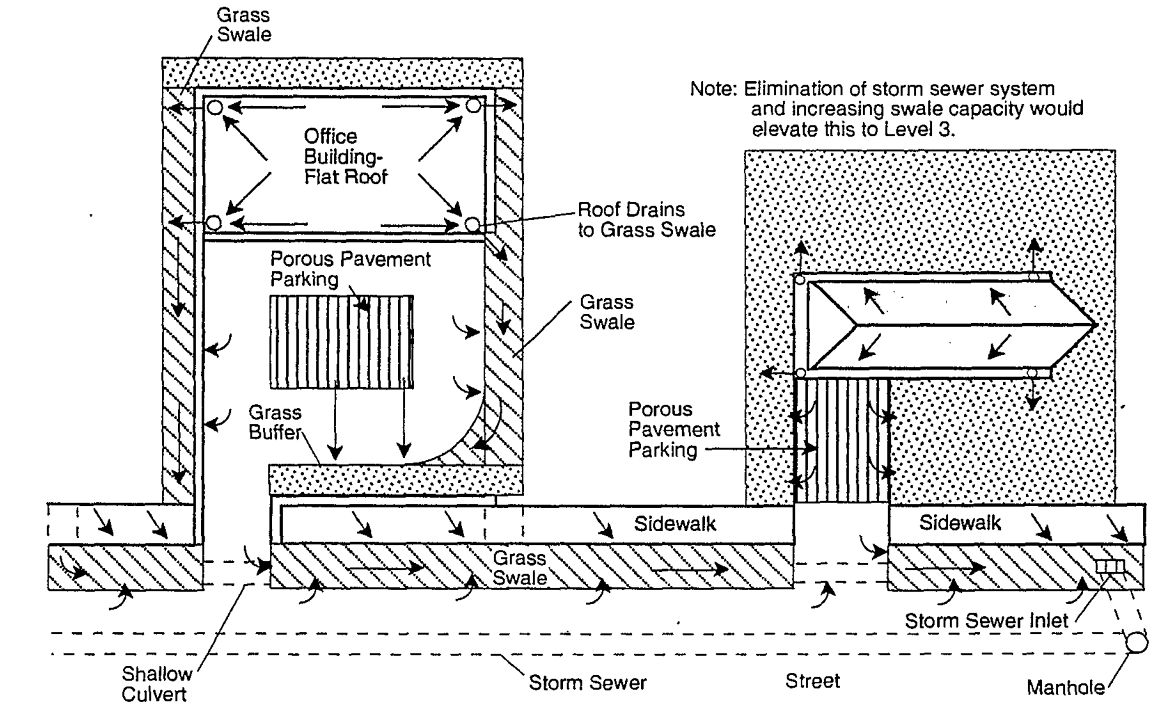


TRADITIONAL SITE & STREET DRAINAGE DESIGN



MINIMIZING DIRECTLY CONNECTED IMPERVIOUS AREAS (LEVEL 2 PRACTICES SHOWN)

FIGURE ND-2
Examples of Minimizing Directly Connected Impervious Areas - Residential And Commercial

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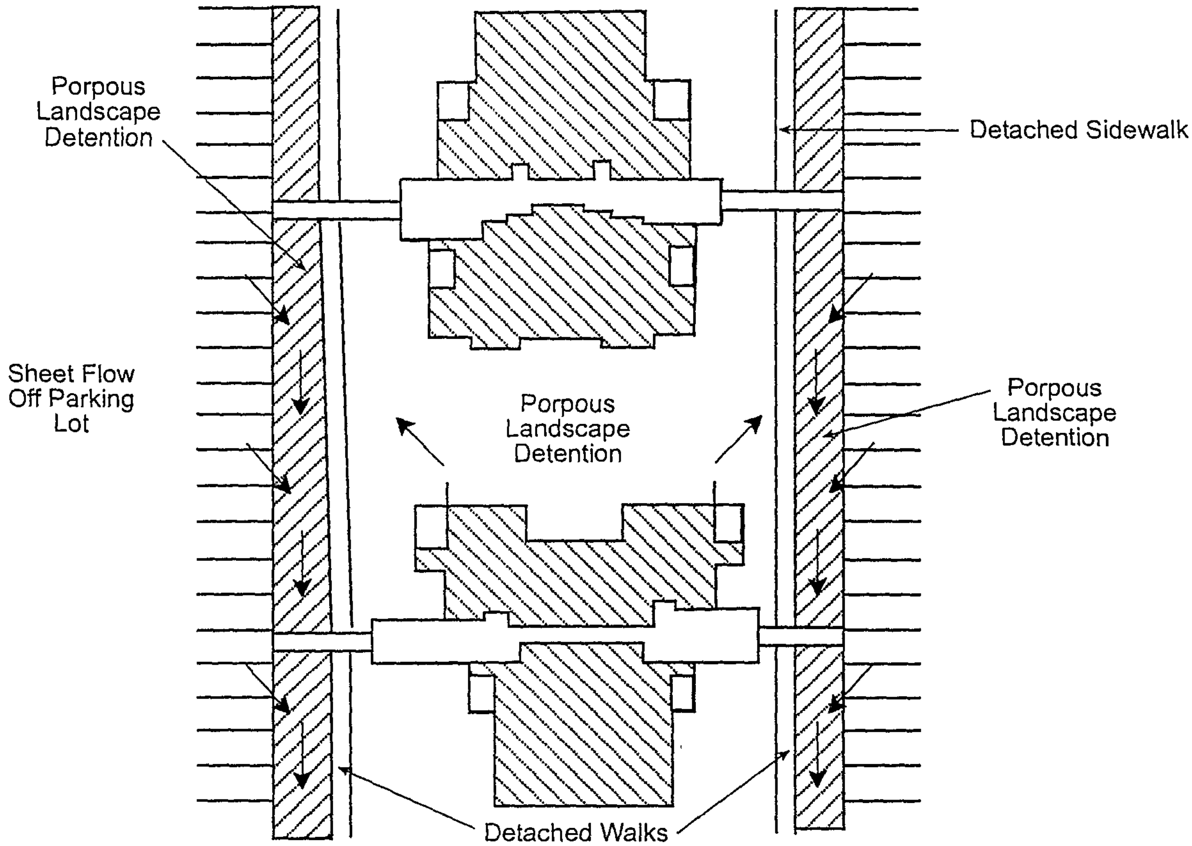

FIGURE ND-3
Examples of Mdcia for Multi-Family Residential Development

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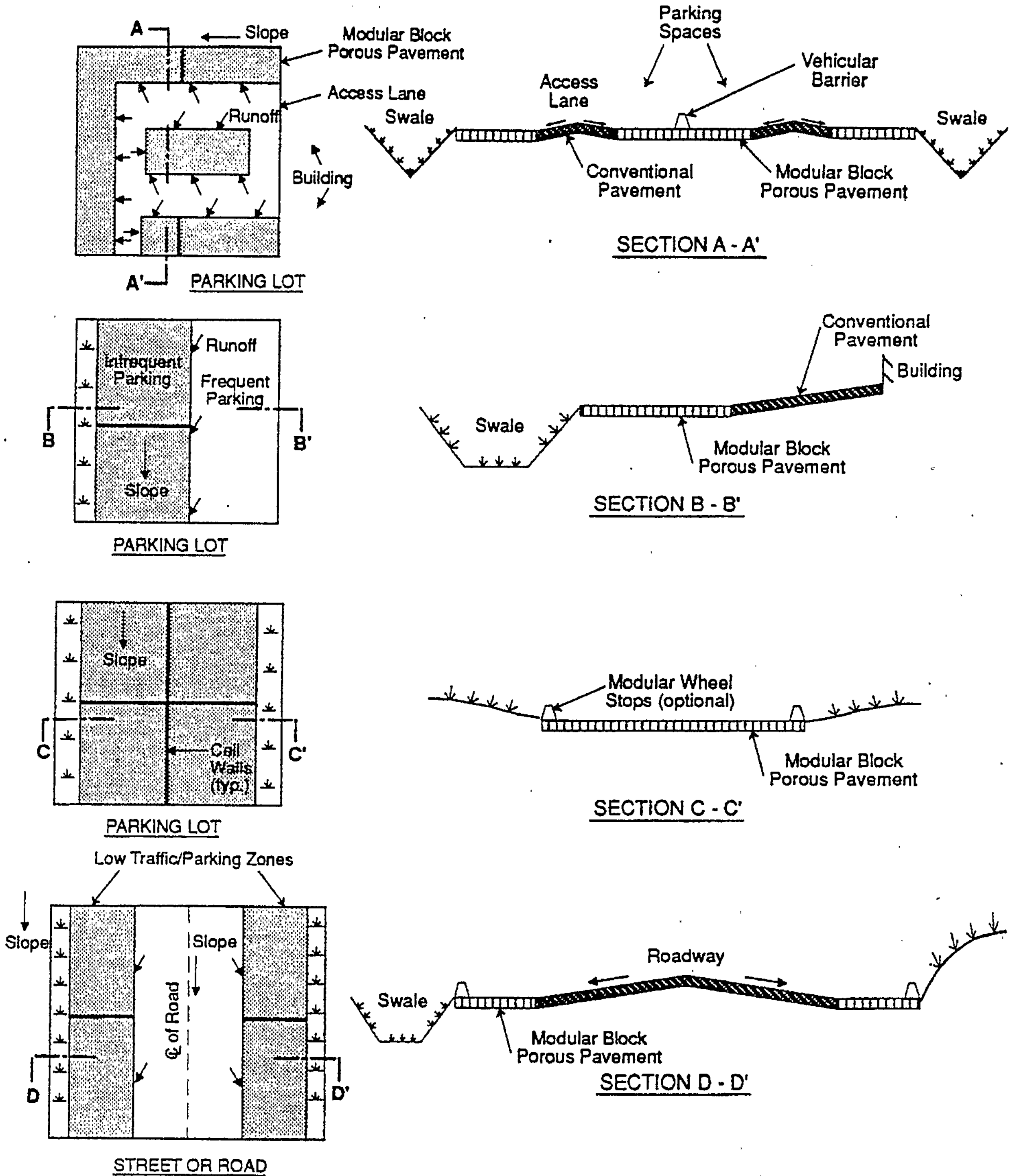

FIGURE ND-4
Typical Applications of Modular Block Porous Pavement

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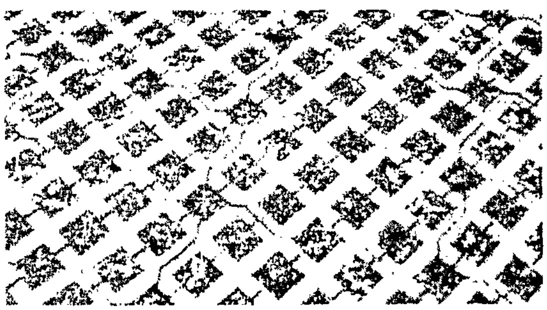
1.5 Implementing Step 2. Provide Water Quality Capture Volume (WQCV)

1.5.1 Benefits of WQCV Facilities. These BMPs are designed to capture and provide treatment for a specific volume of stormwater runoff (about half of the runoff from a 2-year storm). This volume is equivalent to the runoff from an 80th percentile storm, meaning that 80 percent of the most frequently occurring storms are fully captured and treated and larger events are partially treated. Detention periods range from 6- to 40-hours, depending on the type of facility. The primary pollutant removal mechanism consists of physical settling of suspended sediments and associated adsorbed pollutants. Secondary pollutant removal mechanisms include filtering, biological uptake, and adsorption.

The WQCV treatment facilities described herein have been selected for the USDCM because they have demonstrated proven results in the Denver area, are relatively cost-effective and are necessary at any site addressing stormwater quality. Runoff from 100-percent of the impervious surfaces of a site must flow through a properly designed installation of one or more of the six WQCV BMPs that are listed herein. Alternate designs may be considered, but they must have equivalent functional requirements of these six BMPs as to WQCV and drain times.

1.5.2 Types of WQCV Facilities. A brief description of the six types of WQCV facilities follows.



Porous Pavement Detention (PPD)

Porous pavement detention consists of modular block porous pavement that is installed flat and is provided with a 2-inch deep detention zone above its surface to temporarily store the WQCV from the tributary drainage area including its own surface. Runoff infiltrates into the void spaces of the gravel base course through the sand filter and slowly exits through an underdrain.

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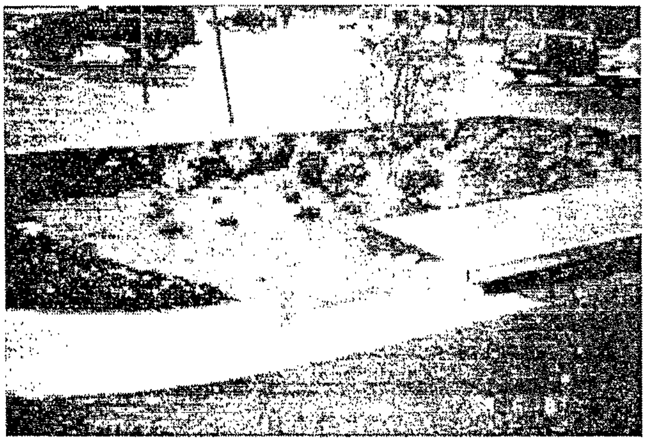
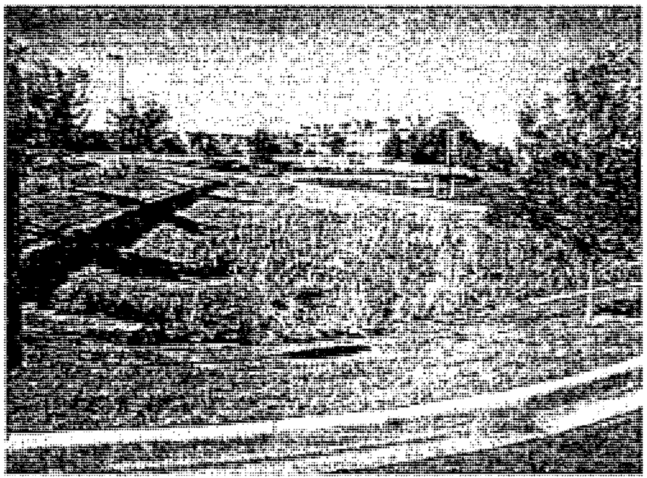


Porous Landscape Detention (PLD)

Porous landscape detention consists of a low lying vegetated area underlain by a sand bed with an underdrain. A shallow surcharge zone exists above the porous landscape detention for temporary storage of the WQCV. This BMP allows small amounts of WQCV to be provided on parking lots or adjacent to buildings without requiring the setaside of significant developable land areas.



Extended Detention Basin (EDB)

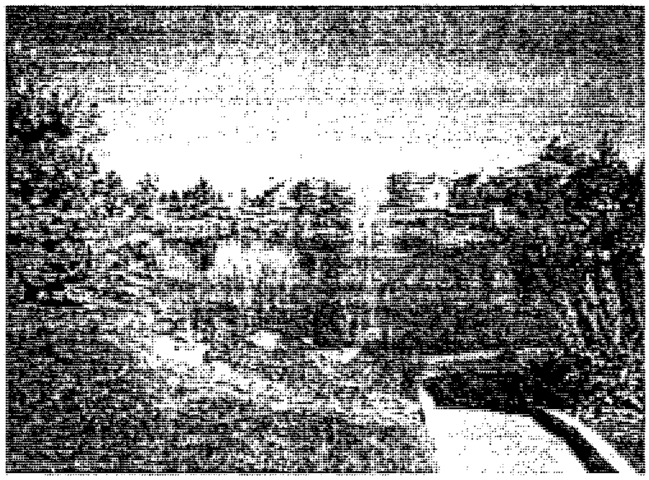
An extended detention basin is appropriate for larger sites and is designed to totally empty out sometime after stormwater runoff ends. The extended basin uses a much smaller outlet than a flood control detention basin which extends the emptying time for the more frequently occurring runoff events to facilitate pollutant removal.

Sand Filter Extended Detention Basin (SFB)

A sand filter extended detention basin consists of a sand bed and underdrain system. Above the vegetated sand bed is an extended detention basin sized to capture the WQCV. A sand filter extended detention basin provides pollutant removal through settling and filtering and is generally suited to offline, onsite configurations where there is no base flow and the sediment load is relatively low.

Constructed Wetland Basin (CWB)

A constructed wetland basin is appropriate for large catchments and is a shallow retention pond which requires a perennial supply of water to permit the growth of rushes, willows, cattails, and reeds. It treats runoff by slowing it down to allow time for settling and biological uptake.



Retention Pond (RP)

A retention pond is appropriate for larger catchments. It has a permanent pool of water that is replaced with stormwater, in part or in total, during storm runoff events. In addition, a temporary extended detention volume is provided above this permanent pool to capture storm runoff and enhance sedimentation. It requires a perennial supply of water to maintain the pool.

1.5.3 Application Examples for Porous Pavement and Porous Landscape Detention. Porous pavement and porous landscape detention provide an opportunity to incorporate WQCV into a new land development site or a redevelopment site while minimizing the impact on developable area. Just as the principle of MDCIA requires a change in drainage philosophy, so does the application of porous pavement and porous landscape detention. These BMPs need to be applied on a relatively small scale and are ideally suited to small sites or individual small sub-catchment areas of large sites.

The following figures provide a number of illustrations of how porous pavement and porous landscape detention can be applied in a development site. Figure ND-5 shows an example for a residential site. Figure ND-6 and ND-6A show an example for a multi-family residential site, and Figure ND-7 shows an example for a commercial site parking lot.

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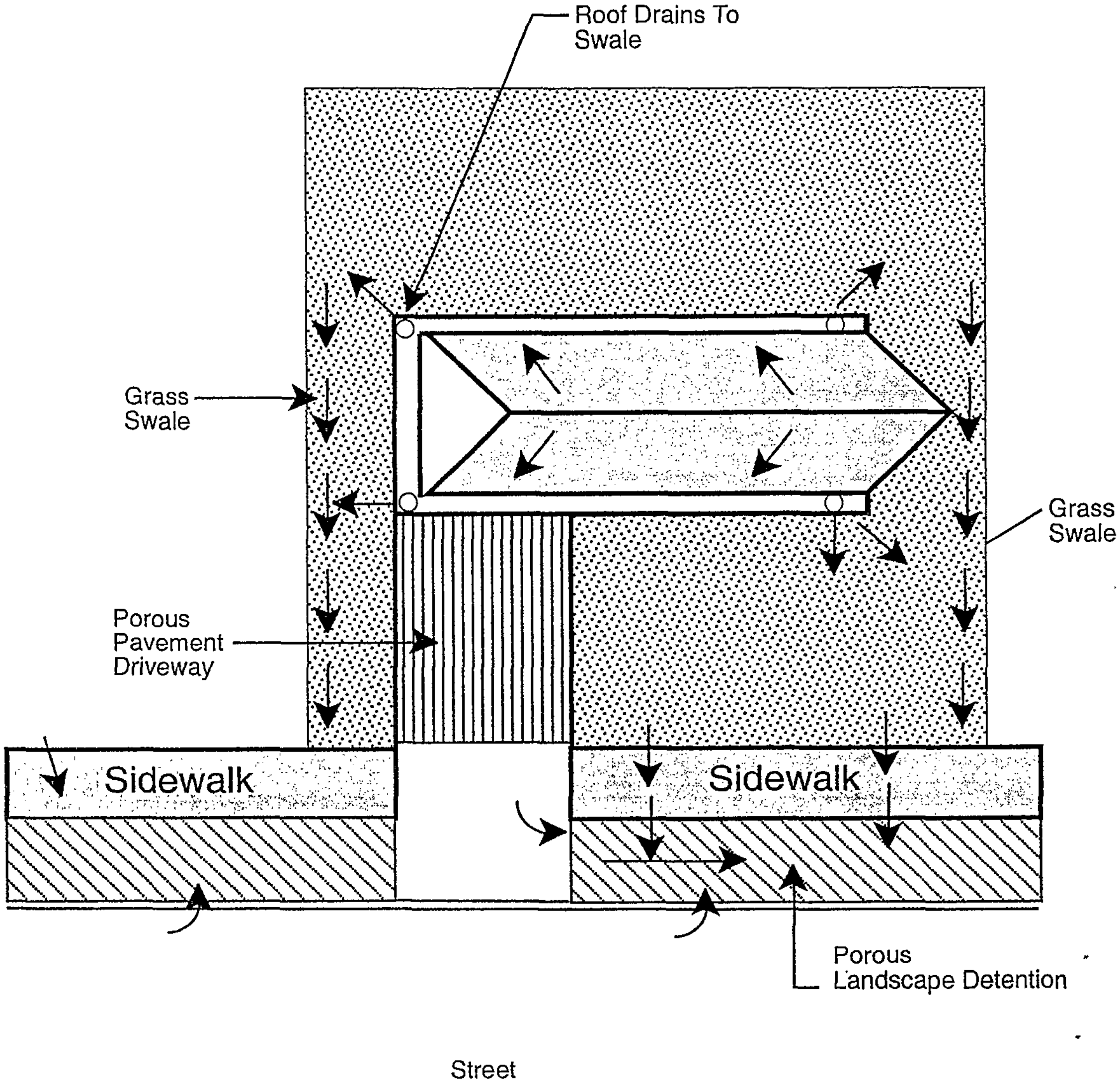

FIGURE ND-5
Examples of Porous Landscape Detention for Single Family Residential Development

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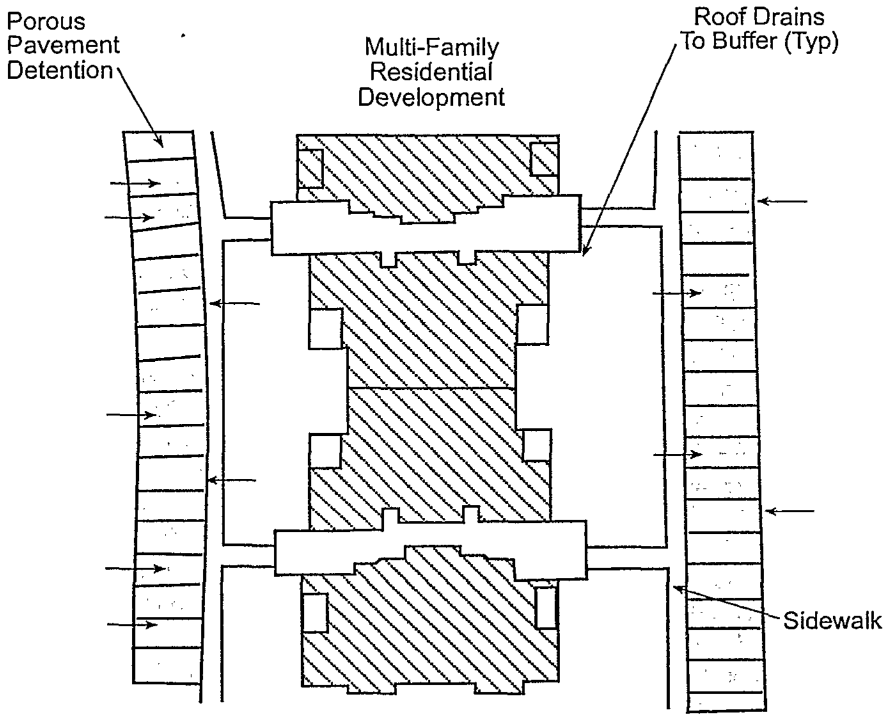

FIGURE ND-6
Example of Porous Pavement Detention for Multi-Family Residential Development

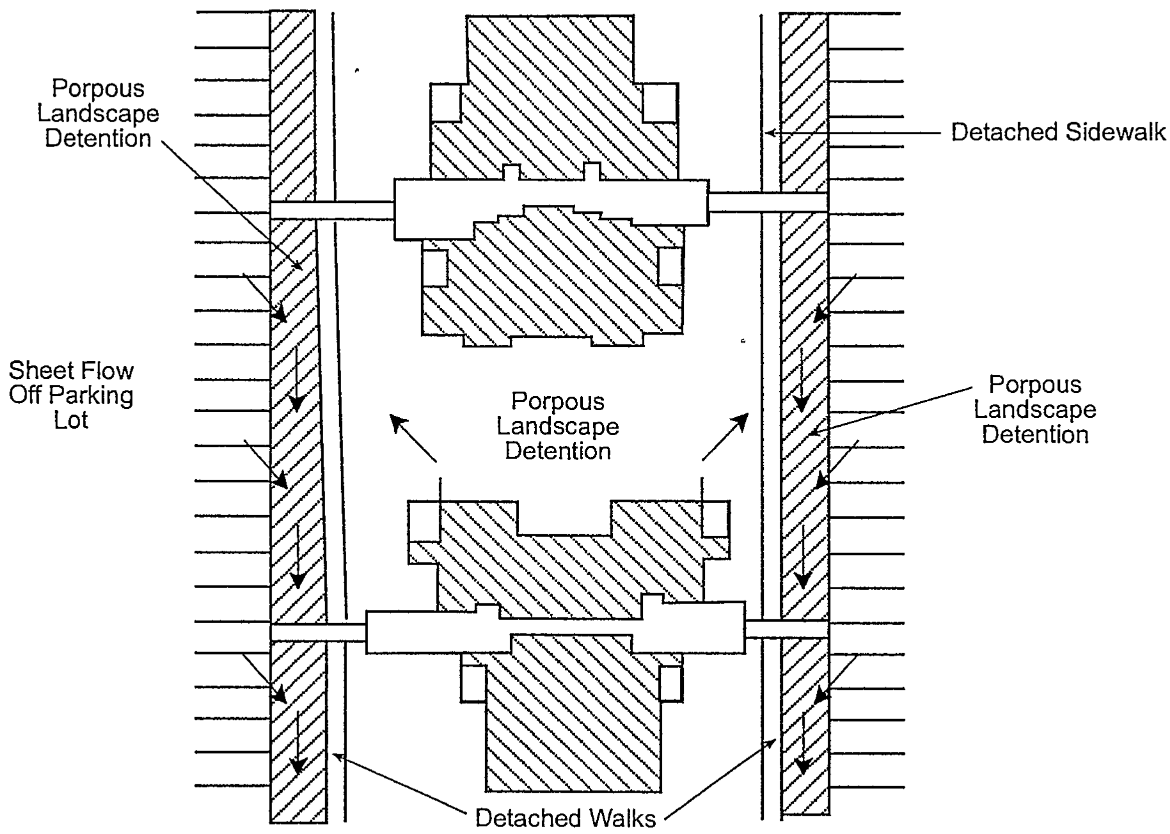

FIGURE ND-6A
Example of Porous Landscape Detention for Multi-Family Residential Development

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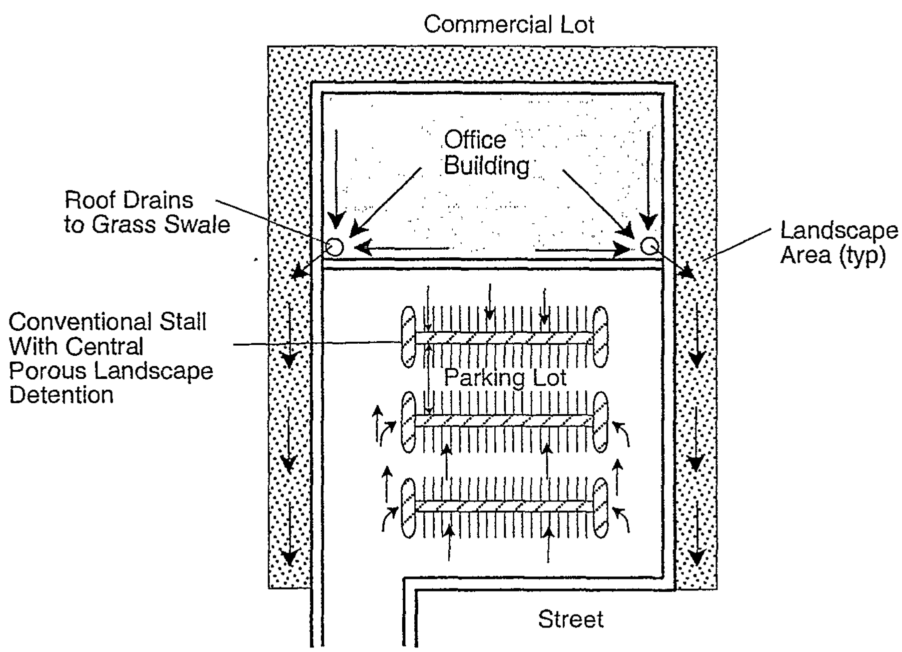

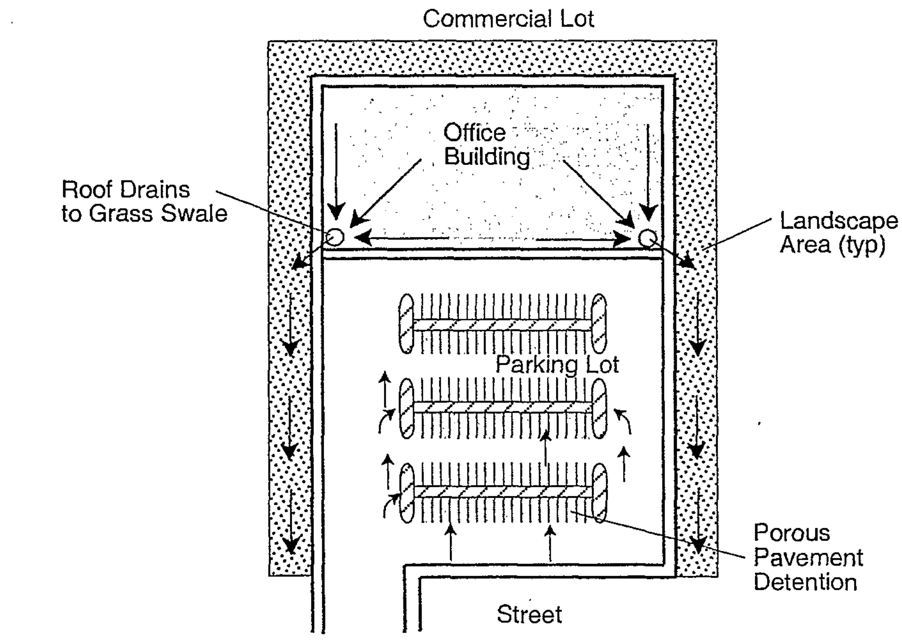

FIGURE ND-7
Examples of Porous Pavement and Porous Landscape Detention for Commercial Development (Parking Lot)

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1.5.4 Guidance for Selecting and Locating WQCV Facilities. Figure ND-8 depicts a decision tree for selecting one of the six WQCV BMPs based on drainage catchment area and whether water is available to satisfy evapotranspiration requirements. Porous pavement and porous landscape detention is generally suited for small drainage areas (i.e. much less than 1.0 acres); however, larger subwatersheds can be subdivided into individual drainage sub-catchment areas meeting the criteria shown in Figure ND-8 for these BMPs.

Laying out WQCV facilities within a development site and watershed requires thought and planning. Often, this decision-making occurs during a master planning process undertaken by local jurisdictions and the District. Outfall system plans and other reports may depict a recommended approach for implementing WQCV on a watershed basis. Such reports may call for a few large regional WQCV facilities, smaller sub-regional facilities, or alternatively an onsite approach. It is always a good idea to find out if a master planning study has been completed that addresses water quality and to attempt to follow the plan's recommendations.

The following guidance is for areas where a master plan addressing water quality has not been completed. One of the questions involved in laying out WQCV facilities on a site is whether to locate a BMP onstream or offstream. Onstream refers to locating a BMP on a drainageway that traverses a site such that all of the runoff from the upstream watershed flows through the facility. A single onstream BMP can treat both site runoff and runoff generated in any upstream offsite catchment areas that are part of that watershed. Locating BMPs offstream requires that all onsite catchment areas flow though a BMP prior to entering the drainageway. Offstream BMPs do not provide treatment of runoff from any upstream drainage catchment areas.

Onstream WQCV facilities are only recommended if the offsite drainage catchment area tributary to the drainageway has less impervious area than the onsite drainage catchment's impervious area tributary to the same drainageway. **Nevertheless, onstream WQCV facilities must be designed to serve the entire upstream watershed, including any catchment areas upstream of the development, based on future development conditions.** This is true even if upstream developments have installed their own WQCV facilities.

Figure ND-9 provides an illustration of selection and location options for WQCV facilities based on the principles discussed above. Table ND-1 indicates the BMP options for the four watershed areas shown in Figure ND-9.

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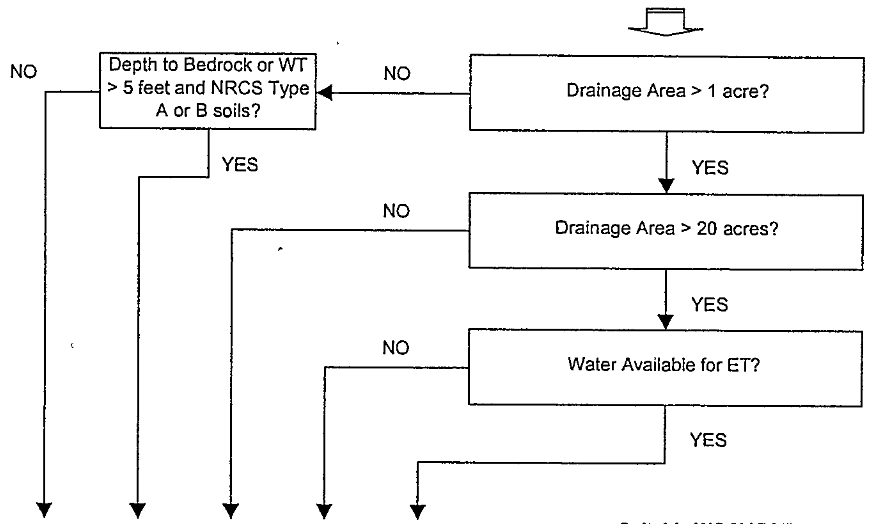

					Suitable WQCV BMP
o					Porous Pavement Detention (PPD) with Underdrain
	o				Porous Pavement Detention (PPD) with Infiltration
o					Porous Landscape Detention (PLD) with Underdrain
	o				Porous Landscape Detention (PLD) with Infiltration
		o	o	o	Extended Detention Basin (EDB)
		o			Sand Filter Extended Detention Basin (SFB)
				o	Construction Wetland Basin (CWB)
				o	Retention Pond (RP)

Note: Large drainage areas may be subdivided into areas < 20 acres for use of SFD or PLD or <1 acre for use of PPD.

FIGURE ND-8

Decision Tree for WQCV BMP Selection

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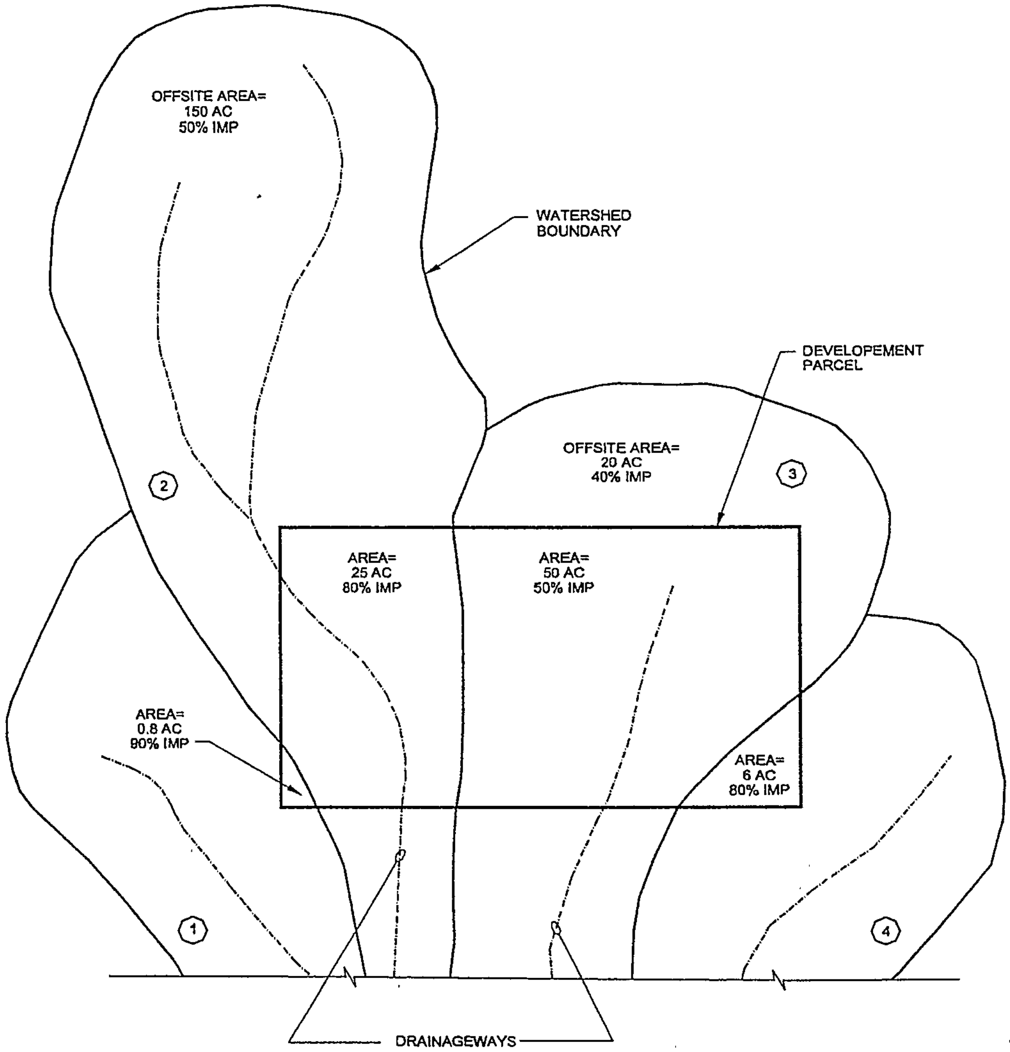

NOTE: FOR THIS EXAMPLE SUFFICIENT MAKE-UP WATER EXISTS FOR CONSTRUCTED WETLANDS AND RETENTION POND FOR THE WATERSHED AREAS > 50 ACRES THROUGH IRRIGATION RETURN FLOWS.

FIGURE ND-9

Illustration of Selection and Location Options For WQCV Facilities

TABLE ND-1
Illustration of Selection and Location Options for WQCV Facilities for the Development Parcel on Figure ND-9

Watershed Number	Onstream or Offstream	BMP Options	Minimum Number of BMP Installations	Average Drainage Area for Sizing Each BMP, acre
1	Offstream	Porous Pavement Detention	1	0.8
		Porous Landscape Detention	1	0.8
2	Offstream	Porous Pavement Detention	24	1
		Porous Landscape Detention	2	12
		Extended Detention Basin	2	12
		Sand Filter Extended Detention Basin	2	12
3	Offstream	Porous Pavement Detention	49	1
		Porous Landscape Detention	3	16
		Extended Detention Basin	2	24
		Sand Filter Extended Detention Basin	3	16
	Onstream	Extended Detention Basin	1	70
		Constructed Wetland Basin	1	70
		Retention Pond	1	70
4	Offstream	Porous Pavement Detention	6	1
		Porous Landscape Detention	1	6
		Extended Detention Basin	1	6
		Sand Filter Extended Detention Basin	1	6

1.5.5 Incorporating WQCV into Stormwater Quantity Detention Basins. Wherever possible, it is recommended that WQCV facilities be incorporated into stormwater quantity detention facilities. This is relatively straightforward for an extended detention basin, constructed wetland basin, and a retention pond. When combined, the 2-, 5-, 10-, and/or 100-year detention levels are provided above the WQCV and the outlet structure is designed to control two or three different releases. Figure 2 in the section on *Water Quality Structure Details* shows of examples of combined quality/quantity outlet structure. Stormwater quantity detention could be provided above the WQCV for porous pavement and landscape detention provided the drain times for the larger events are kept short.

Local jurisdictions in the Denver area use different approaches for sizing a combined water quality and quantity detention facility. This varies from requiring no more than the 100-year detention volume even though the WQCV is incorporated within it, to requiring the 100-year detention volume plus the full WQCV. The *Manual* does not stipulate or recommend which policy should be used. When a local policy is lacking and is being set, the *Manual* suggests the following approach:

- Water Quality. The full WQCV is to be provided according to the design procedures documented in the Structural BMP Section.
- Minor Storm. The full WQCV plus the full minor storm quantity detention volume is to be provided.

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- <u>100-Year Storm</u>. One-half the WQCV plus the full 100-year detention volume is to be provided.

However, local governments may have criteria different than that described above, and such criteria takes precedence over the approach suggested herein. For instance, some jurisdictions require that the full WQCV be added to the full 100-year detention volume and some require no more than the 100-year detention volume even if WQCV is incorporated within the facility

At this time the *Manual* recommends that water quality detention not be incorporated into underground detention facilities, such as installations of buried large-diameter pipe sections, stone trenches, underground "infiltrating" devices, etc.

<u>1.5.6 Separate Presedimentation Facilities.</u> The design criteria shown in the Structural BMP section shows presedimentation forebays at the upstream end of the extended detention basin, constructed wetland basin, and retention pond. The purpose of the forebay is to settling out coarse sediment and skim off floatables prior to the main body of the facility. An option to this approach is to install a separate facility upstream from the main WQCV facility. If this option is selected, the recommended size is at least 20 percent of the WQCV and the recommended drain time is 1 hour for the presedimentation forebay volume only. Using this approach, the size of the main WQCV facility may be reduced by 10 percent, any requirement for sediment storage in the main facility may be reduced by one-half, and the forebay within the main facility may be eliminated.

It is extremely important that high sediment loading be controlled for porous pavement detention, porous landscape detention, and sand filter extended detention basins. These facilities are best suited to being brought on line at the end of the construction phase where disturbed ground has been established with pavement or vegetation.

STRUCTURAL BEST MANAGEMENT PRACTICES

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STRUCTURAL BEST MANAGEMENT PRACTICES

This chapter provides a description and design information for the following structural BMPs:

1. Grass Buffer (GB)
2. Grass Swale (GS)
3. Modular Block Porous Pavement (MBP)
4. Porous Pavement Detention (PPD)
5. Porous Landscape Detention (PLD)
6. Extended Detention Basin (EDB)
7. Sand Filter Extended Detention Basin (SFB)
8. Constructed Wetlands Basin (CWB)
9. Retention Pond (RP)
10. Constructed Wetlands Channel (CWC)
11. Covering of Storage/Handling Areas
12. Spill Containment and Control

Detailed design procedures criteria are described. Forms that designers can use to document the design procedure are included at the end of Volume 3. Typical design details are shown in the section titled Typical Details.

1.0 GRASS BUFFER (GB)

1.1 Description

Grass buffer (GB) strips are an integral part of the MDCIA land development concept. They are uniformly graded and densely vegetated areas of turf grass. They require sheet flow to promote filtration, infiltration and settling to reduce runoff pollutants. GBs differ from grass swales as they are designed to accommodate overland sheet flow rather than concentrated or channelized flow. They can be used to remove larger sediment from runoff off impervious areas.

Whenever concentrated runoff occurs, it should be evenly distributed across the width of the buffer via a flow spreader. This may be a porous pavement strip or another type of structure to achieve uniform sheet-flow conditions. GBs can also be combined with riparian zones in treating sheet flows and in stabilizing channel banks adjacent to major drainageways and receiving waters. GBs can be interspersed with shrubs and trees to improve their aesthetics and to provide shading. Irrigation in the semi-arid climate of Colorado is required to maintain a healthy and dense grass on the GB to withstand the erosive forces of runoff from impervious areas.

1.2 General Application

A GB can be used in residential and commercial areas. They are typically located adjacent to impervious areas. When used, they should be incorporated into site drainage, street drainage, and master drainage planning. Because their effectiveness depends on having an evenly distributed sheet flow over their surface, the size of the contributing area, and the associated volume of runoff have to be limited. Flow can be directly accepted from an impervious area such as from a parking lot and building roofs, provided the flow is distributed uniformly over the strip. GBs provide only marginal pollutant removal and require

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that follow-up structural BMPs be provided. They do, however, help to reduce some of the runoff volume from small storms.

1.3 Advantages/Disadvantages

1.3.1 General. The grass and other vegetation provide aesthetically pleasing green space, which can be incorporated into a development landscaping plan. In addition, their use adds little cost to a development that has to provide open space, and their maintenance should be no different than routine maintenance of the site's landscaping. Eventually, the grass strip next to the spreader or the pavement will have accumulated sufficient sediment to block runoff. At that point in time, a portion of the GB strip will need to be removed and replaced.

Grass and trees within these buffer strips can provide wildlife habitat and help reduce runoff through infiltration. If infiltration occurs, it can reduce the size of downstream drainage facilities. Gravel underdrains can be used where soils are not best suited for infiltration and to help keep the GB's surface dry.

1.3.2 Physical Site Suitability. The site, after final grading, should have a uniform slope and be capable of maintaining an even sheet flow throughout without concentrating runoff into shallow swales or rivulets. The allowable tributary area depends on the width, length, and the soils that lay under the GB. Hydrologic Soil Groups A and B provide the best infiltration capacity, while Soil Groups C and D provide best site stability. The swelling potential of underlying soils should also be taken into account in how the soils may affect adjacent structures and pavement when water is delivered to the grassed areas. Because of the semi-arid nature of Colorado's high plains, an irrigated grass cover is required to be effective.

1.3.3 Pollutant Removal. Pollutant removal depends on many factors such as soil permeability, site slope, the flow path length along the buffer, the characteristics of drainage area, runoff volumes and velocities, and the type of vegetation. The general pollutant removal of both particulate and soluble pollutants is projected to be low to moderate. GBs rely primarily upon the settling and interception of solids, and to only a minor degree, on biological uptake and runoff infiltration. See Table SQ-6 for estimated range of pollutant removals.

1.4 Design Considerations

Design of GBs are based primarily on maintaining sheet-flow conditions across a uniformly graded, irrigated, dense grass cover strip. When a GB is used over unstable slopes, soils, or vegetation, formation of rills and gullies that disrupt sheet flow will occur. The resultant short-circuiting will invalidate the intended water quality benefits. GBs should be protected from excessive pedestrian or vehicular traffic that can damage the grass cover and affect even sheet-flow distribution. A mixture of grass and trees may offer benefits for slope stability and improved aesthetics.

1.5 Design Procedure and Criteria

The following steps outline the GB design procedure and criteria. Figure GB-1 is a schematic of the facility and its components.

1. Design Discharge — Determine the 2-year peak flow rate of the area draining to the GB. Also, determine the flow control type; sheet or concentrated.

2. Minimum Length — Calculate the minimum length (normal to flow) of the GB. The upstream flow needs to be uniformly distributed over this length. General guidance suggests that the hydraulic load should not exceed 0.05 cfs/linear foot of buffer in the Colorado high plains region during a 2-year storm to maintain a sheet flow of less than 1 inch throughout dense grass that is at least 2 inches high. The minimum design length (normal to flow) is therefore calculated as:

$$L_G = \frac{Q_{2-year}}{0.05}$$

In which:

L_g = Minimum design length (feet)

Q_{2-year} = Peak discharge supplied to the GBs by a 2-year event (cfs)

Longer lengths may be used.

3. Minimum Width — The minimum width (W_G) (the distance along the sheet flow direction) of the BG shall be determined by the following criteria for onsite and concentrated flow control conditions:

A. Sheet Flow Control (use the larger value)

$$W_G = 0.2L_I \text{ or } 8 \text{ feet}$$

In which:

L_I = The length of flow path of the sheet flow over the upstream impervious surface (feet)

B. Concentrated Flow Control (use the larger value)

$$W_G = 0.15(A_t/L_t) \text{ or } 8 \text{ feet}$$

In which:

A_t = The tributary area (square feet)

L_t = The length of the tributary (normal to flow) upstream of the GB (feet)

The longer the buffer area is relative to the impervious area draining to it, the smaller the effective imperviousness, per Figure ND-1.

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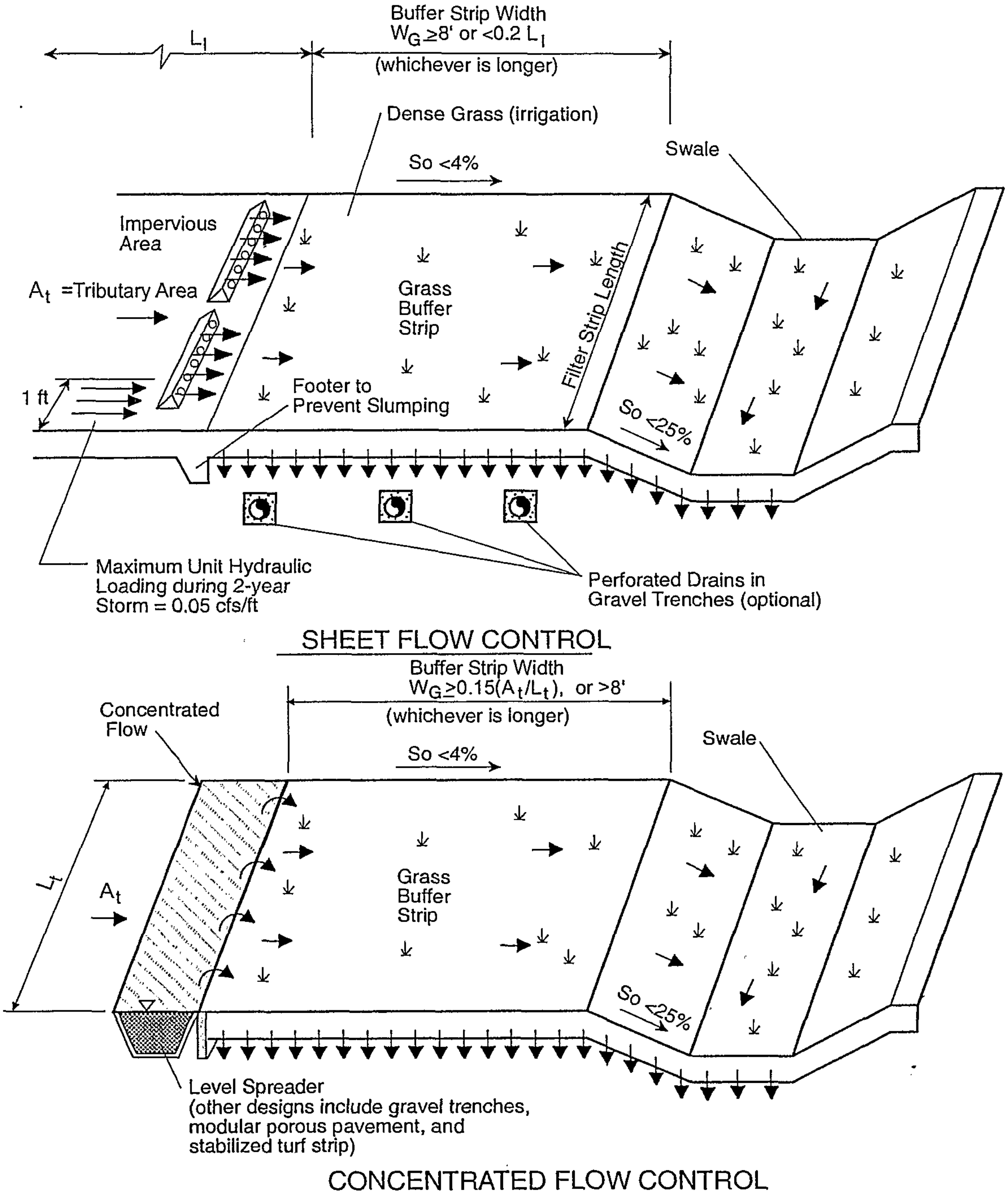
		A generally rectangular shape strip is preferred and should be free of gullies or rills that concentrate the overland flow.
4.	Maximum Slope	Design slopes shall not exceed 4 percent.
5.	Flow Distribution	Incorporate a device on the upstream end of the buffer to evenly distribute flows along the design length. Slotted curbing, modular block porous pavement (MBP), or other spreader devices can be used to apply flows. Concentrated flow supplied to the GB must use a level spreader (or a similar concept) to evenly distribute flow onto the buffer.
6.	Vegetation	Vegetate the GB with irrigated dense turf in semi-arid areas of Colorado to promote sedimentation and entrapment and to protect against erosion.
7.	Outflow Collection	Provide a means for outflow collection. Most of the runoff during significant events will not be infiltrated and will require a collection and conveyance system. A GS can be used for this purpose and can provide another MDCIA type of a BMP. The buffer can also drain to a storm sewer or to a street gutter.

1.6 Design Example

Design forms that provide a means of documenting the design procedure are included in the Design Forms section. A completed form follows as a design example.



Note: Not to Scale

FIGURE GB-1
Applications of Grass Buffers

Design Procedure Form: Grass Buffer (GB)

Designer: ____________
Company: ____________
Date: September 21, 1999
Project: ____________
Location: ____________

1. 2-Year Design Discharge (Total)	Q_2 = 5.0 cfs
2. Tributary Catchment Flow	
A) Design Length (Normal to runoff flow path): $L_G = Q_2 / 0.05$	L_G = 100 feet
B) Tributary Area in Square Feet (A_t)	A_t = 10,000 square feet
3. Design Width Along Direction of Flow (Use A or B)	
A) Sheet Flow Control Upstream	
i) Length of Flow Path Over Upstream Impervious Surface	L_I = ______ feet
ii) Design Width of Buffer: $W_G = 0.2 * L_I$ (8' minimum)	W_G = ______ feet
B) Concentrated (Non-Sheet) Flow Control Upstream (requires a level spreader in step 5 below)	
i) Length of Upstream Flow Level Spreader	L_t = 80 feet
ii) Design Width of Buffer: $W_G = 0.15 * A_t / L_t$ (8' minimum)	W_G = 18.8 feet
4. Design Slope (not to exceed 4%)	S = 4.00 %
5. Flow Distribution (Check the type used or describe "Other") Note: If Method B was Used In Step 3, Level Spreader Must Be Checked Here	___ Slotted Curbing ___ Modular Block Porous Pavement X Level Spreader ___ Other: ______
6. Vegetation (Check the type used or describe "Other") Note: Irrigated Turf Grass Is Required in Semi-Arid Climates	X Irrigated Turf Grass ___ Non-Irrigated Turf Grass ___ Other: ______
7. Outflow Collection (Check the type used or describe "Other")	X Grass Lined Swale ___ Street Gutter ___ Storm Sewer Inlet X Underdrain Used ___ Other: ______

Notes: ____________

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2.0 GRASS SWALE (GS) – SEDIMENTATION FACILITY

2.1 Description

A grass swale (GS) sedimentation facility is an integral part of the MDCIA development concept. They are densely vegetated drainageways with low-pitched sideslopes that collect and slowly convey runoff. Design of their longitudinal slope and cross-section size forces the flow to be slow and shallow, thereby facilitating sedimentation while limiting erosion. Berms or check dams should be installed perpendicular to the flow as needed to slow it down and to encourage settling and infiltration.

2.2 General Application

A GS can be located to collect overland flows from areas such as parking lots, buildings, residential yards, roadways and grass buffer strips (GBs). They can be made a part of the plans to minimize a directly connected impervious area by using them as an alternative to a curb-and-gutter system. A GS is set below adjacent ground level, and runoff enters the swales over grassy banks. The potential exists for wetland vegetation to become established if the swale experiences standing water or if there is a base flow. If that condition is possible, consider the use of underdrains. A site with a base flow should be managed as either a swale with an unlined trickle channel, or as a wetland bottom channel, the latter providing an additional BMP to stormwater runoff.

2.3 Advantages/Disadvantages

2.3.1 General. A GS, which can be more aesthetically pleasing than concrete or rock-lined drainage systems, is generally less expensive to construct. Although limited by the infiltration capacity of local soils, this BMP can also provide some reduction in runoff volumes from small storms. Dense grasses can reduce flow velocities and protect against erosion during larger storm events. Swales in residential and commercial settings can also be used to limit the extent of directly connected impervious areas.

The disadvantages of using GSs without underdrains include the possibility of soggy and wet areas in front yards, the potential for mosquito breeding areas, and the potential need for more right-of-way than is needed for a storm sewer.

2.3.2 Physical Site Suitability. A GS is practical only at sites with general ground slopes of less than 4 percent and are definitely not practical for sites steeper than 6 percent. The longitudinal slopes of a GS should be kept to less than 1.0 percent, which often necessitates the use of grade control checks or drop structures. Where the general terrain slope exceeds 4 percent, a GS is often practical only on the upslope side of the adjacent street.

When soils with high permeability (for example, Class A or B) are available, the swale will infiltrate a portion of the runoff into the ground, but such soils are not required for effective application of this BMP. When Class C and D soils are present, the use of a sand/gravel underdrain is recommended.

2.3.3 Pollutant Removal. Removal rates reported in literature vary and fall into the low to medium range. Under good soil conditions and low flow velocities, moderate removal of suspended solids and associated other constituents can be expected. If soil conditions permit, infiltration can remove low to moderate loads of soluble pollutants when flow velocities are very low. As a result, small frequently occurring storms can benefit the most. See Table SQ-6 in the *Stormwater Quality Management* chapter for estimated ranges in pollutant removal rates by this BMP.

2.4 Design Considerations and Criteria

Figure GS-1 shows trapezoidal and triangular swale configurations. A GS is sized to maintain a low velocity during small storms and to collect and convey larger runoff events, all for the projected fully developed land use conditions. If the design flows are not based on fully developed land conditions, the swales will be undersized and will not provide the intended pollutant removal, flow attenuation, or flow conveyance capacity.

A healthy turf grass cover must be developed to foster dense vegetation. Permanent irrigation in some cases may be necessary. Judicious use of GSs can replace both the curb-and-gutter systems and greatly reduce the storm sewer systems in the upper portions of each watershed when designed to convey the "initial storm" (for example, a 2- or a 5-year storm) at slow velocities. However, if one or both sides of the GS are also to be used as a GB, the design of the GB has to follow the requirements of *Section 1. Grass Buffers.*

2.5 Design Procedure and Criteria

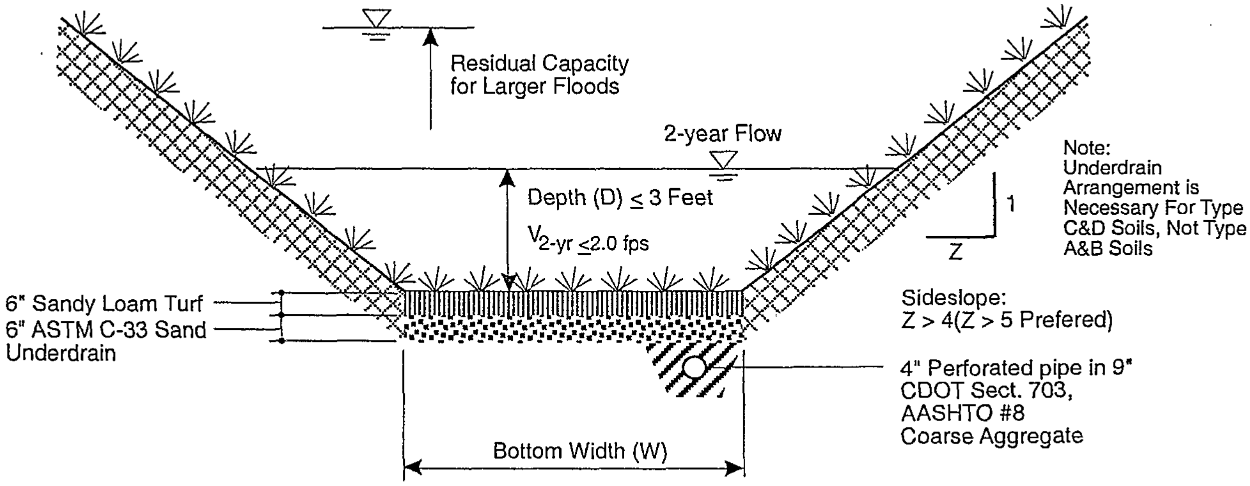
The following steps outline the GS design procedure and criteria.

1.	Design Discharge	Determine the 2-year flow rate in the proposed GS using hydrologic procedures described in Volume 1 of the *USDCM*.
2.	Swale Geometry	Select geometry for the GS. The cross section should be either trapezoidal or triangular with side slopes flatter than 4:1 (Horizontal/ Vertical), preferably 5:1 or flatter. The wider the wetted area of the swale, the slower the flow.
3.	Longitudinal Slope	Maintain a longitudinal slope for the GS between 0.2 and 1.0 percent. If the longitudinal slope requirements can not be satisfied with available terrain, grade control checks or small drop structures must be incorporated to maintain the required longitudinal slope. If the slope of the swale exceeds 0.5 percent in semi-arid areas of Colorado, the swale must be vegetated with irrigated turf grass.
4.	Flow Velocity and Depth	Calculate the velocity and depth of flow through the swale. Based on Mannings equation and a Mannings roughness coefficient of n=0.05, find the channel velocity and depth using the 2-year flow rate determined in Step 1. Maximum flow velocity of the channel shall not exceed 1.5 feet per second and the maximum flow depth shall not exceed 2 feet at the 2-year peak flow rate. If these conditions are not attained, repeat steps 2 through 4 each time altering the depth and bottom width or longitudinal slopes until these criteria are satisfied.
5.	Vegetation	Vegetate the GS with dense turf grass to promote sedimentation, filtration, and nutrient uptake, and to limit erosion through maintenance of low flow velocities.
6.	Street and Driveway Crossings	If applicable, small culverts at each street crossing and/or driveway crossing may be used to provide onsite stormwater capture volume in a similar fashion to an EDB (if adequate volume is available).
7.	Drainage and Flood Control	Check the water surface during larger storms such as the 5-year through the 100-year floods to ensure that drainage from these larger events is being handled without flooding critical areas or residential, commercial, and industrial structures.

2.6 Design Example

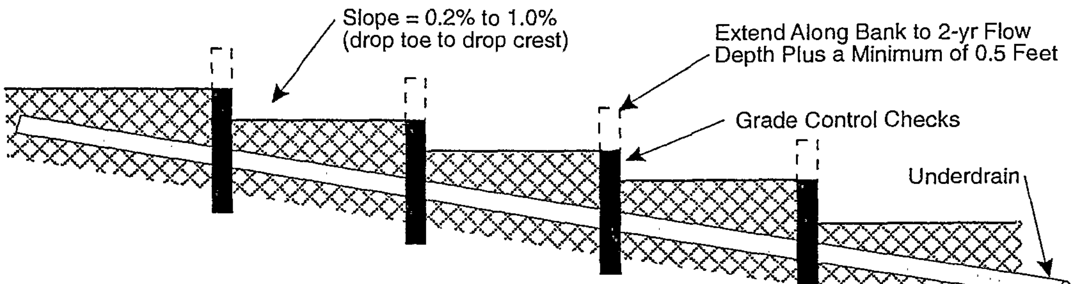
Design forms that provide a means of documenting the design procedure are included in the Design Forms section. A completed form follows as a design example.

R0017705



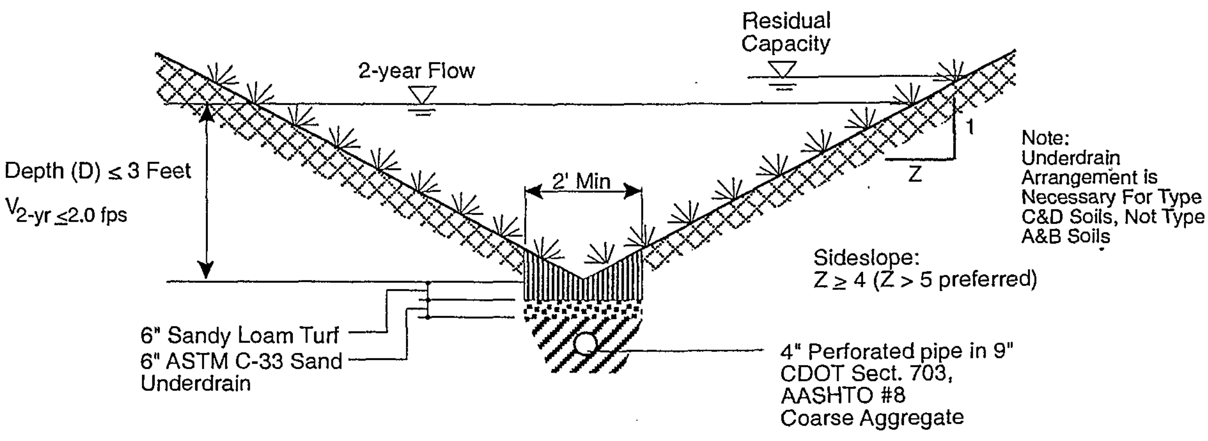
TRAPEZOIDAL GRASS-LINED SWALE SECTION

NOT TO SCALE



GRASS-LINED SWALE PROFILE

NOT TO SCALE



TRIANGULAR GRASS-LINED SWALE SECTION

NOT TO SCALE

FIGURE GS-1
Profile and Sections of a Grass Swale

R0017706

Design Procedure Form: Grass Swale (GS) Sedimentation Facility

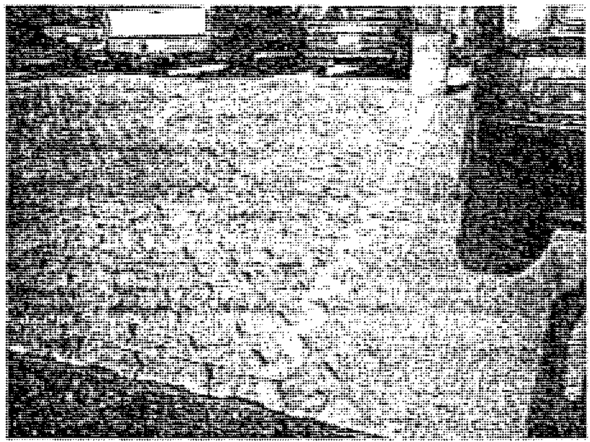
Designer: ______
Company: ______
Date: September 21, 1999
Project: ______
Location: ______

1. 2-Year Design Discharge (Total)	Q_2 = 10.0 cfs
2-Year Design Flow Velocity (V_2, 1.5 fps Maximum)	V_2 = 1.30 fps
2. Swale Geometry	
A) Channel Side Slopes (Z, horizontal distance per unit vertical)	Z = 4.00 (horizontal/vertical)
B) 2-Year Design Flow Depth (D_2, 2 feet maximum)	D_2 = 1.4 feet
C) Bottom Width of Channel (B)	B = 0.0 feet
3. Longitudinal Slope	
A) Froude Number (F, 0.50 maximum, reduce V_2 until $F \leq 0.50$)	F = 0.28
A) Design Slope (S, Based on Manning's n = 0.05, 0.01 Maximum)	S = 0.0032 feet/feet
B) Number of grade control structures required	5 (number)
4. Vegetation (Check the type used or describe "Other") (Must use irrigated turf grass if S >0.005 in semi-arid areas of Colorado)	___ Dryland Grass _X_ Irrigated Turf Grass ___ Other: ______
5. Outlet (Check the type used or describe "Other")	_X_ Infiltration Trench w/ Underdrain ___ Grouted Inlet ___ Other: ______

Notes: ______

R0017707

3.0 MODULAR BLOCK POROUS PAVEMENT (MBP)



3.1 Description

Modular block porous pavement (MBP) consists of open void concrete block units laid on a gravel subgrade. The surface voids are filled with sand or sandy loam turf. An alternate approach is to use stabilized-grass porous pavement, consists of grass turf semiforced with plastic rings and filter fabric underlain by gravel. This BMP is intended to be used in low vehicle movement areas to accommodate vehicles while facilitating stormwater infiltration from rain falling directly on the porous pavement. The MBP may be sloped or flat, and functions to decrease the effective imperviousness of a site. An alternate application of MBP provided for a surcharge zone to capture the WQCV and provide water quality detention. This application is described in Section 4.0 entitled *Porous Pavement Detention* of this chapter. MBP has been in use since the mid-1970s. Although field data that quantify its long-term performance are somewhat limited, the data collected locally and the episodical record from other parts of United States indicate it is reliable and has experienced few problems regardless of the local climatic conditions.

A stabilized (reinforced) sandy loam turf surface (e.g., Invisible Structures, Inc., or equal) may be substituted for the modular concrete block surface if the details below the surface are kept the same as shown in this section of the *Manual.*

3.2 General Application

MBP is best used in low vehicle movement zones such as residential driveways and is often used as a parking pad surface. Although MBP is most commonly used as parking pads in a parking lot, the following are other potential applications:

- Low vehicle movement airport zones such as parking aprons and maintenance roads

- Crossover/emergency stopping/parking lanes on divided highways
- Residential street parking lanes
- Residential driveways
- Maintenance roads and trails
- Emergency vehicle and fire access lanes in apartment/multi-family/office complex situations

Vehicle movement (i.e., not parking) lanes that lead up to the porous pavement parking pads need to be solid asphalt or concrete pavement.

Grass can be used in the block voids; however, it requires irrigation and lawn care in Coloradoś semi-arid climate.

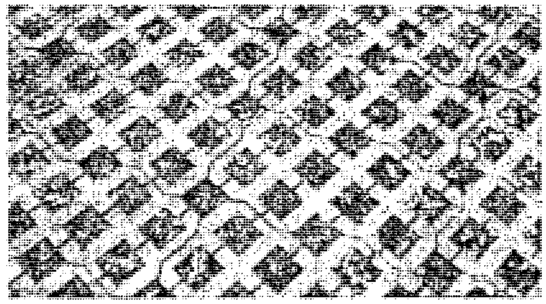
3.3 Advantages/Disadvantages

3.3.1 General. Aside from the potential for high particulate pollutant removal and the removal of other constituents similar to what a sand filter would provide, MBP can reduce flooding potential by infiltrating or slowing down runoff. Modular block patterns, colors, and materials can serve functional and aesthetic purposes.

The primary disadvantages for use of MBP are cost and the lack of significant volume of performance data in semi-arid areas that are subject to severe freeze-thaw cycles; however, the limited testing by the Urban Drainage and Flood Control District as well as observation of several sites since 1990 and the episodic descriptions from public works professional from other parts of the country and Canada indicate this type of pavement, when properly installed, functions well in freeze-thaw cycles. Other disadvantages could be associated with uneven driving surfaces and potential traps for the high heels of women's shoes. Also, the cost of restorative maintenance can be somewhat high when the system seals with sediment and no longer functions as permeable pavement.

3.3.2 Physical Site Suitability. This BMP may be installed without free draining subsoils when provided with underdrains. An underdrain ensures drainage of the gravel subgrade whenever the subsoils are not free draining. In those cases an impermeable liner should be provided to drain the water in the gravel pack and to mitigate concerns about expansive soils. This BMP should be located far enough from foundations in expansive soils so as to limit damage potential to structures. In addition, when a commercial or an industrial site may be handling chemicals and petroleum products that may spill onto the ground, an impermeable liner with an underdrain is required to prevent groundwater and soil contamination.

3.3.3 Pollutant Removal. See Table SQ-6 for estimated ranges in pollutant removals. Specific field data on pollutant removal rates are somewhat limited. Removal rates are projected to be high for both suspended sediment and associated constituents, such as metals, oil, and grease. Runoff filtration through the sand and gravel of the modular block voids and entrapment in the gravel media are the primary removal mechanisms of pollutants along with the filtration, adsorption, and ion exchange that occur as stormwater travels through the underlying soils before the stormwater reaches groundwater. Removal rates for dissolved constituents are expected to be low to moderate, depending on the filtering media used and on the specific constituent.



3.4 Design Considerations

MBP has been tested as a stormwater BMP in the Denver area and the design guidance presented here is based, in part, on those tests. The above photo depicts one type of local available block. Other block patterns are acceptable provided they have at least 40 percent of its surface area as voids. Figures MBP-1 and MBP-2 show a cross-sections of modular block installation and its subgrades. Upon installation, every effort should be made to assure even flow distribution over the entire porous surface. Figure MBP-3 depicts typical applications of modular block porous pavement.

For the purpose of sizing downstream drainage systems and followup BMPs, assume that the permeable pavement areas are only 35 percent impervious.

3.5 Design Procedure and Criteria

The following steps outline the MBP design procedure and criteria.

1.	Select Block	Select appropriate modular blocks that have no less than 40 percent of the surface area open. The manufacturers installation requirements shall be followed with the exception that *Rock Media Pore Volume Inlay Material* and *Base Course* dimensions and requirements in this section shall be adhered with.
2.	Select Porous Pavement Infill	The MBP openings should be filled with ASTM C-33 graded sand (fine concrete aggregate).
3.	Base Coarses	Provide AASHTO No. 8 (CDOT Section 703) coarse aggregate with all fractured surfaces as called for in Figure MBP-1. Assume 30 percent is open pore space.
4.	Design Area Ratio	Calculate the design area ratio which is the contributing impervious area divided by porous pavement area. This ratio cannot exceed 3.0.
5.	Perimeter Wall (optional)	Provide a concrete perimeter wall to confine the edges of the MBP block area. The wall should be minimum 6-inch wide and 6 inches deeper than all the porous media and modular block depth combined (see Figure MBP-2).
6.	Contained Cells	Provide 20 mil or thicker liner placed vertically or concrete walls to separate individual cells of the porous base course so as to cut-off horizontal flow of water (see Figure MBP-2). Space these cut-offs according to the following equation:

R0017710

$$L_{MAX} = \frac{0.8}{S_O}$$

in which

L_{MAX} = Maximum distance between cut off membrane normal to the flow (feet)

S_O = Slope of the base course (ft/ft).

7.	Subbase	If expansive soils are a concern or the tributary catchment has chemical or petroleum products handled or stored, install an impermeable membrane and place the base coarse on top of the membrane. Otherwise install a non-woven geotextile membrane to encourage infiltration.
8.	Subdrain Outlet	When needed due to site and soil conditions, design the subdrain with a permanent restrictor outlet to drain the available pore space volume in the base course in 12 hours. Subdrains are required when the pavement is located on low permeability soils such as clayey silt, sandy clays, clays, etc.

3.6 Design Example

Design forms that provide a means of documenting the design procedure are included in the Design Forms section. A completed form follows as a design example.

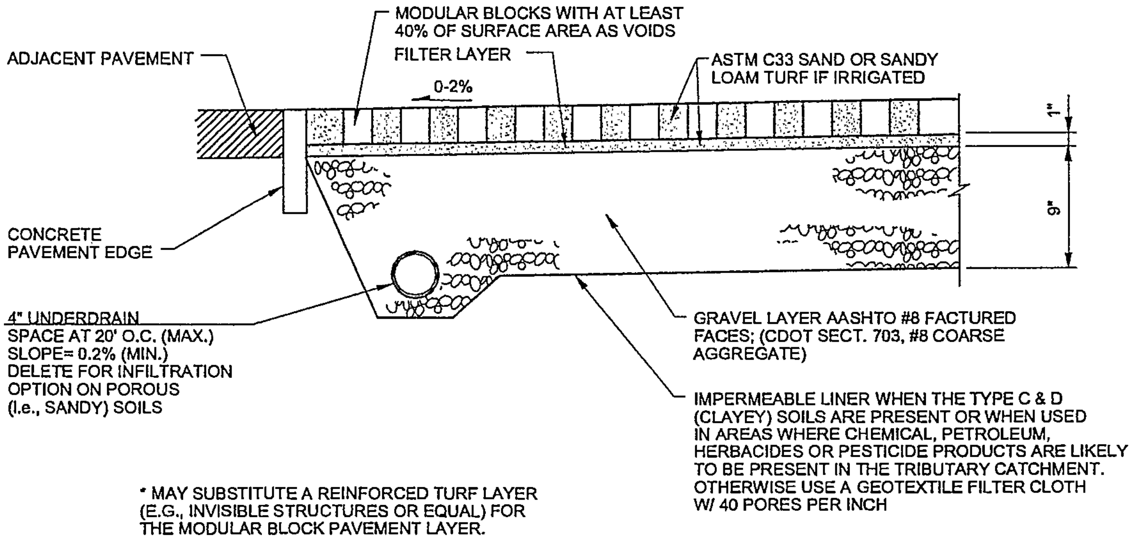
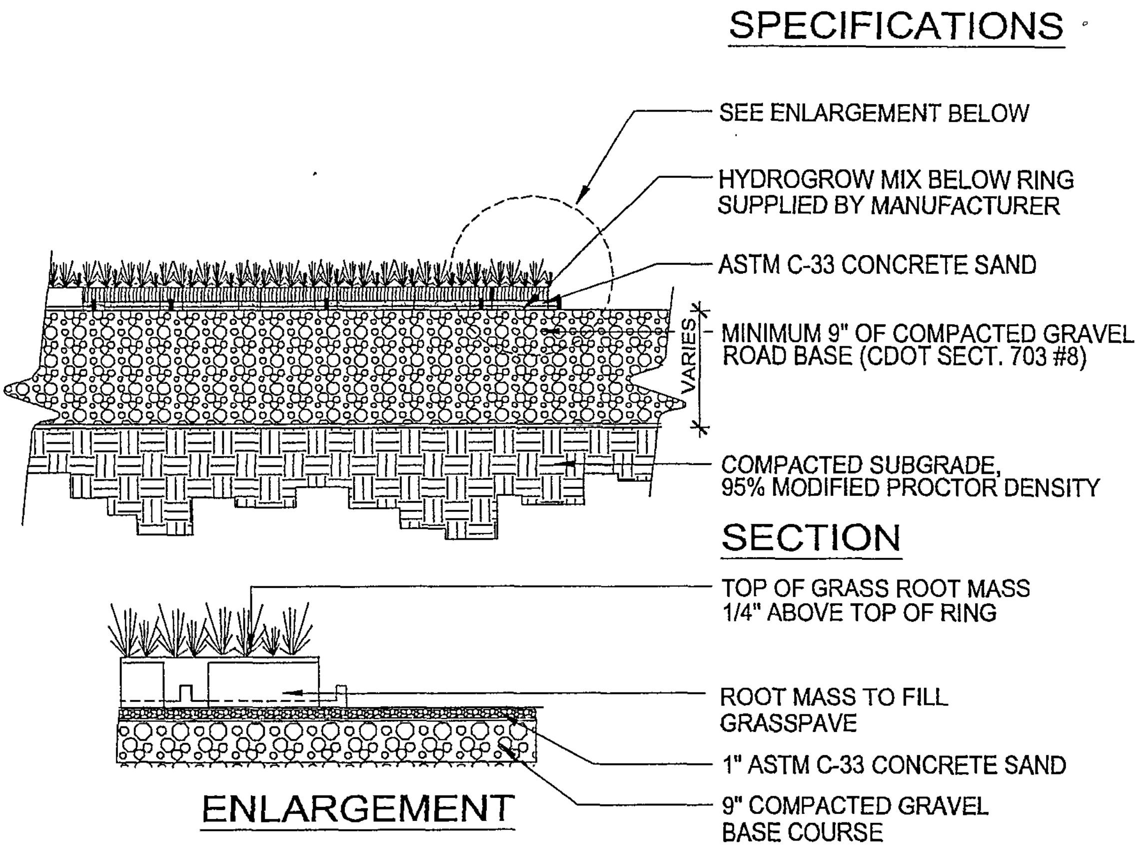


FIGURE MBP-1

Modular Block Porous Pavement Cross Section

R0017712



NOTES:

1. INSTALL GRASS TURF REINFORCING LAYER PER MANUFACTURER'S RECOMMENDATIONS

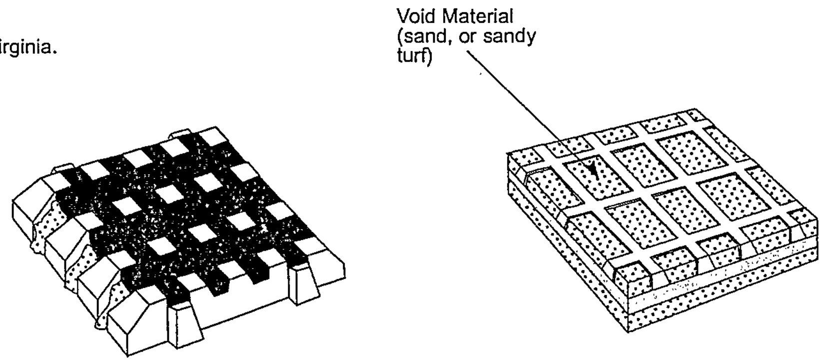
2. DETAIL BASED ON INVISIBLE STRUCTURES, INC., ET AL DETAILS, BUT MODIFIED TO SUIT USDCM REQUIREMENTS.

FIGURE MBP-1A

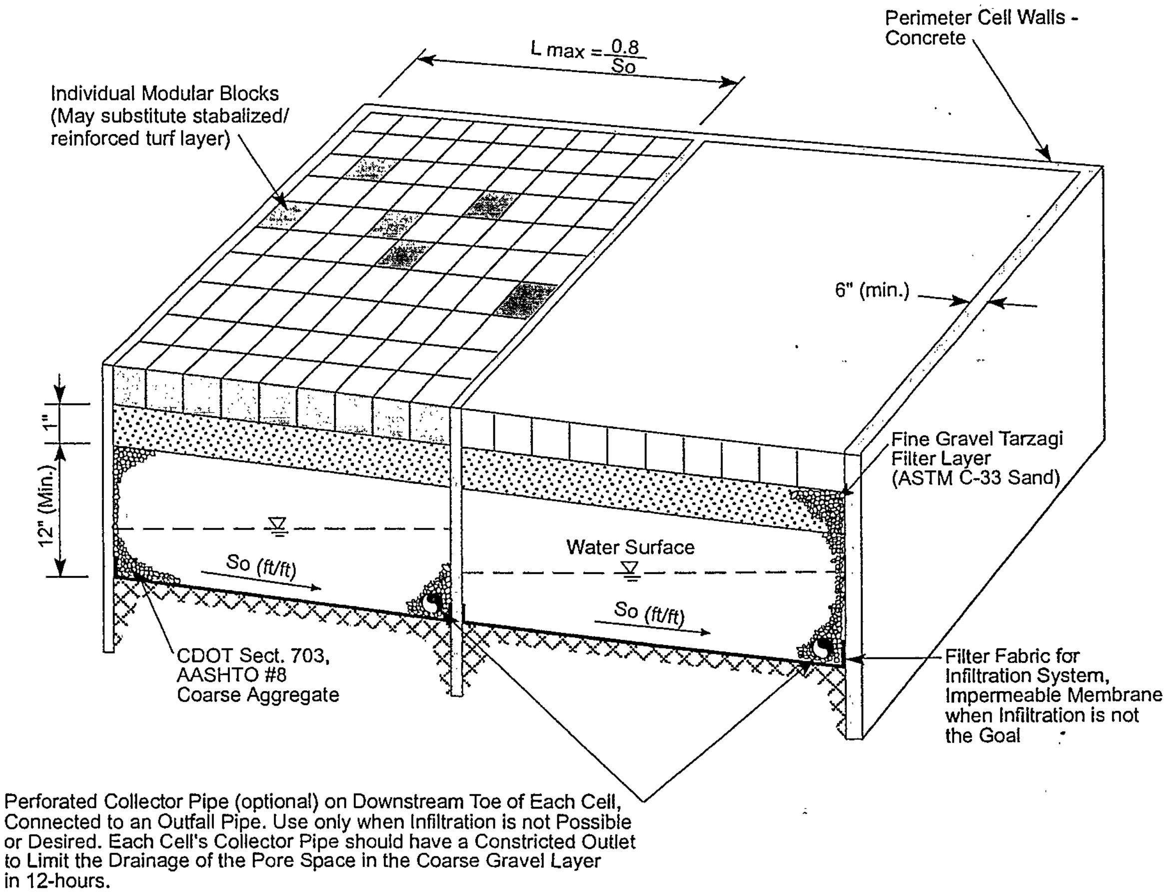
Typical Grasspave Detail

R0017713

Source: State of Virginia.



TWO EXAMPLES OF INDIVIDUAL CONCRETE MODULAR PAVING BLOCK



PERSPECTIVE OF SIDE-BY-SIDE MODULAR BLOCK CELLS

FIGURE MBP-2
Modular Block Porous Pavement

R0017714

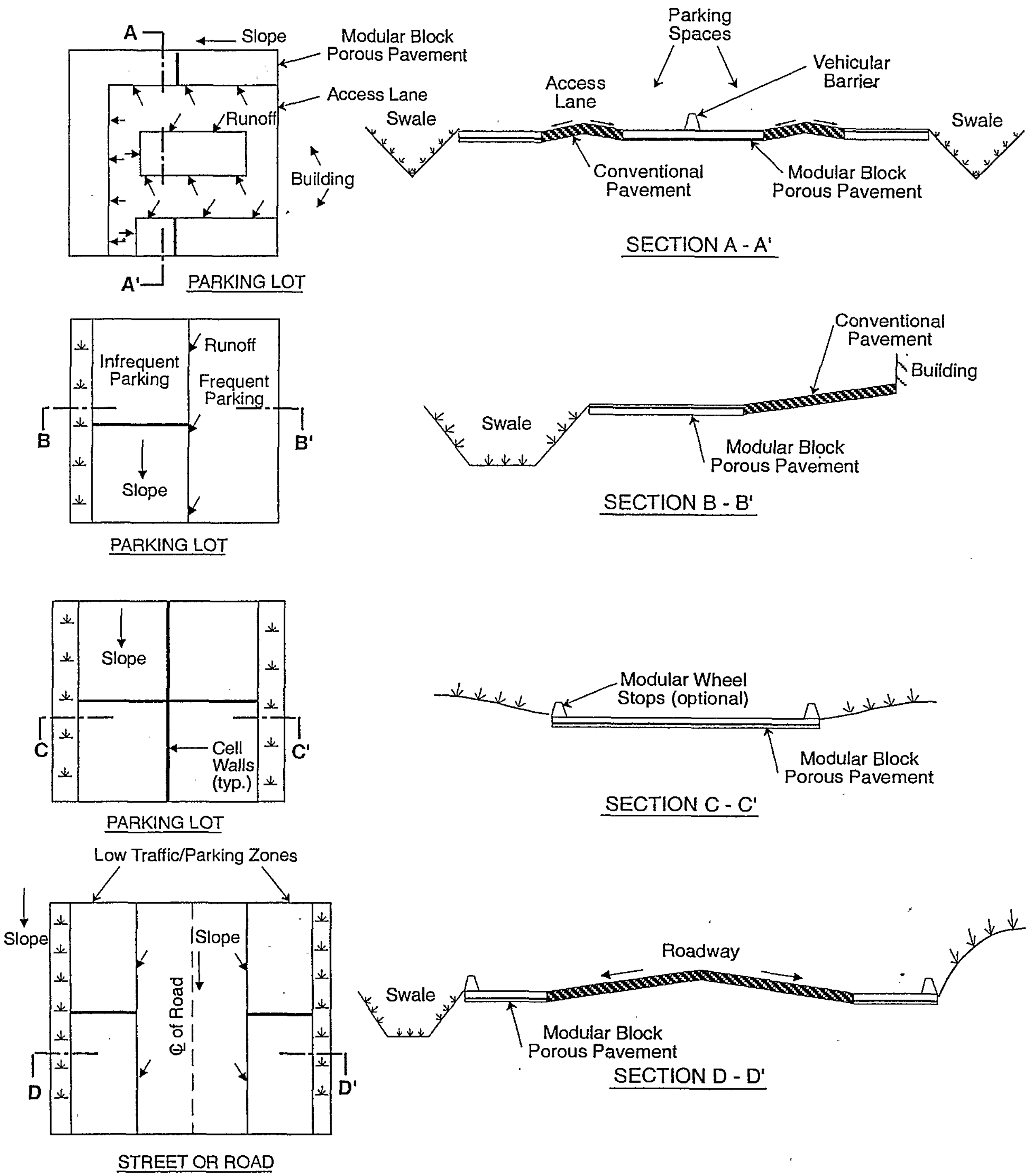


FIGURE MBP-3
Typical Applications of Modular Block Porous Pavement

R0017715

Design Procedure Form: Modular Block Porous Pavement (MBP)

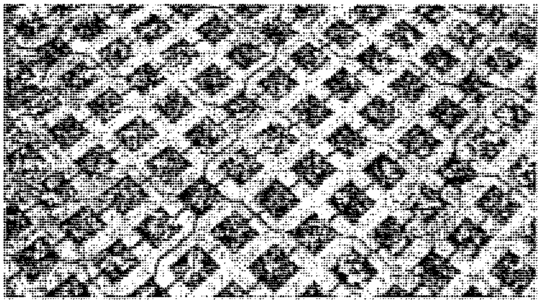
Designer: ____________
Company: ____________
Date: September 21, 1999
Project: ____________
Location: ____________

1. Modular Block Properties May substitute MBP with reinforced turf pavement such as provided by Invisible Structures (or equal). Note: Blocks shall have no less than 40% open area and shall be no less than 4" thick	Block Name: Uni-Green Manufacturer: Pavestone Open Surface Area = 40 % Thickness = 4.00 inches
2. Porous Pavement Infill (Check the type or describe "Other")	X ASTM C-33 Sand ___ Sandy Loam Sod ___ Other: ____
3. Base Course A) Sand (ASTM C-33) B) Gravel (AASHTO #8 Coarse Aggregate-CDOT Section 703)	X 1" Layer ASTM C-33 Sand ___ Other: ____ X 9" Layer AASHTO #8 Course Agg. ___ Other: ____
4. Design Impervious Area to Porous Pavement Area Ratio (Not to Exceed 2.0)	Ratio = 1.5 (A_{IMP} / A_{POROUS})
5. Perimeter Wall (6" deeper than base coarse)	X Concrete 4.0 inches thick ___ Other ____
6. Contained Cells A) Type B) Slope of the base course C) Minimum distance between cutoffs (normal to flow, L_{MAX}) $L_{MAX} = 0.8 / S_O$	X 15 mil (min) P.E. Liner ___ Concrete Wall S_O = 0.02 ft/ft L_{MAX} = 40 feet
7. Draining of modular block pavement (Check a, or b, or c, answer d) Based on answers to 7a through 7d, check the appropriate methoc a) Check box if subgrade is heavy or expansive clay [X] b) Check box if subgrade is silty or clayey sands [ ] c) Check box if subgrade is well-draining soils [ ] d) Does tributary catchment contain land uses that may have petroleum products, greases, or other chemicals present, such as gas station, hardware store, restaurant, etc.? yes [ ] no [X]	___ Infiltration to Subgrade with Permeable Membrane: 7(c) checked and 7(d) = no X Underdrain with Impermeable Membrane: 7(a) checked or 7(d) = yes ___ Underdrain with Permeable Membrane: 7(b) checked and 7(d) = no ___ Other: ____

Notes: ____________

R0017716

4.0 POROUS PAVEMENT DETENTION (PPD)



4.1 Description

Porous pavement detention (PPD) consists of an installation of MBP that is flat (i.e., S_o=0.00% in all directions) and is provided with a 2-inch deep surcharge zone to temporarily store the WQCV draining from an adjacent drainage area. Runoff will infiltrate into the void spaces of the gravel base course through the sand filter media and sandy loam turf. The latter is not used for the PPD facility to insure more rapid drainage of the parking surface and easy maintenance when the media needs to be replaced to maintain rapid drainage of the ponding areas. The ponded and filtered water slowly exits through an underdrain. The application of MBP without the flat slope (i.e., S_o=0.00%) and surcharge zone, described in Section 3, functions to reduce imperviousness of pavement areas (from 100 percent to 35 percent). However, with the detention features, this BMP has the potential to satisfy the WQCV requirement for a site.

4.2 General Application

PPD may be used in the same types of low vehicle movement zones identified in Subsection 3.0 for MBP with the driveways leading up to them being solid pavement.

4.3 Advantages/Disadvantages

PPD has generally the same advantages and disadvantages as MBP. Its additional advantage is to provide a means to provide WQCV for a site that has little available open area for detention.

4.4 Design Considerations

Figure PPD-1 shows a cross-section of modular block installation and its subgrade for PPD.

4.5 Design Procedure and Criteria

The following steps outline the PPD design procedure and criteria.

1. Basin Storage Volume — Provide a storage volume equal to the WQCV based on a 6-hour drain time.

R0017717

A. Find the required storage volume (watershed inches of runoff):

Determine the Required WQCV (watershed inches of runoff) using Figure PPD-2, based on 12-hour drain time. Assume imperviousness of 100 percent for the PPD area.

B. Calculate the Design Volume in cubic-feet as follows:

$$Design\ Volume = \left(\frac{WQCV}{12}\right) * Area$$

In which:

Area = The watershed area tributary to the extended detention pond (square feet)

2. Surface Area — Calculate minimum required surface area as follows:

$$\text{Minimum surface area } (FT^2) = \frac{\text{Design Volume } (ft^3)}{0.17 \text{ feet}}$$

3. Select Block — Select appropriate modular blocks that have no less than 40 percent of the surface area open. The manufacturer's installation requirements shall be followed with the exception that *Rock Media Pore Volume Inlay Material* and *Base Course* dimension and requirements of this section shall be adhered with.

4. Select Porous Pavement Infill — The MBP openings should be filled with ASTM C-33 graded sand (fine concrete aggregate) and not sandy loam turf.

5. Base Coarses — Provide base courses as shown in Figure PPD-1.

6. Perimeter Wall — Provide a concrete perimeter wall to confine the edges of the PPD area. The wall should be minimum 6-inch wide and at least 6 inches deeper than all the porous media and modular block depth combined.

7. Subbase — If expansive soils are a concern or the tributary catchment has chemical or petroleum products handled or stored, install an impermeable membrane below the base coarse. Otherwise install a non-woven geotextile membrane to encourage infiltration.

8. Overflow — Provide an overflow, possibly with an inlet to a storm sewer, set at 2 inches (-0, + ½-inch) above the level of the porous pavement surface. Make sure the 2-inch ponding depth is contained and does not flow out of the area at ends or sides until the 2-inch ponding depth is reached.

4.6 Design Example

Design forms that provide a means of documenting the design procedure are included in the Design Forms section. A completed form follows as a design example.

For an example of where PPD would be applied see Sections A-A and B-B of Figure MBP-3.

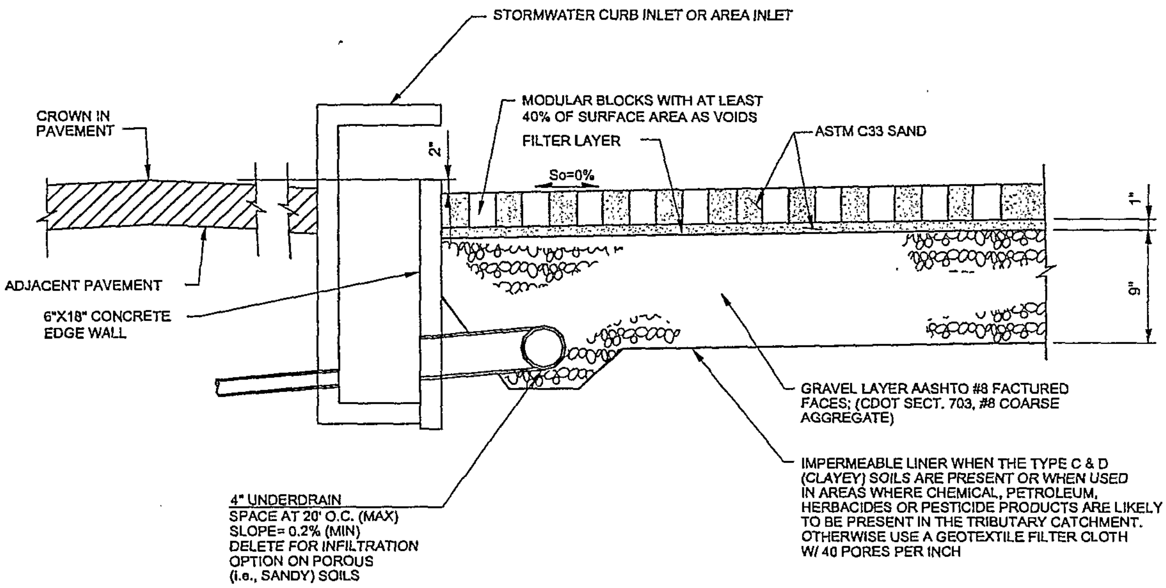


FIGURE PPD-1

Porous Pavement Detention

R0017719

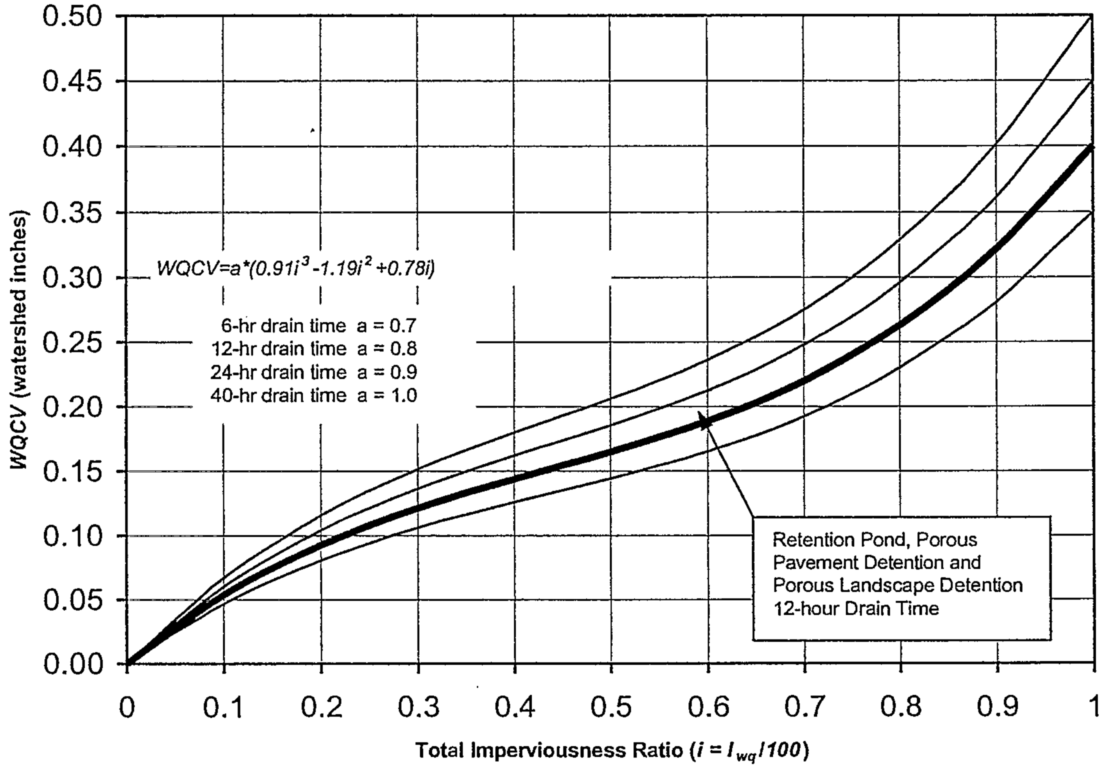


FIGURE PPD-2

Water Quality Capture Volume (WQCV), 80th Percentile Runoff Event

R0017720

Design Procedure Form: Porous Pavement Detention (PPD)

Designer: ______
Company: ______
Date: September 22, 1999
Project: ______
Location: ______

1. Basin Storage Volume A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) (I_a = 100% if all paved and roofed areas)	I_a = 100.00 % i = 1.00
B) Contributing Watershed Area, Including PPD Area	Area = 600 square feet
C) Water Quality Capture Volume (WQCV) ($WQCV = 0.8 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)$)	WQCV = 0.40 watershed inches
D) Design Volume: Vol = (WQCV / 12) * Area	Vol = 20.0 cubic feet
E) Porous Pavement Suface Elevation	Elev. = 5,485.50 feet
2. Required Minimum MBP Surface Area: A = Vol / 0.17	A = 118 square feet
Overflow Inlet Elevation: Porous Pavement Elev. + 0.17 feet	Elev. = 5,485.67 feet
3. Modular Block Properties Note: Blocks shall have no less than 40% open area and shall be no less than 4" thick	Block Name: Uni-Green Manufacturer: Pavestone Open Surface Area = 40 % Thickness (4" min.) 4.00 inches
4. Porous Pavement Infill (Check the type used or describe "Other")	X ASTM C-33 Sand ___ Other: ___
5. Base Course A) Sand B) Gravel	X 1" Layer ASTM C-33 Sand ___ Other: ___ X 9" Layer AASHTO #8 Course Agg. ___ Other: ___
6. Perimeter Wall (required)	X Concrete 4.0 inches thick ___ Other: ___
7. Draining of porous pavement (Check a, or b, or c, answer d) Based on answers to 7a through 7d, check the appropriate method a) Check box if subgrade is heavy or expansive clay [ ] b) Check box if subgrade is silty or clayey sands [X] c) Check box if subgrade is well-draining soils [ ] d) Does tributary catchment contain land uses that may have petroleum products, greases, or other chemicals present, such as gas station, hardware store, restaurant, etc.? yes [ ] no [X]	___ Infiltration to Subgrade with Permeable Membrane: 7(c) checked and 7(d) = no ___ Underdrain with Impermeable Membrane: 7(a) checked or 7(d) = yes X Underdrain with Permeable Membrane: 7(b) checked and 7(d) = no ___ Other: ___
8. Overflow For Larger Storms	Yes Yes / No

Notes: ______

R0017721

5.0 POROUS LANDSCAPE DETENTION (PLD) – SEDIMENTATION FACILITY

Photo: Courtesy Prince Georges County

5.1 Description

Porous landscape detention (PLD) consists of a low lying vegetated area underlain by a sand bed with an underdrain pipe. A shallow surcharge zone exists above the PLD for temporary storage of the WQCV. During a storm, accumulated runoff ponds in the vegetated zone and gradually infiltrates into the underlying sand bed, filling the void spaces of the sand. The underdrain gradually dewaters the sand bed and discharges the runoff to a nearby channel, swale, or storm sewer. Like PPD, this BMP allows WQCV to be provided on a site that has little open area available for stormwater detention.

5.2 General Application

5.2.1 Locating. A PLD can be located in just about any of the open areas of a site. It is ideally suited for small installations such as:

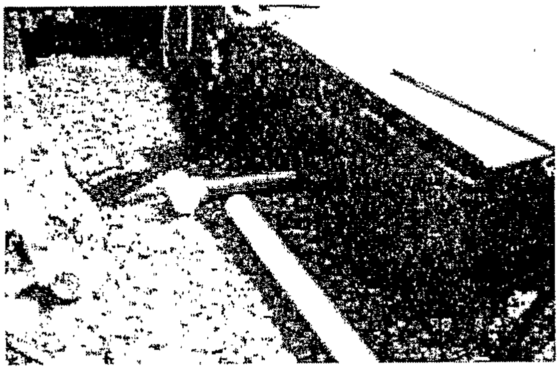
- Parking lot islands
- Street medians
- Roadside swale features
- Site entrance or buffer features

This BMP may also be implemented at a larger scale, serving as an infiltration basin for an entire site if desired provided the water quality capture volume and average depth requirements contained in this section are met.

Vegetation may consist of irrigated bluegrass or natural grasses with shrub and tree plantings if desired.

5.2.2 Example Application. The following photos illustrate an installation of PLD in Prince Georges County, Maryland.

Parking lot island before installation of PLD

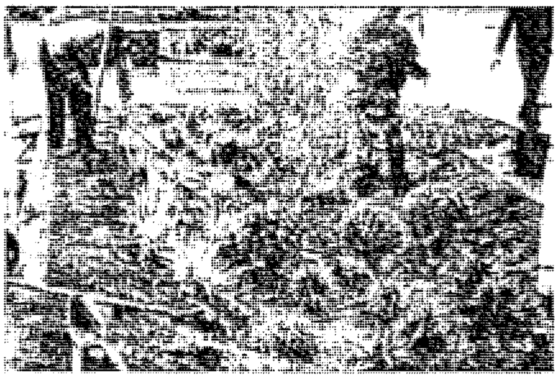


Excavation and installation of underdrain.

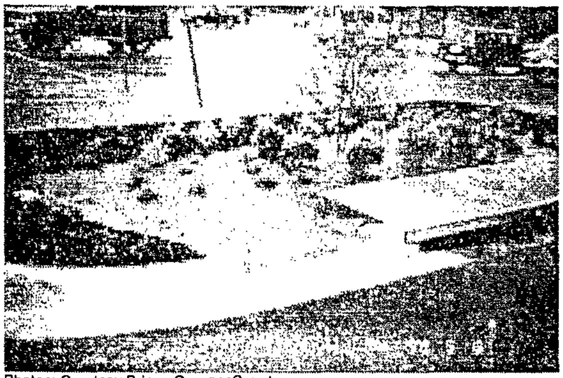
Sandy material used as planting medium

Photos: Courtesy Prince Georges County

R0017723



Installation of plant materials

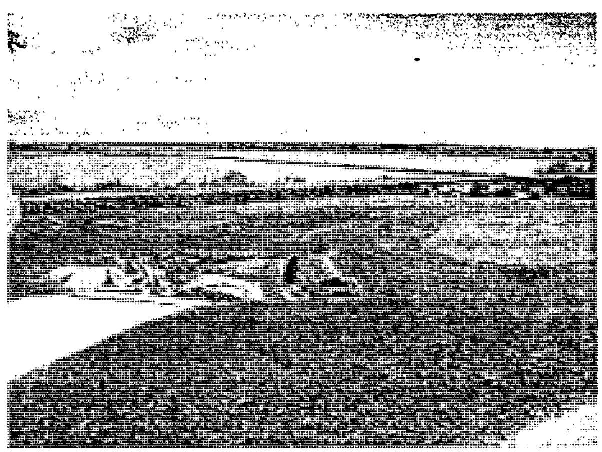


Completed PLD facility during storm event

Photos: Courtesy Prince GeorgesCounty

5.3 Advantages/Disadvantages

5.3.1 General. A primary advantage of PLD is making it possible to provide WQCV on a site while reducing the impact on developable land. It works well with irrigated bluegrass, whereas experience has shown that conditions in the bottom of extended detention basins (EDBs) become too wet for bluegrass. A PLD provides a natural moisture source for vegetation, enabling "green areas" to exist with reduced irrigation. The adjacent photograph shows an example of a relatively large PLD facility featuring a bluegrass bottom with a putting green.



The primary disadvantage of PLD is a potential for clogging if a moderate to high level of silts and clays is allowed to flow into the facility. Also, this BMP needs to be avoided close to building foundations or other areas where expansive soils are present, although an underdrain and impermeable liner can ameliorate some of this concern.

5.3.2 Physical Site Suitability. If an underdrain system is incorporated into this BMP, PLD is suited for about any site regardless of in-situ soil type. If sandy soils are present, the facility can be installed without an underdrain (infiltration option); sandy subsoils is not a requirement. This BMP has a relatively flat surface area, and may be more difficult to incorporate it into steeply sloping terrain.

5.3.3 Pollutant Removal. Although not tested to date in the Denver area, the amount of pollutant removed by this BMP should be significant and should equal or exceed the removal rates provided by sand filters. In addition to settling, PLD provides for filtering, adsorption, and biological uptake of constituents in stormwater. See Table SQ-6 for estimated ranges in pollutant removals.

5.4 Design Considerations

Figure PLD-1 shows a cross-section for a PLD. When implemented using multiple small installations on a site, it is increasingly important to accurately account for each upstream drainage area tributary to each PLD site to make sure that each facility is properly sized, and that all portions of the development site are directed to a PLD.

5.5 Design Procedure

The following steps outline the PLD design procedure and criteria.

1. Basin Storage Volume — Provide a storage volume based on a 12-hour drain time.

   A. Find the required storage volume (watershed inches of runoff):

   Using the tributary areas imperviousness, determine the Required WQCV (watershed inches of runoff) using Figure PLD-2, based on the PLD 12-hour drain time.

   B. Calculate the Design Volume in cubic feet as follows:

$$Design\ Volume = \left(\frac{WQCV}{12}\right) * Area$$

   In which:

   $Area$ = The watershed area tributary to the extended detention pond (square feet)

2. Surface Area — Calculate the minimum required surface area as follows:

$$Surface\ Area = \frac{Design\ Volume\ in\ ft^3}{d_{av}}$$

   in which,

   d_{av} = average depth of the PLD basin.

3. Base Coarses — Provide base coarses as shown in Figure PLD-1.

4. Subbase — If expansive soils are a concern, install an impermeable membrane and place the base coarse on top of the membrane. If soils are not expansive, use geotextile fabric to line the entire basin bottom and walls.

R0017725

5.	Average Depth	Maintain the average WQCV depth between 6" and 12". Average depth is defined as water volume divided by the water surface area.
6.	Sand-Peat Mix Filter Layer	Provide a minimum of a 12-inch thick layer above the base course consisting of a thoroughly mixed ASTMC-3 Sand and Peat for filtration and adsorption of constituents.
7.	Irrigated Vegetative Layer	Provide a sandy loam turf layer above the sand-peat mix layer. This layer shall be no less than 6-inches thick, but a thicker layer is recommended to promote healthier vegetation.

5.6 Design Example

Design forms that provide a means of documenting the design procedure are included in the Design Forms section. A completed form follows as a design example.

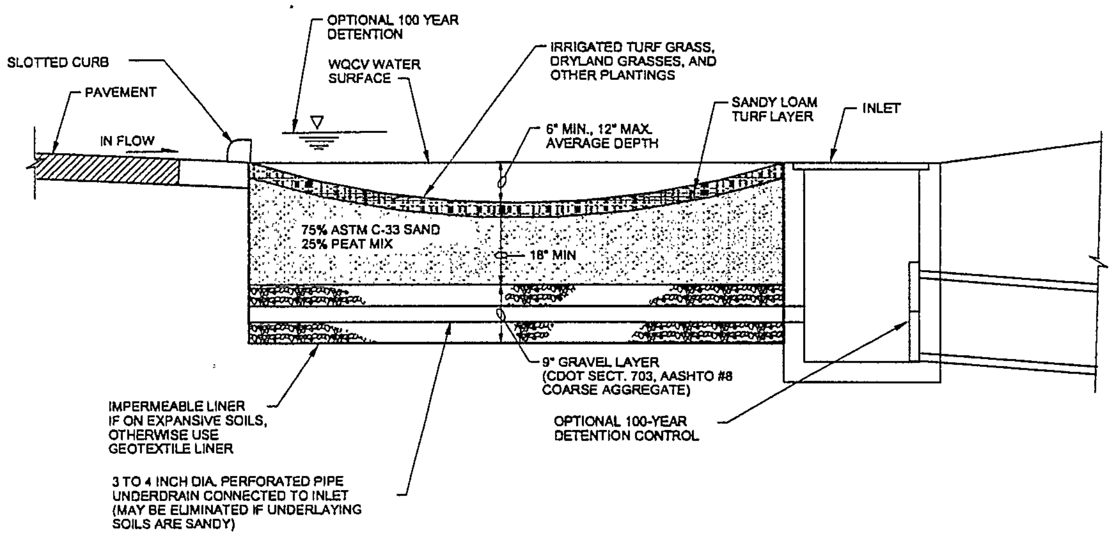


FIGURE PLD-1

Porous Landscape Detention

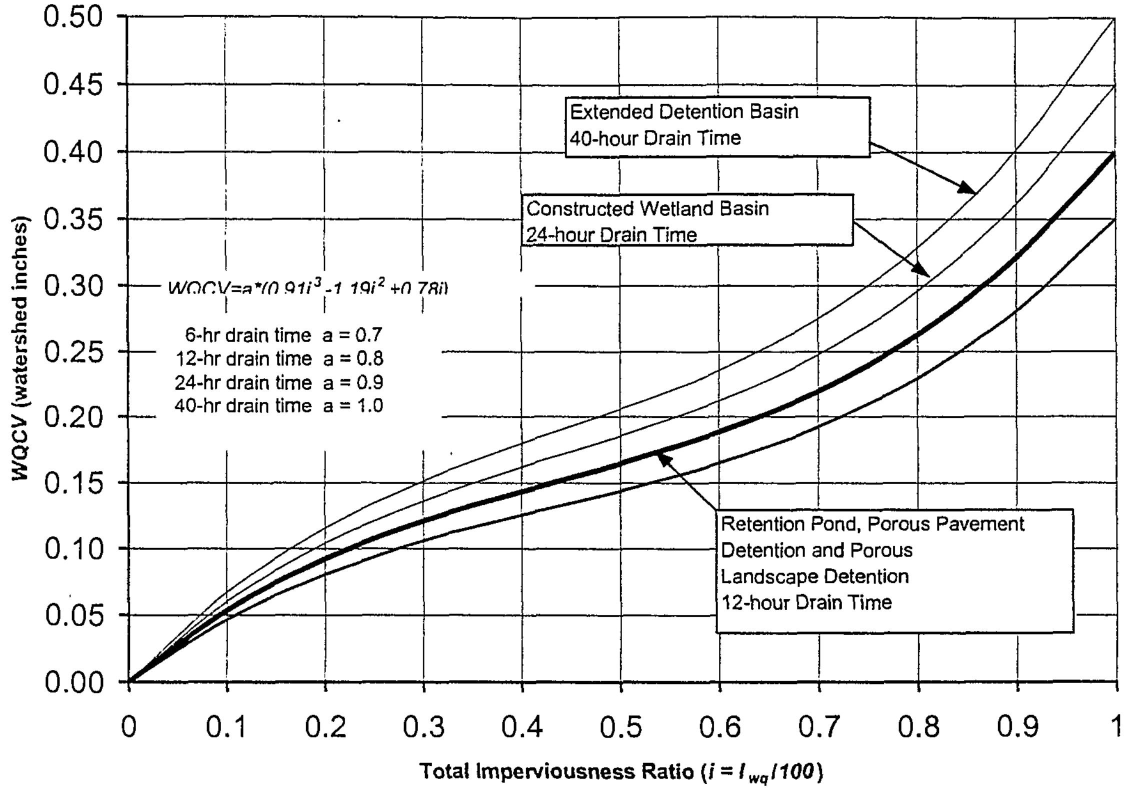


FIGURE PLD-2

Water Quality Capture Volume (WQCV), 80th Percentile Runoff Event

R0017728

Design Procedure Form: Porous Landscape Detention (PLD)

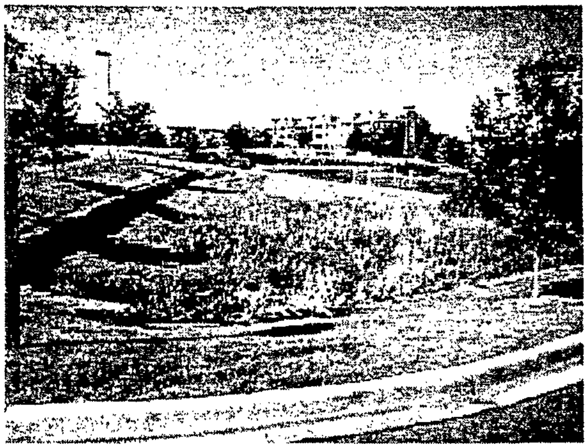
Designer: ____________________
Company: ____________________
Date: September 22, 1999
Project: ____________________
Location: ____________________

1. Basin Storage Volume (I_a = 100% if all paved and roofed areas u/s of PLD) A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	I_a = 100.00 % i = 1.00
B) Contributing Watershed Area Including the PLD (Area)	Area = 10,000 square feet
C) Water Quality Capture Volume (WQCV) ($WQCV = 0.8 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)$)	WQCV = 0.40 watershed inches
D) Design Volume: Vol_{PLD} = (WQCV / 12) * Area	Vol = 333.3 cubic feet
2. PLD Surface Area (A_{PLD}) and Average Depth (d_{av})	A_{PLD} = 350 square feet
(d_{av} = (Vol / A_{PLD}), Min=0.5', Max=1.0')	d_{av} = 0.95 feet
3. Base Course (See Figure PLD-1)	X 6" (Min.) Sandy Loam Turf Layer, Plus 18" (Min.) Layer of 25% Peat and 75% Sand Mix, Plus 9" (Min.) Layer of ASSHTO #8 Coarse Aggregate (CDOT Section 703 Specification). ___ Other: ____________
5. Draining of porous pavement (Check a, **or** b, or c, **answer** d) Based on answers to 5a through 5d, check the appropriate method a) Check box if subgrade is heavy or expansive clay [ ] b) Check box if subgrade is silty or clayey sands [ ] c) Check box if subgrade is well-draining soils [X] d) Does tributary catchment contain land uses that may have petroleum products, greases, or other chemicals present, such as gas station, hardware store, restaurant, etc.? yes [ ] no [X]	X Infiltration to Subgrade with Permeable Membrane: 5(c) checked **and** 5(d) = no ___ Underdrain with Impermeable Membrane: 5(a) checked **or** 5(d) = yes ___ Underdrain with Permeable Membrane: 5(b) checked **and** 5(d) = no ___ Other: ____________

Notes: ____________________

R0017729

6.0 EXTENDED DETENTION BASIN (EDB)— SEDIMENTATION FACILITY



6.1 Description

An extended detention basin (EDB) is a sedimentation basin designed to totally drain dry sometime after stormwater runoff ends. It is an adaptation of a detention basin used for flood control. The primary difference is in the outlet design. The EDB uses a much smaller outlet that extends the emptying time of the more frequently occurring runoff events to facilitate pollutant removal. The EDB's drain time for the brim-full water quality capture volume (i.e., time to fully evacuate the design capture volume) of 40 hours is recommended to remove a significant portion of fine particulate pollutants found in urban stormwater runoff. Soluble pollutant removal can be somewhat enhanced by providing a small wetland marsh or ponding area in the basin's bottom to promote biological uptake. The basins are considered to be "dry" because they are designed not to have a significant permanent pool of water remaining between storm runoff events. However, EDB may develop wetland vegetation and sometimes shallow pools in the bottom portions of the facilities.

6.2 General Application

An EDB can be used to enhance stormwater runoff quality and reduce peak stormwater runoff rates. If these basins are constructed early in the development cycle, they can also be used to trap sediment from construction activities within the tributary drainage area. The accumulated sediment, however, will need to be removed after upstream land disturbances cease and before the basin is placed into final long-term use. Also, an EDB can sometimes be retrofitted into existing flood control detention basins.

EDBs can be used to improve the quality of urban runoff from roads, parking lots, residential neighborhoods, commercial areas, and industrial sites and are generally used for regional or follow-up treatment. They can also be used as an onsite BMP and work well in conjunction with other BMPs, such as upstream onsite source controls and downstream infiltration/filtration basins or wetland channels. If

R0017730

desired, a flood routing detention volume can be provided above the water quality capture volume (WQCV) of the basin.

6.3 Advantages/Disadvantages

6.3.1 General. An EDB can be designed to provide other benefits such as recreation and open space opportunities in addition to reducing peak runoff rates and improving water quality. They are effective in removing particulate matter and the associate heavy metals and other pollutants. As with other BMPs, safety issues need to be addressed through proper design.

6.3.2 Physical Site Suitability. Normally, the land required for an EDB is approximately 0.5 to 2.0 percent of the total tributary development area. In high groundwater areas, consider the use of retention ponds (RP) instead in order to avoid many of the problems that can occur when the EDB's bottom is located below the seasonal high water table. Soil maps should be consulted, and soil borings may be needed to establish design geotechnical parameters.

6.3.3 Pollutant Removal. The pollutant removal range of an EDB was presented in Table SQ-6 in the *Stormwater Quality Management* chapter of this volume. Removal of suspended solids and metals can be moderate to high, and removal of nutrients is low to moderate. The removal of nutrients can be improved when a small shallow pool or wetland is included as part of the basin's bottom or the basin is followed by BMPs more efficient at removing soluble pollutants, such as a filtration system, constructed wetlands or wetland channels.

The major factor controlling the degree of pollutant removal is the emptying time provided by the outlet. The rate and degree of removal will also depend on influent particle sizes. Metals, oil and grease, and some nutrients have a close affinity for suspended sediment and will be removed partially through sedimentation.

6.3.4 Aesthetics and Multiple Uses. Since an EDB is designed to drain very slowly, its bottom and lower portions will be inundated frequently for extended periods of time. Grasses in this frequently inundated zone will tend to die off, with only the species that can survive the specific environment at each site eventually prevailing. In addition, the bottom will be the depository of all the sediment that settles out in the basin. As a result, the bottom can be muddy and may have an undesirable appearance to some. To reduce this problem and to improve the basin's availability for other uses (such as open space habitat passive recreation), it is suggested that the designer provide a lower-stage basin as suggested in the Two Stage Design procedure. As an alternative, a retention pond (RP) could be used, in which the settling occurs primarily within the permanent pool.

6.4 Design Considerations

Whenever desirable and feasible, incorporate the EDB within a larger flood control basin. Also, whenever possible try to provide within the basin for other urban uses such as passive recreation, and wildlife habitat. If multiple uses are being contemplated, consider the multiple-stage detention basin to limit inundation of passive recreational areas to one or two occurrences a year. Generally, the area within the WQCV is not well suited for active recreation facilities such as ballparks, playing fields, and picnic areas. These are best located above the WQCV pool level.

Figure EDB-1 shows a representative layout of an EDB. Although flood control storage can be accomplished by providing a storage volume above the water quality storage, how best to accomplish this is not included in this discussion. Whether or not flood storage is provided, all embankments should be protected from catastrophic failure when runoff exceeds the design event. The State Engineer's regulatory requirements for larger dam embankments and storage volumes must be followed whenever regulatory height and/or volume thresholds are exceeded. Below those thresholds, the engineer should design the embankment-spillway-outlet system so that catastrophic failure will not occur.

Perforated outlet and trash rack configurations are illustrated in the typical details section. Figure EDP-3 equates the WQCV that needs to be emptied over 40 hours, to the total required area of perforations per row for the standard configurations shown in that section. The chart is based on the rows being equally spaced vertically at 4-inch centers. This total area of perforations per row is then used to determine the number of uniformly sized holes per row (see detail in the typical details section). One or more perforated columns on a perforated orifice plate integrated into the front of the outlet can be used. Other types of outlets may also be used, provided they control the release of the WQCV in a manner consistent with the drain time requirements and are approved in advance by the District.

Although the soil types beneath the pond seldom prevent the use of this BMP, they should be considered during design. Any potential exfiltration capacity should be considered a short-term characteristic and ignored in the design of the WQCV because exfiltration will decrease over time as the soils clog with fine sediment and as the groundwater beneath the basin develops a mound that surfaces into the basin.

High groundwater should not preclude the use of an EDB. Groundwater, however, should to be considered during design and construction, and the outlet design must account for any upstream base flows that enter the basin or that may result from groundwater surfacing within the basin itself.

Stable, all weather access to critical elements of the pond, such as the inlet, outlet, spillway, and sediment collection areas must be provided for maintenance purposes.

6.5 Design Procedure and Criteria

The following steps outline the design procedure and criteria for an EDB.

1. Basin Storage Volume — Provide a storage volume equal to 120 percent of the WQCV based on a 40-hour drain time, above the lowest outlet (i.e., perforation) in the basin. The additional 20 percent of storage volume provides for sediment accumulation and the resultant loss in storage volume.

   A. Determine the WQCV tributary catchment's percent imperviousness. Account for the effects of DCIA, if any, on Effective Imperviousness. Using Figure ND-1, determine the reduction in impervious area to use with WQCV calculations.

   B. Find the required storage volume (watershed inches of runoff):

   Determine the Required WQCV (watershed inches of runoff) using Figure EDB-2, based on the EDB's 40 -hour drain time.

   Calculate the Design Volume in acre-feet as follows:

$$Design\ Volume = \left(\frac{WQCV}{12}\right) * Area * 1.2$$

   In which:

   Area = The watershed area tributary to the extended detention pond

   1.2 factor = Multiplier of 1.2 to account for the additional 20% of required storage for sediment accumulation

2. Outlet Works — The Outlet Works are to be designed to release the WQCV (i.e., not the 'Design Volume') over a 40-hour period, with no more than 50 percent of the WQCV being released in 12 hours. Refer to the *Water Quality Structure Details* section for schematics pertaining to structure geometry; grates, trash racks, and screens; outlet type: orifice plate or perforated riser pipe; cutoff collar size and location; and all other necessary components.

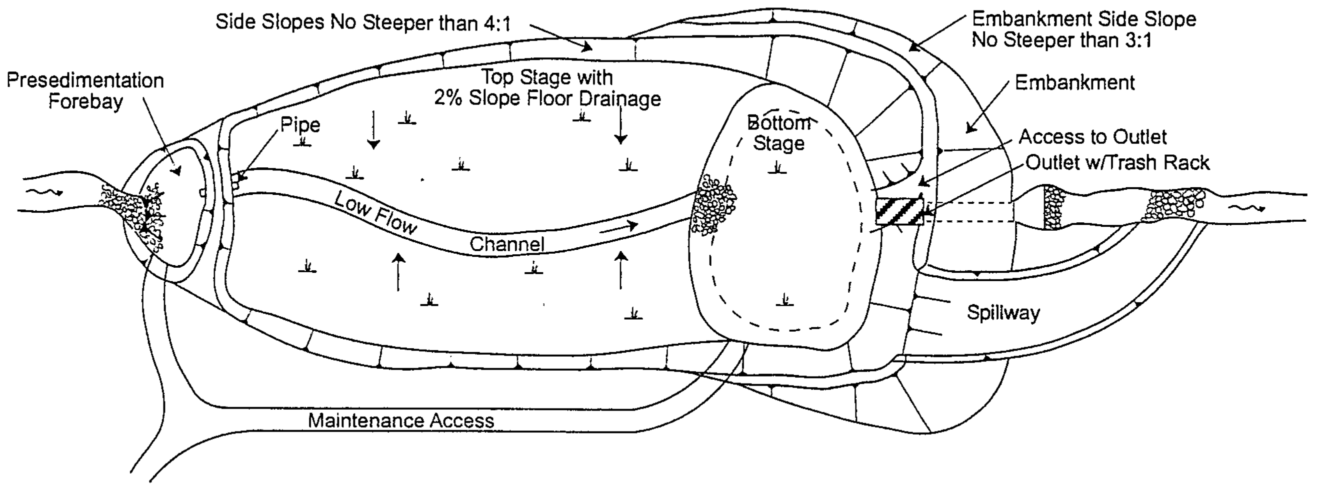
   For a perforated outlet, use Figure EDB-3 to calculate the required area per row based on WQCV and the depth of perforations at the outlet. See the *Water Quality Structure Details* section to determine the appropriate perforation geometry and number of rows (The lowest perforations should be set at the water surface elevation of the outlet micropool). The total outlet area can then be calculated by multiplying the the area per row by the number of rows.

3.	Trash Rack	Provide a trash rack of sufficient size to prevent clogging of the primary water quality outlet. Size the rack so as not to interfere with the hydraulic capacity of the outlet. Using the total outlet area and the selected perforation diameter (or height), Figures 6, 6a or 7 in the *Water Quality Structure Details* section will help to detemrine the minimum open area required for the trash rack. If a perforated vertical plate or riser is used as suggested in the *Manual*, use one-half of the total outlet area to calculate the trash rack's size. This accounts for the variable inundation of the outlet orifices. Figures 6 and 6a were developed as suggested standardized outlet designs for smaller sites.
4.	Basin Shape	Shape the pond whenever possible with a gradual expansion from the inlet and a gradual contraction toward the outlet, thereby minimizing short circuiting. The basin length to width ratio between the inlet and the outlet should be between 2:1 to 3:1, with the larger being preferred. It may be necessary to modify the inlet and outlet points through the use of pipes, swales or channels to accomplish this.
5.	Two-Stage Design	A two-stage design with a pool that fills often with frequently occurring runoff minimizes standing water and sediment deposition in the remainder of the basin. The two stages are as follows: A. Top Stage: The top stage should be 2 or more feet deep with its bottom sloped at 2 percent toward the low flow channel. B. Bottom Stage: The active storage basin of the bottom stage should be 1.5 to 3 feet deeper than the top stage and store 5 to 15 percent of the WQCV. Provide a micro-pool below the bottom active storage volume of the lower stage at the outlet point. The pool should be ½ the depth of the upper WQCV depth or 2.5 feet, whichever is the larger.
6.	Low-Flow Channel	Conveys low flows from the forebay to the bottom stage. Erosion protection should be provided where the low-flow channel enters bottom stage. Lining the low flow channel with concrete is recommended. Otherwise line its sides with VL Type riprap and bottom with concrete. Make it at least 9 inches deep; at a minimum provide capacity equal to twice the release capacity at the upstream forebay outlet.
7.	Basin Side Slopes	Basin side slopes should be stable and gentle to facilitate maintenance and access. Side slopes should be no steeper than 4:1, the flatter, the better and safer.
8.	Dam Embankment	The embankment should be designed not to fail during a 100-year <u>and larger storms</u>. Embankment slopes should be no steeper than 3:1, preferably 4:1 or flatter, and planted with turf forming grasses. Poorly compacted native soils should be excavated and replaced. Embankment soils should be compacted to at least 95 percent of their maximum density according to ASTM D 698-70 (Modified Proctor). Spillway structures and overflows should be designed in accordance with local drainage criteria and should consider UDFCD drop-structure design guidelines.
9.	Vegetation	Bottom vegetation provides erosion control and sediment entrapment. Pond bottom, berms, and side sloping areas may be planted with native grasses or with irrigated turf, depending on the local setting.

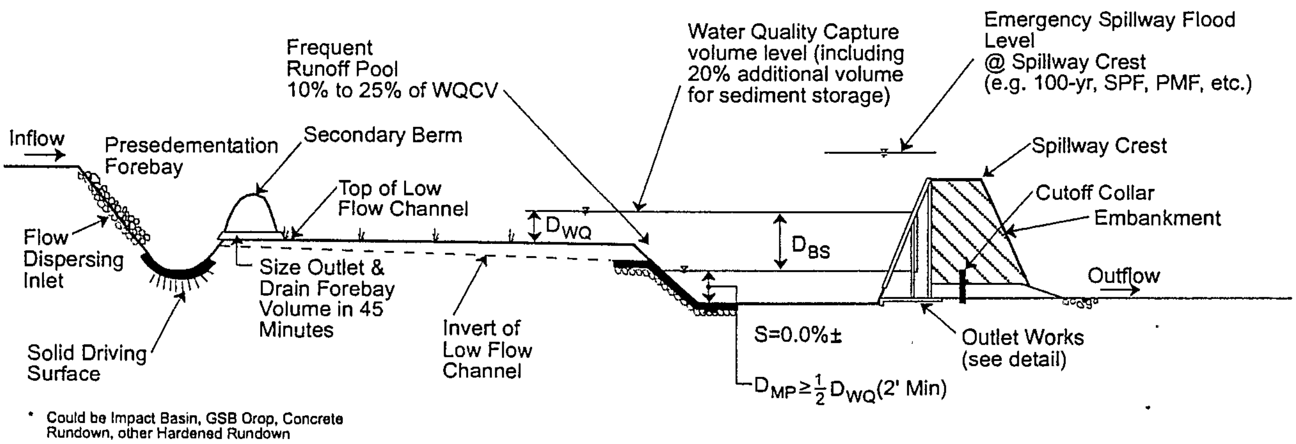
10.	Access	All weather stable access to the bottom, forebay, and outlet works area shall be provided for maintenance vehicles. Maximum grades should be 10 percent, and a solid driving surface of gravel, rock, concrete, or gravel-stabilized turf should be provided.
11.	Inlet	Dissipate flow energy at pond's inflow point(s) to limit erosion and promote particle sedimentation. Inlets should be designed in accordance with UDFCD drop structure criteria or as another type of an energy dissipating structure.
12.	Forebay Design	Provide the opportunity for larger particles to settle out in the inlet in an area that has a solid surface bottom to facilitate mechanical sediment removal. A rock berm should be constructed between the forebay and the main EDB. The forebay volume of the permanent pool should be 5 to 10 percent of the design water quality capture volume. A pipe throughout the berm to convey water the EDB should be offset from the inflow streamline to prevent short circuiting and should be sized to drain the forebay volume in 5 minutes.
13.	Flood Storage	Combining the water quality facility with a flood control facility is recommended. The 10-year, 100-year, or other floods may be detained above the WQCV. See Section 1.5.5 of the *BMP Planning For New Development and Significant Redevelopment*chapter of this volume for further guidance.
14.	Multiple Uses	Whenever desirable and feasible, incorporate the EDB within a larger flood control basin. Also, whenever possible try to provide for other urban uses such as active or passive recreation, and wildlife habitat. If multiple uses are being contemplated, use the multiple-stage detention basin to limit inundation of passive recreational areas to one or two occurrences a year. Generally, the area within the WQCV is not well suited for active recreation facilities such as ballparks, playing fields, and picnic areas. These are best located above the EDB level.

6.6 Design Example

Design forms that provide a means of documenting the design procedure are included in the Design Forms section. A completed form follows as a design example.



PLAN
NOT TO SCALE



SECTION
NOT TO SCALE

FIGURE EDB-1
Plan and Section of an Extended Detention Basin Sedimentation Facility

R0017736

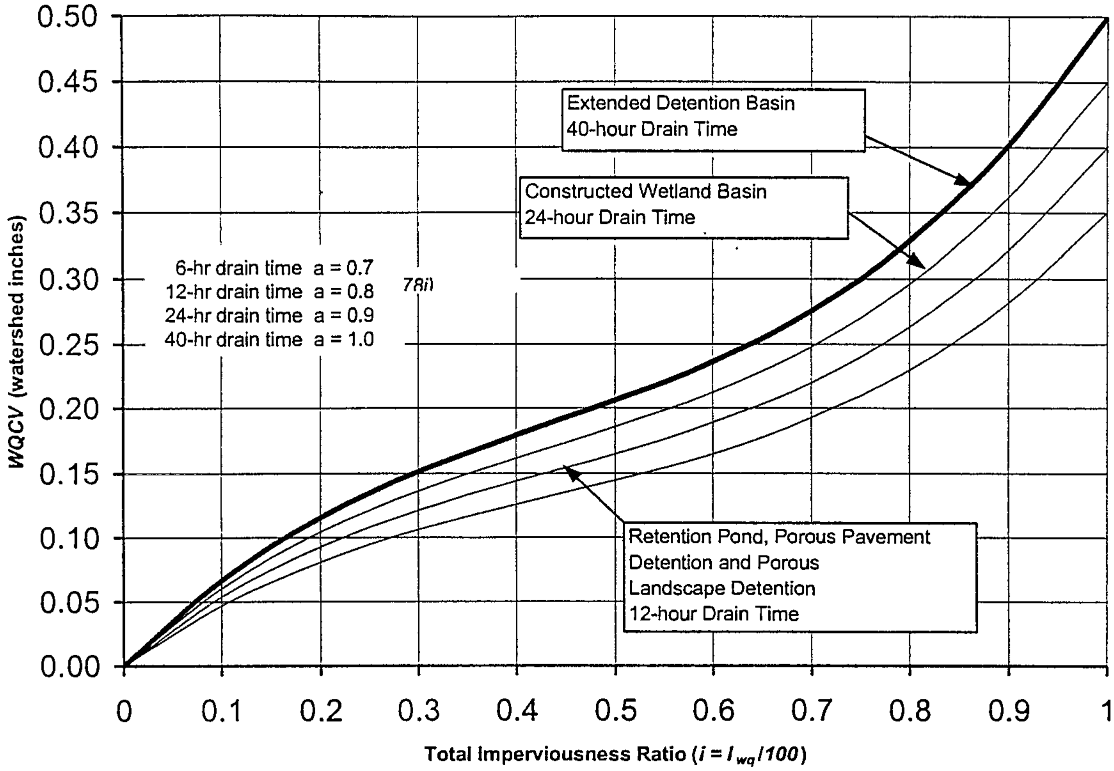


FIGURE EDB-2

Water Quality Capture Volume (WQCV), 80th Percentile Runoff Event

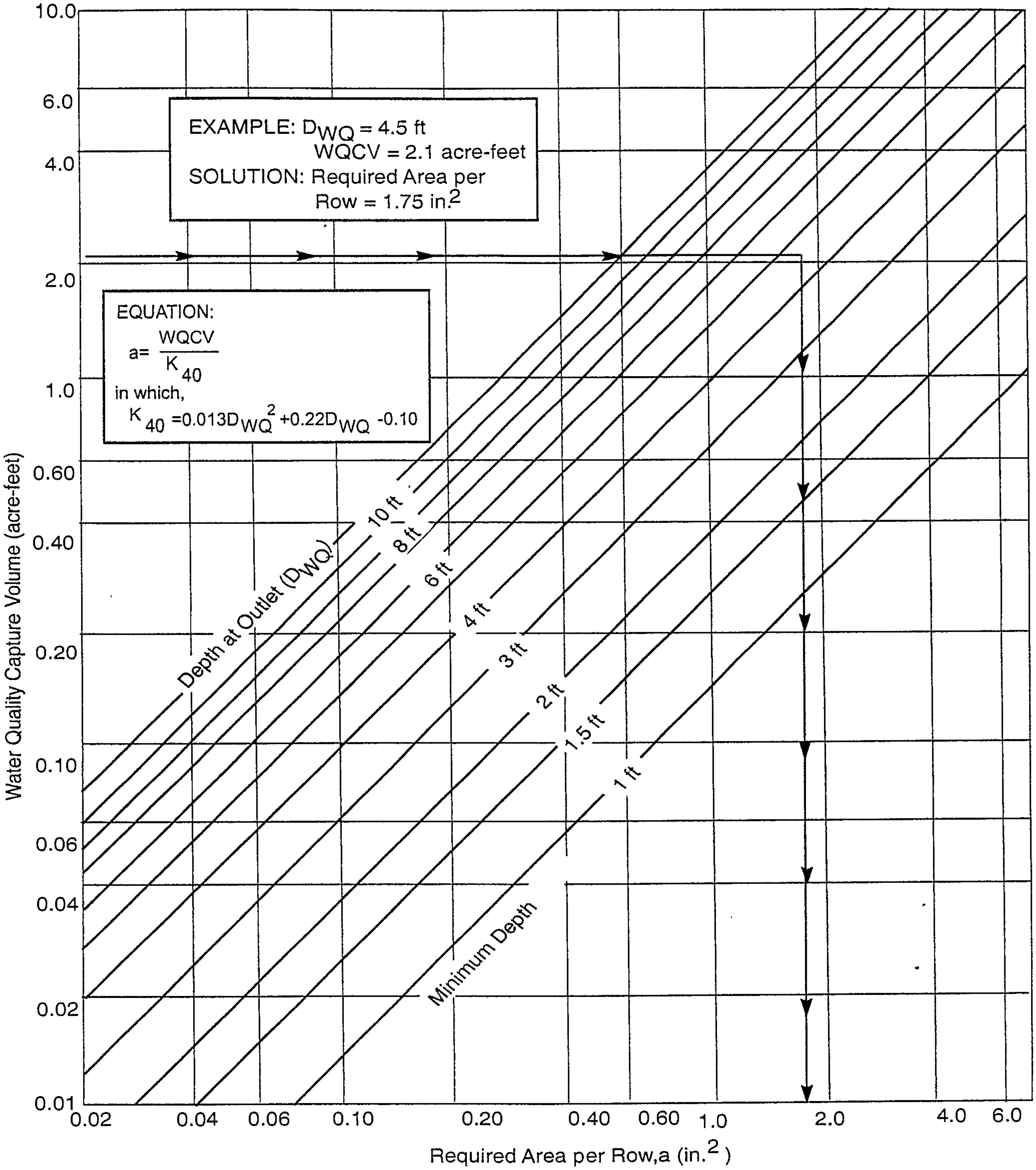


FIGURE EDB-3
Water Quality Outlet Sizing:
Dry Extended Detention Basin With a 40-Hour Drain Time of the Capture Volume

R0017738

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Sheet 1 of 3

Designer:
Company:
Date: September 22, 1999
Project:
Location:

1. Basin Storage Volume	
A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	I_a = 50.00 % i = 0.50
B) Contributing Watershed Area (Area)	Area = 100.00 acres
C) Water Quality Capture Volume (WQCV) ($WQCV = 1.0 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)$)	WQCV = 0.21 watershed inches
D) Design Volume: Vol = (WQCV / 12) * Area * 1.2	Vol = 2.063 acre-feet
2. Outlet Works	
A) Outlet Type (Check One)	X Orifice Plate __ Perforated Riser Pipe __ Other:
B) Depth at Outlet Above Lowest Perforation (H)	H = 4.00 feet
C) Required Maximum Outlet Area per Row, (A_o)	A_o = 2.09 square inches
D) Perforation Dimensions **(enter one only)**: i) Circular Perforation Diameter **OR** ii) 2" Height Rectangular Perforation Width	D = 1.1250 inches, **OR** W = inches
E) Number of Columns (nc, See Table 6a-1 For Maximum)	nc = 2 number
F) Actual Design Outlet Area per Row (A_o)	A_o = 1.99 square inches
G) Number of Rows (nr)	nr = 12 number
H) Total Outlet Area (A_{ot})	A_{ot} = 23.86 square inches
3. Trash Rack	
A) Needed Open Area: $A_t = 0.5 * (\text{Figure 7 Value}) * A_{ot}$	A_t = 799 square inches
B) Type of Outlet Opening (Check One)	X ≤ 2" Diameter **Round** __ 2" High **Rectangular** __ Other:
C) For 2", or Smaller, **Round Opening** (Ref.: Figure 6a):	
i) Width of Trash Rack and Concrete Opening (W_{conc}) from Table 6a-1	W_{conc} = 24 inches
ii) Height of Trash Rack Screen (H_{TR})	H_{TR} = 72 inches

R0017739

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Sheet 2 of 3

Designer: ______
Company: ______
Date: September 13, 1999
Project: ______
Location: ______

iii) Type of Screen (Based on Depth H), Describe if "Other"	X S.S. #93 VEE Wire (US Filter) ___ Other: ______
iv) Screen Opening Slot Dimension, Describe if "Other"	X 0.139" (US Filter) ___ Other: ______
v) Spacing of Support Rod (O.C.) Type and Size of Support Rod (Ref.: Table 6a-2)	1.00 inches **TE 0.074 in. x 0.75 in.**
vi) Type and Size of Holding Frame (Ref.: Table 6a-2)	**1.00 in. x 1.50 in. angle**
D) For 2" High **Rectangular Opening** (Refer to Figure 6b):	
I) Width of Rectangular Opening (W)	W = ______ inches
ii) Width of Perforated Plate Opening (W_{conc} = W + 12")	W_{conc} = ______ inches
iii) Width of Trashrack Opening ($W_{opening}$) from Table 6b-1	$W_{opening}$ = ______ inches
iv) Height of Trash Rack Screen (H_{TR})	H_{TR} = ______ inches
v) Type of Screen (based on depth H) (Describe if "Other")	___ Klemp™ KPP Series Aluminum ___ Other: ______
vi) Cross-bar Spacing (Based on Table 6b-1, Klemp™ KPP Grating). Describe if "Other"	___ inches ___ Other: ______
vii) Minimum Bearing Bar Size (Klemp ™ Series, Table 6b-2) (Based on depth of WQCV surcharge)	______
4. Detention Basin length to width ratio	2.00 (L/W)
5 Pre-sedimentation Forebay Basin - Enter design values	
A) Volume (5 to 10% of the Design Volume in 1D)	0.200 acre-feet
B) Surface Area	0.069 acres
C) Connector Pipe Diameter (Size to drain this volume in 5-minutes under inlet control)	6 inches
D) Paved/Hard Bottom and Sides	Yes yes/no

R0017740

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Sheet 3 of 3

Designer: ____________
Company: ____________
Date: September 22, 1999
Project: ____________
Location: ____________

6. Two-Stage Design	
A) Top Stage (D_{WQ} = 2' Minimum)	D_{WQ} = 2.00 feet Storage= 1.800 acre-feet
B) Bottom Stage (D_{BS} = D_{WQ} + 1.5' Minimum, D_{WQ} + 3.0' Maximum, Storage = 5% to 15% of Total WQCV)	D_{BS} = 4.00 feet Storage= 0.110 acre-feet Surf. Area= 0.028 acres
C) Micro Pool (Minimum Depth = the Larger of 0.5 * Top Stage Depth or 2.5 Feet)	Depth= 2.50 feet Storage= 0.015 acre-feet Surf. Area= 0.006 acres
D) Total Volume: Vol_{tot} = Storage from 5A + 6A + 6B Must be ≥ Design Volume in 1D	Vol_{tot} = 2.110 acre-feet
7. Basin Side Slopes (Z, horizontal distance per unit vertical) Minimum Z = 4, Flatter Preferred	Z = 5.00 (horizontal/vertical)
8. Dam Embankment Side Slopes (Z, horizontal distance per unit vertical) Minimum Z = 4, Flatter Preferred	Z = 4.00 (horizontal/vertical)
9. Vegetation (Check the method or describe "Other")	X Native Grass ___ Irrigated Turf Grass ___ Other: ______

Notes: ____________

R0017741

7.0 SAND FILTER EXTENDED DETENTION BASIN (SFB)

7.1 Description

A sand filter extended detention basin (SFB) is a stormwater filter that consists of a runoff storage zone underlain by a sand bed with an underdrain system. During a storm, accumulated runoff ponds in the surcharge zone and gradually infiltrates into the underlying sand bed, filling the void spaces of the sand. The underdrain gradually dewaters the sand bed and discharges the runoff to a nearby channel,swale, or storm sewer.

7.2 General Application

A SFB is generally suited to offline, onsite configurations where there is no baseflow and the sediment load is relatively low.

7.3 Advantages/Disadvantages

7.3.1 General. Primary advantages of SFBs include effective water quality enhancement through settling and filtering. The primary disadvantage is a potential for clogging if a moderate to high level of silts and clays are allowed to flow into the facility. For this reason, it should **not** be put into operation while construction activities are taking place in the tributary catchment. Also, this BMP should not be located close to building foundations or other areas where expansive soils are a concern, although an underdrain and impermeable liner can ameliorate some of this concern.

7.3.2 Physical Site Suitability. Since an underdrain system is incorporated into this BMP, SFB is suited for about any site; presence of sandy subsoils is not a requirement. This BMP has a relatively flat surface area, so it may be more challenging to incorporate it into steeply sloping terrain.

R0017742

7.3.3 Pollutant Removal. Although not fully tested to date in the Denver area, the tests on filter vaults in the Denver area and other parts of United States show that the amount of pollutant removed by this BMP should be significant and should at least equal the removal rates by sand filters tested elsewhere. See Table SQ-6 for estimated ranges in pollutant removals.

7.3.4 Maintenance Needs. Before selecting this BMP, be sure that the maintenance specified in the "Maintenance" chapter of the *Manual* will be provided by either a local government or by the owner. This BMP's performance is critical on having regular maintenance provided.

7.4 Design Procedure and Criteria

The following steps outline the design procedure and criteria for an SFB.

1. Basin Storage Volume — Provide a storage volume equal to 100 percent of the WQCV based on a 40-hour drain time, above the sand bed of the basin.

   A. Determine the WQCV tributary catchment's percent imperviousness. Account for the effects of DCIA, if any, on Effective Imperviousness. Using Figure ND-1, determine the reduction in impervious area to use with WQCV calculations.

   B. Find the required storage volume (watershed inches of runoff):

   Determine the Required WQCV (watershed inches of runoff) using Figure SFB-2, based on the SFB's 40-hour drain time.

   C. Calculate the Design Volume in acre-feet as follows:

   $$Design\ Volume = \left(\frac{WQCV}{12}\right) * Area$$

   In which:

   $Area$ = The watershed area tributary to the extended detention pond (acres)

2. Basin Depth — Maximum Design Volume depth shall be 3 feet.

3. Filter's Surface Area — Calculate the **minimum** sand filter area (A_s) at the basin's bottom with the following equation:

   $$A_s = Design\ Volume / 3 \quad *43{,}560 \text{ (square feet)}$$

4. Outlet Works — An 18 inch layer of sand (ASTM C-33) over a 9 inch gravel layer (AASHTO No. 8; CDOT Section 703, #8) shall line the entire SFB for purposes of draining the WQCV.

   If expansive soils are a concern or if the tributary catchment has chemical or petroleum products handled or stored, install an impermeable membrane below the gravel layer.

   In addition, an overflow shall be provided to convey flows in excess of the WQCV out of the basin.

R0017743

7.5 Design Example

Design forms that provide a means of documenting the design procedure are included in the Design Forms section. A completed form follows as a design example.

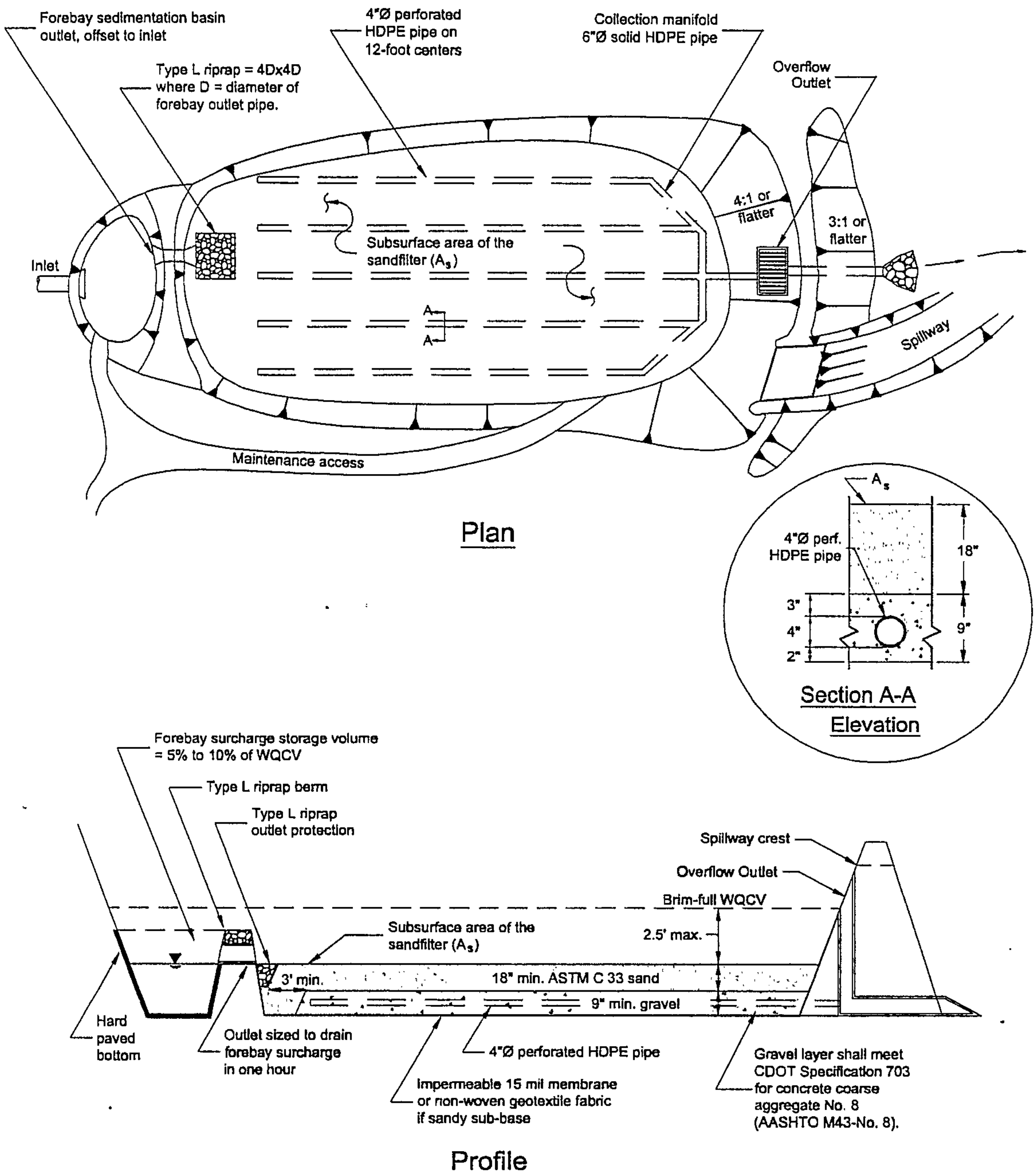


FIGURE SFB-1

Sand Filter Basin

R0017745

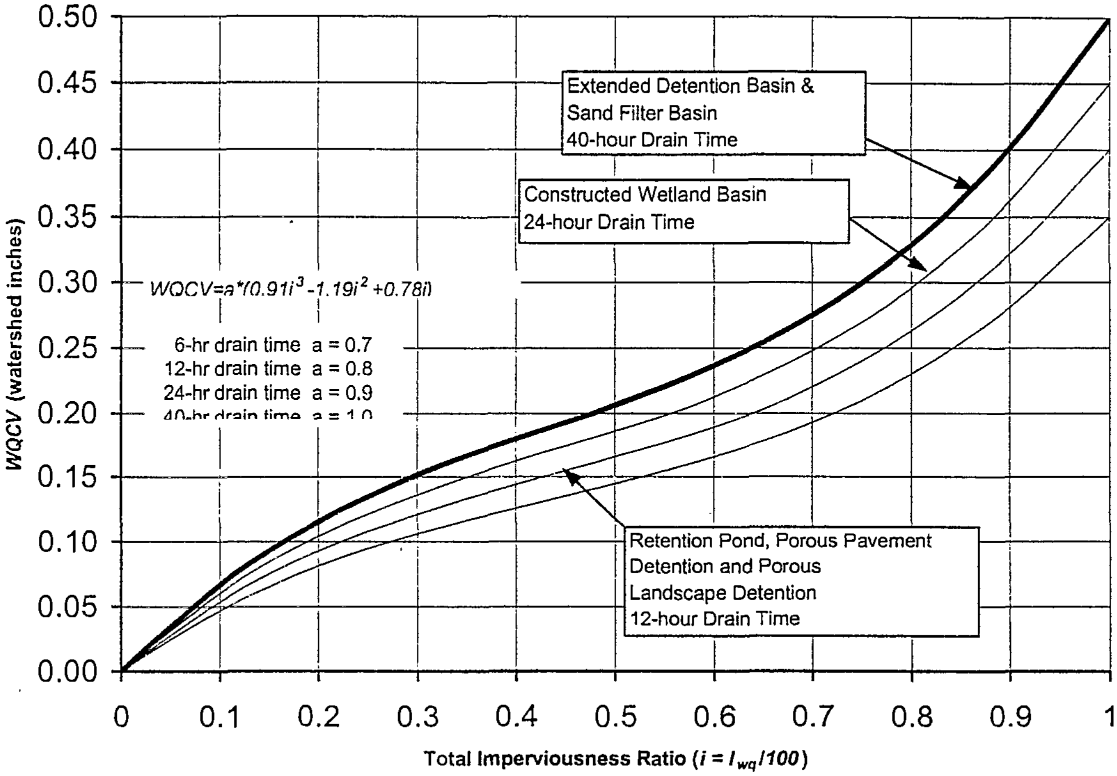


FIGURE SFB-2

Water Quality Capture Volume (WQCV), 80th Percentile Runoff Event

R0017746

Design Procedure Form: Sand Filter Basin (SFB)

Designer:
Company:
Date: September 22, 1999
Project:
Location:

1. Basin Storage Volume	
A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	I_a = 50.00 % i = 0.50
B) Contributing Watershed Area (Area)	Area = 40.00 acres
C) Water Quality Capture Volume (WQCV) ($WQCV = 1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$)	WQCV = 0.21 watershed inches
D) Design Volume: Vol = (WQCV / 12) * Area	Vol = 0.688 acre-feet
2. Minimum Filter Surface Area: A_s = (Vol / 3) * 43,560	A_s = 9,983 square feet
Filter Surface Elevation	5478.50 feet
Average Side Slope of the Filter Basin (4:1 or flatter)	Z = 4.0
3. Estimate of Basin Depth (D), based on filter area A_s	D = 2.6 feet
4. Outlet Works	
A) Sand (ASTM C-33) Layer Thickness (18" min.)	18 inches
Gravel (AASHTO No. 8; CDOT Section 703) Layer Thickness (9" min.)	9 inches
B) Overflow Elevation At Top of Design Volume (Filter Surface Elev. + 0.70')	5481.10 feet
5. Draining of porous pavement (Check a, **or** b, **or** c, **answer** d) Based on answers to 5a through 5d, check the appropriate method	___ Infiltration to Subgrade with Permeable Membrane: 5(c) checked **and** 5(d) = no
a) Check box if subgrade is heavy or expansive clay [ ] b) Check box if subgrade is silty or clayey sands [ ] c) Check box if subgrade is well-draining soils [X]	X Underdrain with Impermeable Membrane: 5(a) checked **or** 5(d) = yes
d) Does tributary catchment contain land uses that may have petroleum products, greases, or other chemicals present, such as gas station, hardware store, restaurant, etc.? yes [X] no [ ]	___ Underdrain with Permeable Membrane: 5(b) checked **and** 5(d) = no ___ Other: ___
6 Describe Provisions for Maintenance	**The Alcove Homeowner's Association will be responsible for providing routine maintenance specified in the "Maintenance" chapter of the Urban Storm Drainage Criteria Manual Volume 3.**

Notes:

R0017747

8.0 CONSTRUCTED WETLANDS BASIN (CWB)— SEDIMENTATION FACILITY

8.1 Description

A constructed wetlands basin (CWB) is a shallow retention pond (RP) which requires a perennial base flow to permit the growth of rushes, willows, cattails, and reeds to slow down runoff and allow time for sedimentation, filtering, and biological uptake. It is a sedimentation basin and a form of a treatment plant.

A CWB differ from "natural" wetlands as they are totally human artifacts that are built to enhance stormwater quality. Sometimes small wetlands that exist along ephemeral drainageways on Colorado's high plains could be enlarged and incorporated into the constructed wetland system. Such action, however, requires the approval of federal and state regulators.

Current (1999) regulations intended to protect natural wetlands recognize a separate classification of wetlands constructed for a water quality treatment. Such wetlands generally are not allowed on receiving waters and cannot be used to mitigate the loss of natural wetlands but are allowed to be disturbed by maintenance activities. Therefore, the legal and regulatory status of maintaining a wetland constructed for the primary purpose of water quality treatment, such as the CWB, is separate from the disturbance of a natural wetland. Nevertheless, the U.S. Army Corps of Engineers has established maximum areas that can be maintained under a nationwide permit. Thus, any activity that disturbs a constructed wetland should be first cleared through the U.S. Army Corps of Engineers to ensure it is covered by some form of an individual, general, or nationwide 404 permit.

8.2 General Application

A CWB can be used as a followup structural BMP in a watershed, or as a stand-alone onsite facility if the owner provides sufficient water to sustain the wetland. Flood control storage can be provided above the CWB's water quality capture volume (WQCV) pool to act as a multiuse facility.

R0017748

CWB requires a net influx of water to maintain its vegetation and microorganisms. A complete water budget analysis is necessary to ensure the adequacy of the base flow.

8.3 Advantages/Disadvantages

8.3.1 General. A CWB offers several potential advantages, such as natural aesthetic qualities, wildlife habitat, erosion control, and pollutant removal. It can also provide an effective followup treatment to onsite and source control BMPs that rely upon settling of larger sediment particles. In other words, it offers yet another effective structural BMP for larger tributary catchments.

The primary drawback of the CWB is the need for a continuous base flow to ensure viable wetland growth. In addition, silt and scum can accumulate and unless properly designed and built, can be flushed out during larger storms. In addition, in order to maintain a healthy wetland growth, the surcharge depth for WQCV above the permanent water surface cannot exceed 2 feet.

Along with routine good housekeeping maintenance, occasional "mucking out" will be required when sediment accumulations become too large and affect performance. Periodic sediment removal is also needed for proper distribution of growth zones and of water movement within the wetland.

8.3.2 Physical Site Suitability. A perennial base flow is needed to sustain a wetland, and should be determined using a water budget analysis. Loamy soils are needed in a wetland bottom to permit plants to take root. Exfiltration through a wetland bottom cannot be relied upon because the bottom is either covered by soils of low permeability or because the groundwater is higher than the wetland's bottom. Also, wetland basins require a near-zero longitudinal slope, which can be provided using embankments.

8.3.3 Pollutant Removal. See Table SQ-6 for estimated ranges in pollutant removals. Reported removal efficiencies of constructed wetlands vary significantly. Primary variables influencing removal efficiencies include design, influent concentrations, hydrology, soils, climate, and maintenance. With periodic sediment removal and routine maintenance, removal efficiencies for sediments, organic matter, and metals can be moderate to high; for phosphorous, low to high; and for nitrogen, zero to moderate. Pollutants are removed primarily through sedimentation and entrapment, with some of the removal occurring through biological uptake by vegetation and microorganisms. Without a continuous dry-weather base flow, salts and algae can concentrate in the water column and can be released into the receiving water in higher levels at the beginning of a storm event as they are washed out.

Researchers still do not agree whether routine aquatic plant harvesting affects pollutant removals significantly. Until research demonstrates and quantifies these effects, periodic harvesting for the general upkeep of wetland, and not routine harvesting of aquatic plants, is recommended.

R0017749

8.4 Design Considerations

Figure CWB-1 illustrates an idealized CWB. An analysis of the water budget is needed to show the net inflow of water is sufficient to meet all the projected losses (such as evaporation, evapotranspiration, and seepage for each season of operation). Insufficient inflow can cause the wetland to become saline or to die off.

8.5 Design Procedure and Criteria

The following steps outline the design procedure for a CWB.

1. **Basin Surcharge Storage Volume** — Provide a surcharge storage volume equal to the WQCV based on a 24-hour drain time, above the lowest outlet (i.e., perforation) in the basin.

   A. Determine the WQCV using the tributary catchments percent imperviousness. Account for the effects of DCIA, if any, on Effective Imperviousness. Using Figure ND-1, determine the reduction in impervious area to use with WQCV calculations.

   B. Find the Required Storage Surcharge Volume (watershed inches of runoff) above the permanent pool level.

   Determine the Required Storage (watershed inches of runoff) using Figure CWB-2, based on the constructed wetland basin 24-hour drain time.

   Calculate the Surcharge Volume in acre-feet as follows:

$$Design\ Surcharge\ Volume = \left(\frac{WQCV}{12}\right) * Area$$

   In which:

   $Area$ = The tributary drainage area tributary to the CWB (Acres).

2. **Wetland Pond Depth and Volume** — The volume of the permanent wetland pool shall be no less than 75% of the WQCV found in Step 1.

   Proper distribution of wetland habitat is needed to establish a diverse ecology. Distribute pond area in accordance with the following:

TABLE 1

Components	Percent of Permanent Pool Surface Area	Water Design Depth
Forebay, outlet and free water surface areas	30% to 50%	2 to 4 feet deep
Wetland zones with emergent vegetation	50% to 70%	6 to 12 inches deep*

*One-third to one-half of this zone should be 6 inches deep.

3. **Depth of Surcharge WQCV** — The surcharge depth of the WQCV above he permanent pool's water surface shall not exceed 2.0 feet.

4. Outlet Works

Provide outlet works that limit WQCV depth to 2 feet or less. Use a water quality outlet that is capable of releasing the WQCV in no less than a 24-hour period. Refer to the *Water Quality Structure Details* section for schematics pertaining to structure geometry; grates, trash racks, and screens; outlet type: orifice plate or perforated riser pipe; cutoff collar size and location; and all other necessary components.

For a perforated outlet, use Figure CWB-3 to calculate the required area per row based on WQCV and the depth of perforations at the outlet. See the *Water Quality Structure Details* section to determine the appropriate perforation geometry and number of rows (The lowest perforations should be set at the water surface elevation of the outlet pool). The total outlet area can then be calculated by multiplying the the area per row by the number of rows.

5. Trash Rack

Provide a trash rack of sufficient size to prevent clogging of the primary water quality outlet. Size the rack so as not to interfere with the hydraulic capacity of the outlet. Using the total outlet area and the selected perforation diameter (or height), Figures 6, 6a or 7 in the *Water Qaulity Structure Details* section will help to detemrine the minimum open area required for the trash rack. If a perforated vertical plate or riser is used as suggested in the *Manual*, use one-half of the total outlet area to calculate the trash racks size. This accounts for the variable inundation of the outlet orifices. Figures 6 and 6a were developed as suggested standardized outlet designs for smaller sites.

6. Basin Use

Determine if flood storage or other uses will be provided for above the wetland surcharge storage or in an upstream facility. Design for combined uses when they are to be provided for.

7. Basin Shape

Shape the pond with a gradual expansion from the inlet and a gradual contraction to the outlet, thereby limiting short circuiting. The basin length to width ratio between the inlet and outlet should be 2:1 to 4:1 with 3:1 recommended. It may be necessary to modify the inlet and outlet point through the use of pipes, swales, or channels, to accomplish this.

8. Basin Side Slopes

Basin side slopes are to be stable and gentle to facilitate maintenance and access needs. Side slopes should be no steeper than 4:1, preferably 5:1 or flatter.

9. Base Flow

A net influx of water must be available throughout the year that exceeds all of the losses. The following equation and parameters can be used to estimate the net quantity of base flow available at a site:

$$Q_{net} = Q_{Inflow} - Q_{Evap} - Q_{Seepage} - Q_{E.T.}$$

Where:

Q_{Net} = Net quantity of base flow (acre-ft/year)

Q_{Inflow} = Estimated base flow (acre-ft/year) (Estimate by seasonal measurements and/or comparison to similar watersheds)

Q_{Evap} = Loss attributed to evaporation less the precipitation (acre-ft/year) (Computed for average water surface)

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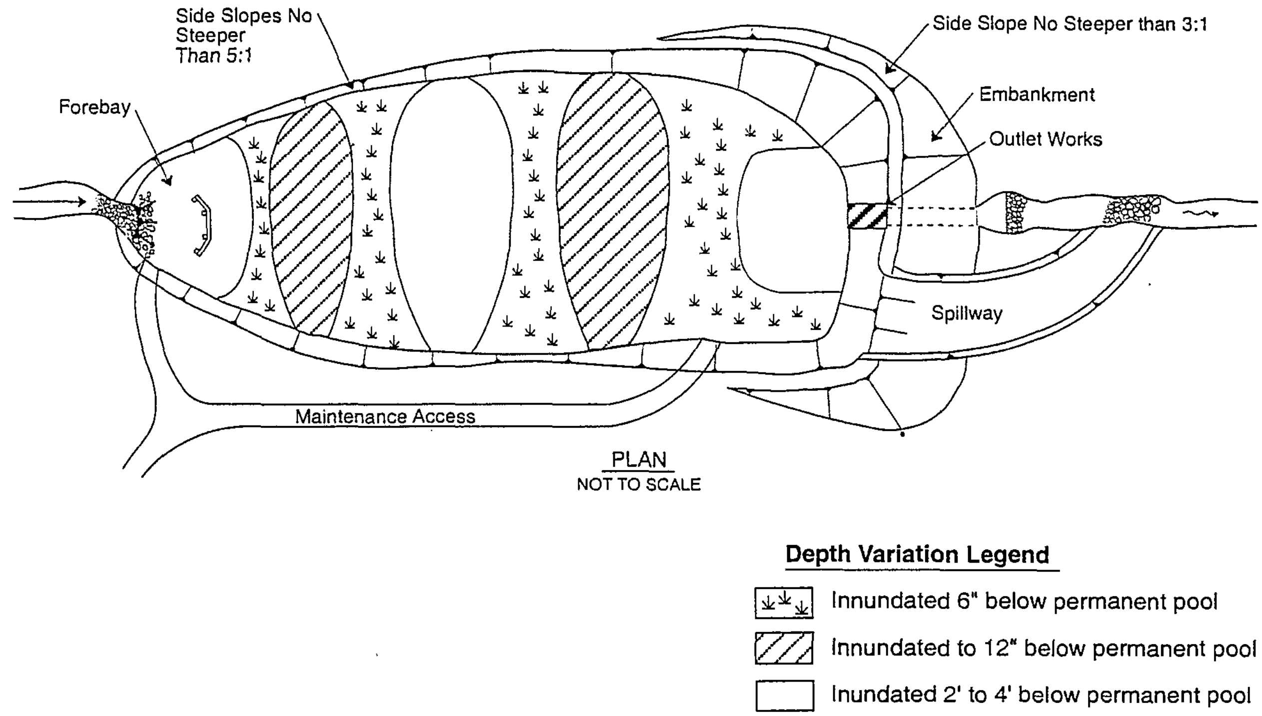
	$Q_{Seepage}$	= Loss (or gain) attributed to seepage to groundwater (acre-ft/year)
	$Q_{E.T.}$	= Loss attributed to plant evapotranspiration (computed for average plant area above water surface, not including the water surface)

10.	Inlet/Outlet Protection	Provide a means to dissipate flow energy entering the basin to limit sediment resuspension. Inlets should correspond to UDFCD drop-structure criteria. Outlets should be placed in an offbay that is at least 3 feet deep. The outlet should be protected from clogging by a skimmer shield that starts at the bottom of the permanent pool and extends above the maximum capture volume depth. Provide for a trash rack also.
11.	Forebay Design	Provide the opportunity for larger particles to settle out in an area that has a solid driving surface bottom for vehicles to facilitate sediment removal. The forebay volume of the permanent pool should be 5 to 10 percent of the design water quality capture volume.
12.	Vegetation	Cattails, sedges, reeds, and wetland grasses should be planted in the wetland bottom. Berms and side-sloping areas should be planted with native or irrigated turf-forming grasses. Initial establishment of the wetlands requires control of the water depth. After planting wetland species, the permanent pool should be kept at 3 to 4 inches to allow growth and to help establish the plants, after which the pool should be raised to its final operating level.
13.	Maintenance Access	Provide vehicle access to the forebay and outlet area for maintenance and removal of bottom sediments. Maximum grades should not exceed 10 percent, and a stabilized, all-weather driving surface needs to be provided.

8.6 Design Example

Design forms that provide a means of documenting the design procedure are included in the Design Forms section. A completed form follows as a design example.



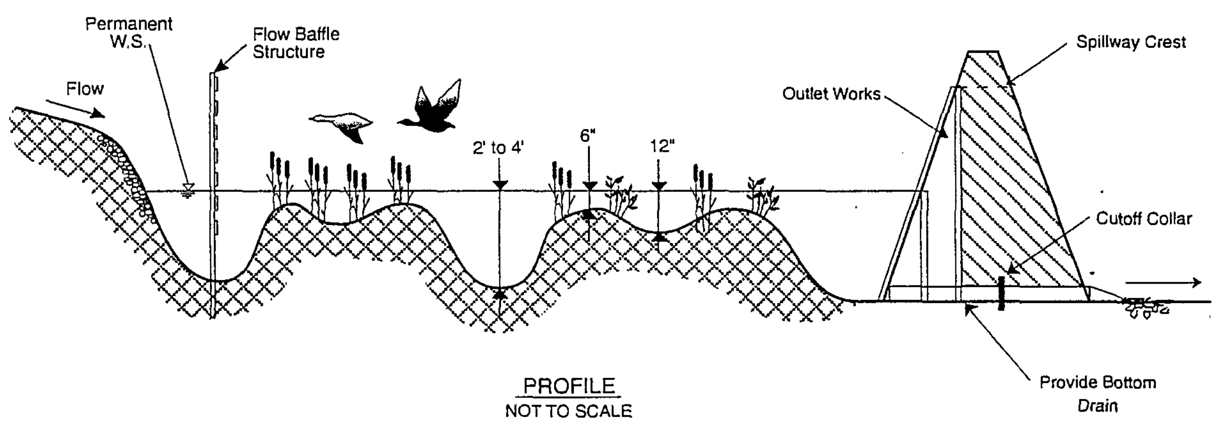


FIGURE CWB-1
Plan and Profile of a Constructed Wetland Basin Sedimentation Facility

R0017753

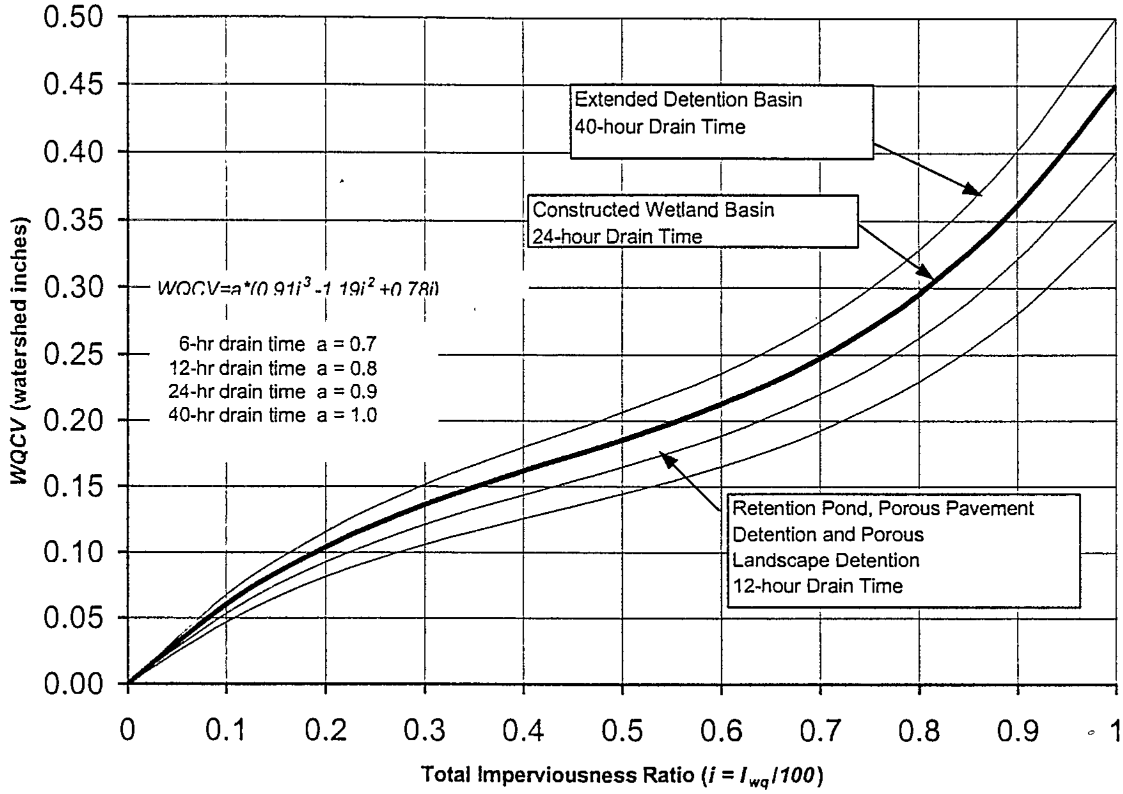
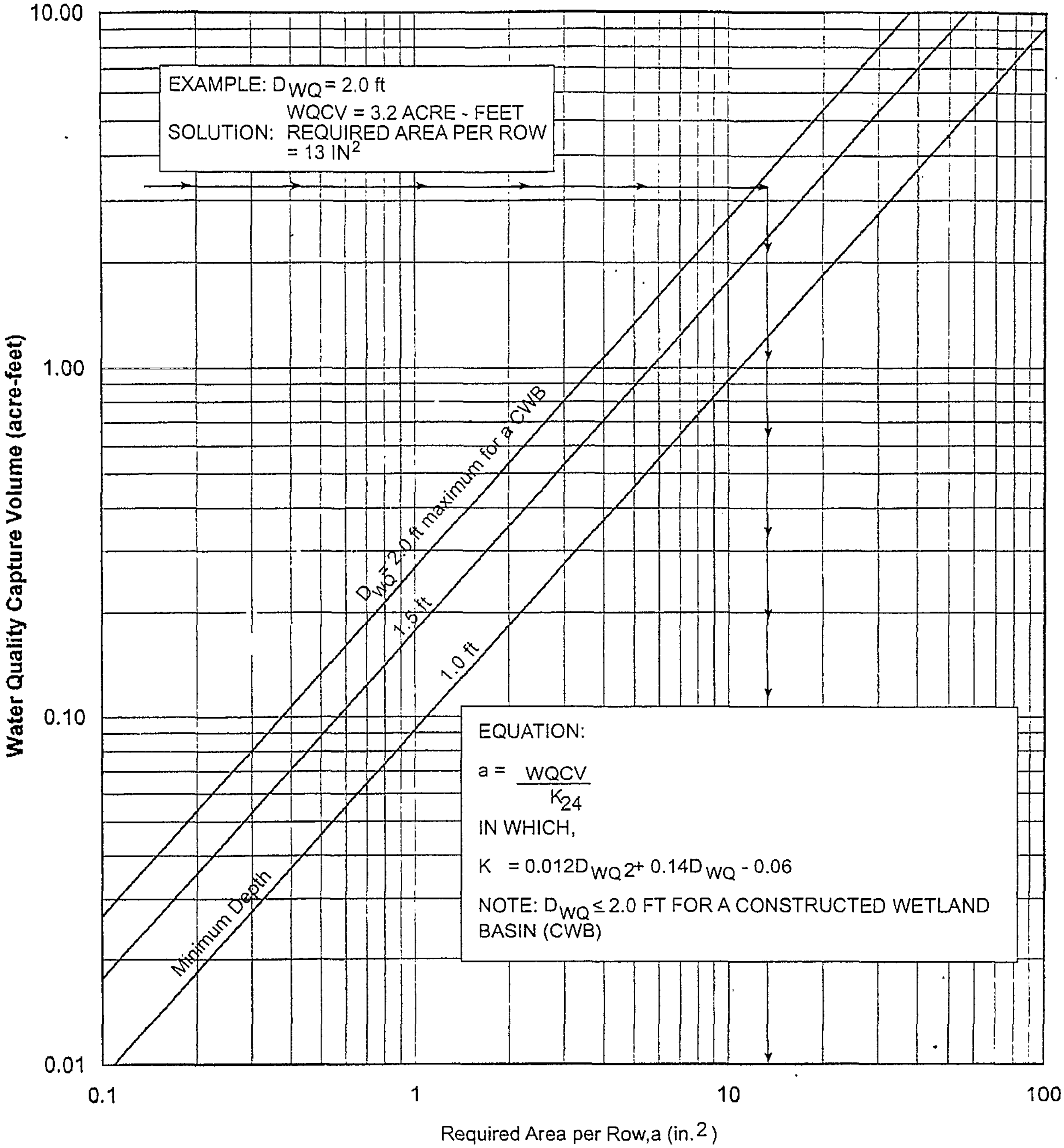


FIGURE CWB-2

Water Quality Capture Volume (WQCV), 80th Percentile Runoff Event



Source: Douglas County Storm Drainage and Technical Criteria, 1986.

FIGURE CWB-3
Water Quality Outlet Sizing: Constructed Wetland Basin With a 24-Hour Drain Time of the Capture Volume

R0017755

Design Procedure Form: Constructed Wetland Basin (CWB) - Sedimentation Facility

Sheet 1 of 3

Designer: ____________________
Company: ____________________
Date: September 22, 1999
Project: ____________________
Location: ____________________

1. Basin Storage Volume	
A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	I_a = 50.00 % i = 0.50
B) Contributing Watershed Area (Area)	Area = 50.00 acres
C) Water Quality Capture Volume (WQCV) ($WQCV = 0.9 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)$)	WQCV = 0.19 watershed inches
D) Design Volume: Vol = (WQCV / 12) * Area	Vol = 0.77 acre-feet
2. Wetland Pond Volume, Depth, and Water Surface Area	Calculated Required Minimums:
A) Minimum Permanent Pool: $Vol_{Pool} \geq 0.75 * Vol$	$Vol_{Pool} \geq$ 0.58 acre-feet WS Area = 0.39 acres, estimated Enter the Actual Design Values: $Vol_{Pool} \geq$ 0.60 acre-feet, final design WS Area = 0.40 acres, final design
B) Forebay (Volume ≥ 0.05 * Vol in 1D) Depth minimum = 2.5', maximum = 4.0'	Volume= 0.04 acre-feet Depth= 3.50 feet Area= 0.011 acres, % = 2.86%
C) Outlet Pool (Area > 0.06 * Design WS Area) Depth minimum = 2.5', maximum = 4.0'	Depth= 3.00 feet Area= 0.025 acres, % = 6.25%
D) Wetland Zones with Emergent Vegetation (6" to 12" deep) (Area = 50% to 70% of Design WS Area)	Depth= 0.75 feet Area= 0.220 acres, % = 55.00%
E) Free Water Surface Areas (2' to 4' deep) (Area = 30% to 50% of Design WS Area)	Depth= 3.50 feet Area= 0.144 acres, % = 35.89% 100.00%
3 Average Side Slope Above Water Surface (4:1 or flatter)	Z = 4.00
A) Depth of WQCV Surcharge (above permanent pool, 2' max.)	1.8 feet
4. Outlet Works	
A) Outlet Type (Check One)	X Orifice Plate __ Perforated Riser Pipe __ Other:
B) Depth at Outlet Above Lowest Perforation (H, 2' max.)	H = 1.80 feet
C) Required Maximum Outlet Area per Row, (A_o)	A_o = 3.35 square inches
D) Perforation Dimensions (Refer to Figure 5 in W.Q. Str. Det.): **(Enter one only)**: i) Circular Perforation Diameter **OR** ii) 2" Height Rectangular Perforation Width	D = ____ inches, **OR** W = 1.63 inches

R0017756

Design Procedure Form: Constructed Wetland Basin (CWB) - Sedimentation Facility

Sheet 2 of 3

Designer: ____
Company: ____
Date: September 13, 1999
Project: ____
Location: ____

E) Number of Columns (nc)	nc = 1 Number
F) Actual Design Outlet Area per Row (A_o)	A_o = 3.25 square inches
G) Number of Rows (nr)	nr = 5 Number
H) Total Outlet Area (A_{ot})	A_{ot} = 17.55 square inches
5. Trash Rack	
A) Needed Open Area: $A_t = 0.5 * (\text{Figure 7 Value}) * A_{ot}$	A_t = 552.37 square inches
B) Type of Outlet Opening (Check One)	___ ≤ 2" Diameter **Round** X 2" High **Rectangular** ___ Other: ____
C) For 2", or Smaller, **Round Opening** (Ref.: Figure 6a):	
i) Width of Trash Rack and Concrete Opening (W_{conc}) from Table 6a-1	W_{conc} = ____ inches
ii) Height of Trash Rack Screen (H_{TR})	H_{TR} = ____ inches
iii) Type of Screen (Based on Depth H), Describe if "Other"	___ S.S. #93 VEE Wire (US Filter) ___ Other: ____
iv) Screen Opening Slot Dimension, Describe if "Other"	___ 0.139" (US Filter) ___ Other: ____
v) Spacing of Support Rod (O.C.) Type and Size of Support Rod (Ref.: Table 6a-2)	___ inches ____
vi) Type and Size of Holding Frame (Ref.: Table 6a-2)	____
D) For 2" High **Rectangular Opening** (Refer to Figure 6b):	
I) Width of Rectangular Opening (W)	W = 1.625 inches
ii) Width of Perforated Plate Opening (W_{conc} = W + 12")	W_{conc} = 13.63 inches
iii) Width of Trashrack Opening ($W_{opening}$) from Table 6b-1	$W_{opening}$ = 24.0 inches
iv) Height of Trash Rack Screen (H_{TR})	H_{TR} = 46 inches
v) Type of Screen (based on depth H) (Describe if "Other")	X Klemp™ KPP Series Aluminum ___ Other: ____
vi) Cross-bar Spacing (Based on Table 6b-1, Klemp™ KPP Grating). Describe if "Other"	2 inches ___ Other: ____

Design Procedure Form: Constructed Wetland Basin (CWB) - Sedimentation Facility

Sheet 3 of 3

Designer: ______
Company: ______
Date: September 22, 1999
Project: ______
Location: ______

vii) Minimum Bearing Bar Size (Klemp ™ Series, Table 6a-2) (Based on depth of WQCV surcharge)	**1.00 in. x 3/16 in.**
6. Basin Use for Quantity Controls (Check one or describe if "Other")	X Detention within the facility __ Detention upstream of the facility __ Other: ______
7. Basin length to width ratio	3.00 (L/W)
8. Basin Side Slopes (Z, horizontal distance per unit vertical)	4.00 (horizontal/vertical)
9 Annual/Seasonal Water Balance (Q_{net} has to be positive)	Q_{inflow} 362.00 acre-feet/year Q_{evap} 1.40 acre-feet/year $Q_{seepage}$ 2.80 acre-feet/year $Q_{E.T.}$ 1.50 acre-feet/year Q_{net} 356.30 acre-feet/year
10 Vegetation (Check the method being applied or describe)	__ Native Grass X Irrigated Turf Grass Side Slopes X Wetland Species in Pool* __ Other: ______ *Describe Species Density and Mixl. **See attached specification**

Notes: ______

R0017758

9.0 RETENTION POND (RP)— SEDIMENTATION FACILITY

9.1 Description

A Retention Pond (RP) is a sedimentation facility and a form of a treatment plant that has a permanent pool of water that is replaced with stormwater, in part or in total, during storm runoff events. In addition, a temporary detention volume is provided above this permanent pool to capture storm runoff and enhance sedimentation. RPs are similar to EDBs because they are designed to capture in total, as a surcharge to the pond, runoff from frequently occurring storms. However, RPs differ from extended detention basins (EDBs) because the influent water mixes with the permanent pool water as it rises above the permanent pool level. The surcharge captured volume above the permanent pool is then released over 12 hours.

RPs require a dry-weather base flow to maintain the permanent pool. They can be very effective in removing pollutants, and, under the proper conditions, can satisfy multiple objectives.

9.2 General Application

A RP can be used to improve the quality of urban runoff from roads, parking lots, residential neighborhoods, commercial areas, and industrial sites and is generally used as regional or follow-up treatment because of the base-flow requirements. It can be used as an onsite BMP if the owner provides sufficient water to keep the pond full between storms. A RP works well in conjunction with other BMPs, such as upstream onsite source controls and downstream filter basins or wetland channels.

R0017759

9.3 Advantages/Disadvantages

9.3.1 General. A RP can be cost-effective for larger tributary watersheds. It provides the following:

- Achieves moderate to high removal rates of many urban pollutants
- Creates wildlife habitat opportunities
- Provides recreation, aesthetics, and open space opportunities
- Be a part of a larger flood control basin

Their primary disadvantages include safety concerns, more difficult maintenance sediment removal than for EDBs, floating litter, scum and algal blooms, possible nuisance odors and possible mosquito problems. Aquatic plant growth can be a factor in clogging outlet works. The permanent pool can attract water fowl, which can add to the nutrient load entering and leaving the pond.

9.3.2 Physical Site Suitability. Although site suitability concerns are similar to those stated for an EDB, a RP has one primary difference— it requires sufficient continuous base flow to maintain the pool. A complete water budget under the projected urbanized watershed conditions should be performed to assure that the base flow will exceed evaporation, evapotranspiration, and seepage losses.

9.3.3 Pollutant Removal. See Table SQ-6 for pollutant removal ranges. A RP achieves moderate to high removal rates for particulate matter through sedimentation during and shortly after the runoff event. During a storm event, a portion or all of the permanent pool water is displaced and the pool becomes a mixture of the former pool water and new runoff. The period between storms allows biological uptake of soluble nutrients and metals from the water column in the permanent pool while also providing time for quiescent settling of fine sediment particles that remain in the pool after a storm. Some of the sediment can resuspend and soluble compounds can remobilize if a large storm event causes intense mixing or when unfavorable chemical conditions exist in the pool (such as low dissolved oxygen [DO] or pH). Also, algal growth and other biological activity can produce suspended solids and increased concentrations of certain forms of phosphates and nitrogen compounds in dry-weather base flow discharges from the pond.

Without a sufficient continuous base flow, a wet pond can concentrate levels of salts and algae between storm events through evaporation. Besides contributing to nuisance problems, the water quality of the pool is very important. A storm event will displace any concentrated pond water, and in some instances, can result in discharges of water with pollutant concentrations exceeding the inflow, exactly the opposite of the intent for providing this BMP.

9.3.4 Aesthetics and Multiple Uses. A RP offers improved aesthetics and multiple-uses beyond those typically found at an EDB. The bulk of the capture volume occurs as a surcharge above the permanent pool, with some of it occurring above the dry-weather bank areas. As a result, most of the sediment deposits are left behind within the permanent pool zone, where they are not seen by the public. Also, the permanent pool offers some aquatic habitat and is a habitat for water fowl. However, water fowl can be a nuisance because of the fecal matter they deposit on the banks and in the pool.

9.4 Design Considerations

The required total basin design volume of a RP facility includes the volume needed for a permanent pool (≥water quality capture volume) plus a water quality capture volume as a surcharge above the permanent pool. If desired, a flood routing detention volume can be provided above the water quality capture volume.

Whenever desirable and feasible, incorporate the RP within a larger flood control basin. Also, whenever possible try to provide for other urban uses such as active or passive recreation, and wildlife habitat. Try to locate recreational areas to limit the frequency of inundation to one or two occurrences a year. Generally, the area within the water quality capture volume is not well suited for active recreation facilities such as ballparks, playing fields, and picnic areas. These should be located above this pool level.

Land requirements are typically 0.5 to 2 percent of the tributary watershed's area. High exfiltration rates can initially make it difficult to maintain a permanent pool in a new RP, but the bottom can eventually seal with fine sediment and become relatively impermeable over time. It is best, however, to seal the bottom and the sides of a permanent pool if the pool is located on permeable soils and to leave the areas above the permanent pool unsealed to promote exfiltration of the stormwater detained in the surcharge water quality capture volume.

There are two primary differences in design between a RP and an EDB:

- The RP requires a base flow to maintain and to flush a permanent pool.
- A RP is designed to empty the surcharge water quality capture volume over a 12-hour period, instead of the longer 40 hours needed for an EDB. The reason for this is that the sediment removal process is more efficient when the outflow occurs above the bottom of the basin. Sediments become trapped below the outlet and sedimentation continues in the pool after the captured surcharge volume is emptied.

Figure RP-1 shows a representative layout for a RP. Although flood storage has not been addressed in these recommendations for the same reasons mentioned under EDBs, it can be easily provided for above the surcharge water quality capture volume. Embankment design and safety design considerations for a RP are identical to those discussed for an EDB, except more attention should be given to cutoff collars on the outlet pipe to safeguard against piping along the outlet.

The amount of construction activity within a basin, the erosion control measures implemented, and the size of the basin will influence the frequency of sediment removal from the pond. It is estimated that accumulated sediment will need to be removed at 5- to 20-year intervals if there are no construction activities within the tributary catchment.

9.5 Design Procedure and Criteria

The following steps outline the design procedure and criteria for a RP.

1. Basin Surcharge Storage Volume

Provide a storage volume equal to the WQCV based on a 12-hour drain time, above the lowest outlet (i.e., perforation) in the basin.

A. Determine the WQCV using the tributary catchment's percent imperviousness. Account for the effects of DCIA, if any, on Effective Imperviousness. Using Figure ND-1, determine the reduction in impervious area to use with WQCV calculations.

B. Find the required storage surcharge volume (watershed inches of runoff).

Determine the required water quality capture volume in watershed inches of runoff using Figure RP-2, based on the RP, 12-hour drain time. The water quality capture volume is the surcharge volume above the permanent pool.

Calculate the design surcharge volume in acre-feet as follows:

$$Design\ Surcharge\ Volume = \left(\frac{WQCV_i}{12} \right) * Area$$

In which:

$WQCQ_i$ = Water quality capture volume from Figure RP-2 in watershed inches

$Area$ = The tributary drainage area tributary to the RP (acres).

2. Permanent Pool

The permanent pool provides stormwater quality enhancement between storm runoff events through biochemical processes and continuing sedimentation.

A. Volume of the permanent pool:

$$Permanent\ Pool = 1.0\ to\ 1.5\ (WQCV)$$

B. Depth Zones: The permanent pool shall have two depth zones:

1. A littoral zone 6 to 12 inches deep that is between 25 to 40 percent of the permanent pool surface area for aquatic plant growth along the perimeter of the permanent pool, and
2. A deeper zone of 4 to 8 feet average depth in the remaining pond area to promote sedimentation and nutrient uptake by phytoplankton. Maximum depth in the pond shall not exceed 12 feet.

R0017762

3. Base Flow

A net influx of water must be available through a perennial base flow and must exceed the losses. The following equation and parameters can be used to estimate the net quantity of baseflow available at a site:

$$Q_{Net} = Q_{Inflow} - Q_{Evap} - Q_{Seepage} - Q_{E.T.}$$

In which:

Q_{net} = Net quantity of base flow (acre-ft/year)

Q_{inflow} = Estimated base flow (acre-ft/year) (Estimate by seasonal measurements and/or comparison to similar watersheds)

Q_{evap} = Loss because of evaporation less the precipitation (acre-ft/year) (Computed for average water surface)

$Q_{Seepage}$ = Loss (or gain) because of seepage to groundwater (ac-ft/year)

$Q_{E.T.}$ = Loss because of plant evapotranspiration (additional loss through plant area above water surface not including the water surface)

4. Outlet Works

The Outlet Works are to be designed to release the WQCV (above the permanent pool elevation) over a 12-hour period. Refer to the *Water Quality Structure Details* section for schematics pertaining to structure geometry; grates, trash racks, and screens; outlet type: orifice plate or perforated riser pipe; cutoff collar size and location; and all other necessary components.

For a perforated outlet, use Figure RP-3 to calculate the required area per row based on WQCV and the depth of perforations at the outlet. See the *Water Quality Structure Details* section to determine the appropriate perforation geometry and number of rows (The lowest perforations should be set at the water surface elevation of the permanent pool). The total outlet area can then be calculated by multiplying the the area per row by the number of rows.

5. Trash Rack

Provide a trash rack of sufficient size to prevent clogging of the primary water quality outlet. Size the rack so as not to interfere with the hydraulic capacity of the outlet. Using the total outlet area and the selected perforation diameter (or height), Figures 6, 6a or 7 in the *Water Quality Structure Details* section will help to detemrine the minimum open area required for the trash rack. If a perforated vertical plate or riser is used as suggested in the *Manual*, use one-half of the total outlet area to calculate the trash rack's size. This accounts for the variable inundation of the outlet orifices. Figures 6 and 6a were developed as suggested standardized outlet designs for smaller sites.Basin Slope Shape the pond with a gradual expansion from the inlet and a gradual contraction toward the outlet, thereby limiting short circuiting. The basin length to width ratio between the inlet and outlet should be between 2:1 and 3:1, with the larger being preferred. It may be necessary to modify the inlet and outlet pointed through the use of pipes, swales, or channels to accomplish this.

6.	Basin Side Slopes	Side slopes should be stable and sufficiently gentle to limit rill erosion and to facilitate maintenance. Side slopes above the permanent pool should be no steeper than 4:1, preferably 5:1 or flatter. The littoral zone should be very flat (that is, 40:1 or flatter) with the depth ranging from 6 inches near the shore and extending to no more than 12 inches at the furthest point from the shore. The side slope below the littoral zone shall be 3:1 or flatter.
7.	Dam Embankment	The embankment should be designed not to fail during a 100-year or larger storm. Embankment slopes should be no steeper than 3:1, preferably 4:1 or flatter, covered with turf-forming grasses to limit erosion. Poorly compacted native soils should be removed and replaced. Embankment soils should be compacted to 95 percent of their maximum density according to ASTM D 698-70 (modified proctor).
8.	Vegetation	Vegetation provides erosion control and enhances site stability. Berms and side-sloping areas should be planted with native turf-forming grasses or irrigated turf, depending on the local setting and proposed uses for the pond area. The shallow littoral bench should have a 4- to 6-ing organic topsoil layer and be vegetated with aquatic species.
9.	Maintenance Access	Access to the basin bottom, forebay, and outlet area must be provided to maintenance vehicles. Maximum grades should be 10 percent, and a solid driving surface of gravel, rock, concrete, or gravel stabilized turf should be provided.
10.	Inlet	Dissipate flow energy at the inlet to limit erosion and to diffuse the inflow plume where it enters the pond. Inlets should be designed in accordance with *USDCM* drop-structure and energy-dissipating structure criteria in Volume 2.
11.	Forebay Design	To provide an opportunity for larger particles to settle out, install an area that has a solid driving surface bottom to facilitate sediment removal. A berm consisting of rock and topsoil mixture should be part of the littoral bench to create the forebay and have a minimum top width of 8 feet and side slopes no steeper than 4:1. The forebay volume of the permanent pool should be 5 to 10 percent of the design water quality capture volume.
12.	Underdrains	Provide underdrain trenches near the edge of the pond. The trenches should be no less than 12 inches wide filled with ASTM C-33 sand to within 2 feet of the ponds permanent pool water surface, and with an underdrain pipe connected through a valve to the outlet. These underdrains will permit the drying out of the pond when it has to be "mucked out" to restore volume lost due to sediment deposition.

9.6 Design Example

Design forms that provide a means of documenting the design procedure are included in the Design Forms section. A completed form follows as a design example.

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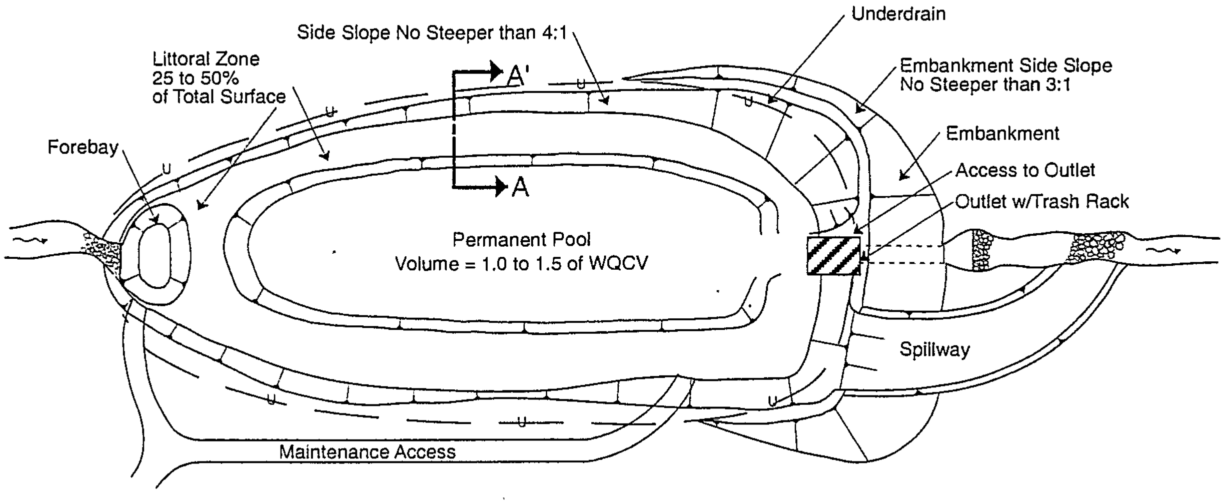
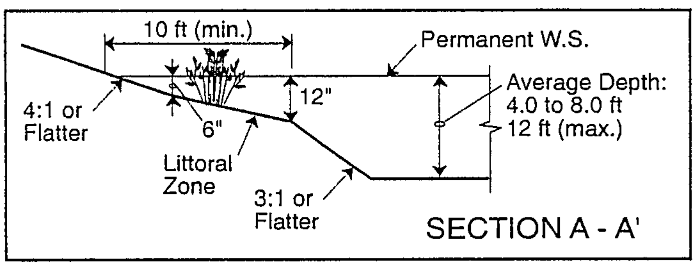
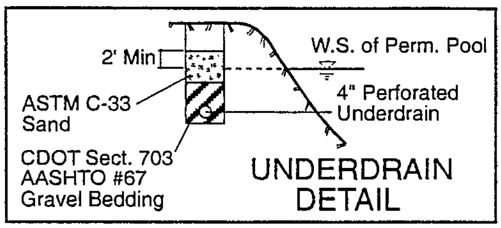
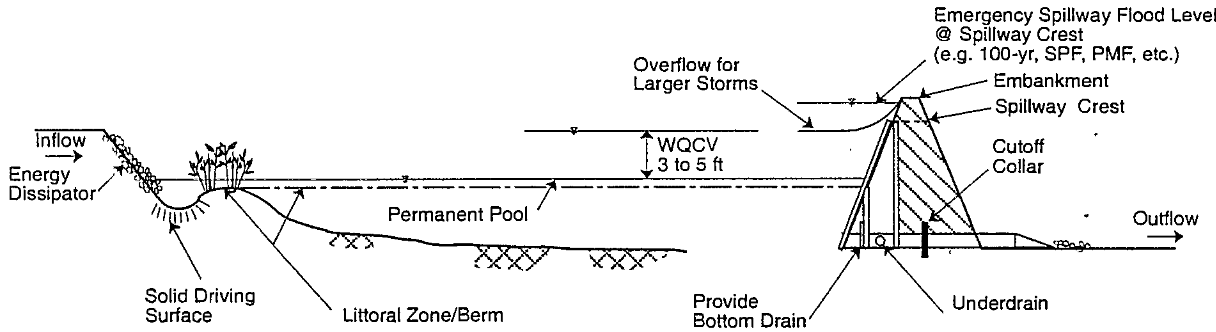


PLAN
NOT TO SCALE







SECTION
NOT TO SCALE

FIGURE RP-1
Plan and Section of a Wet Extended Detention Basin

R0017765

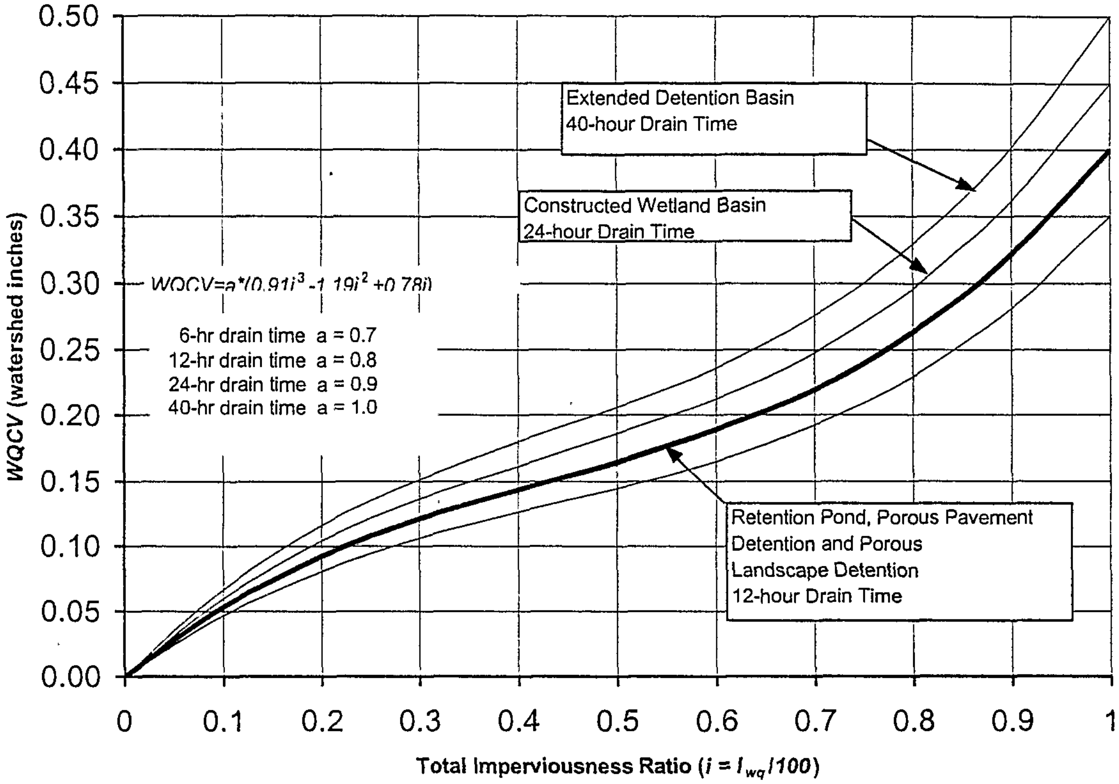
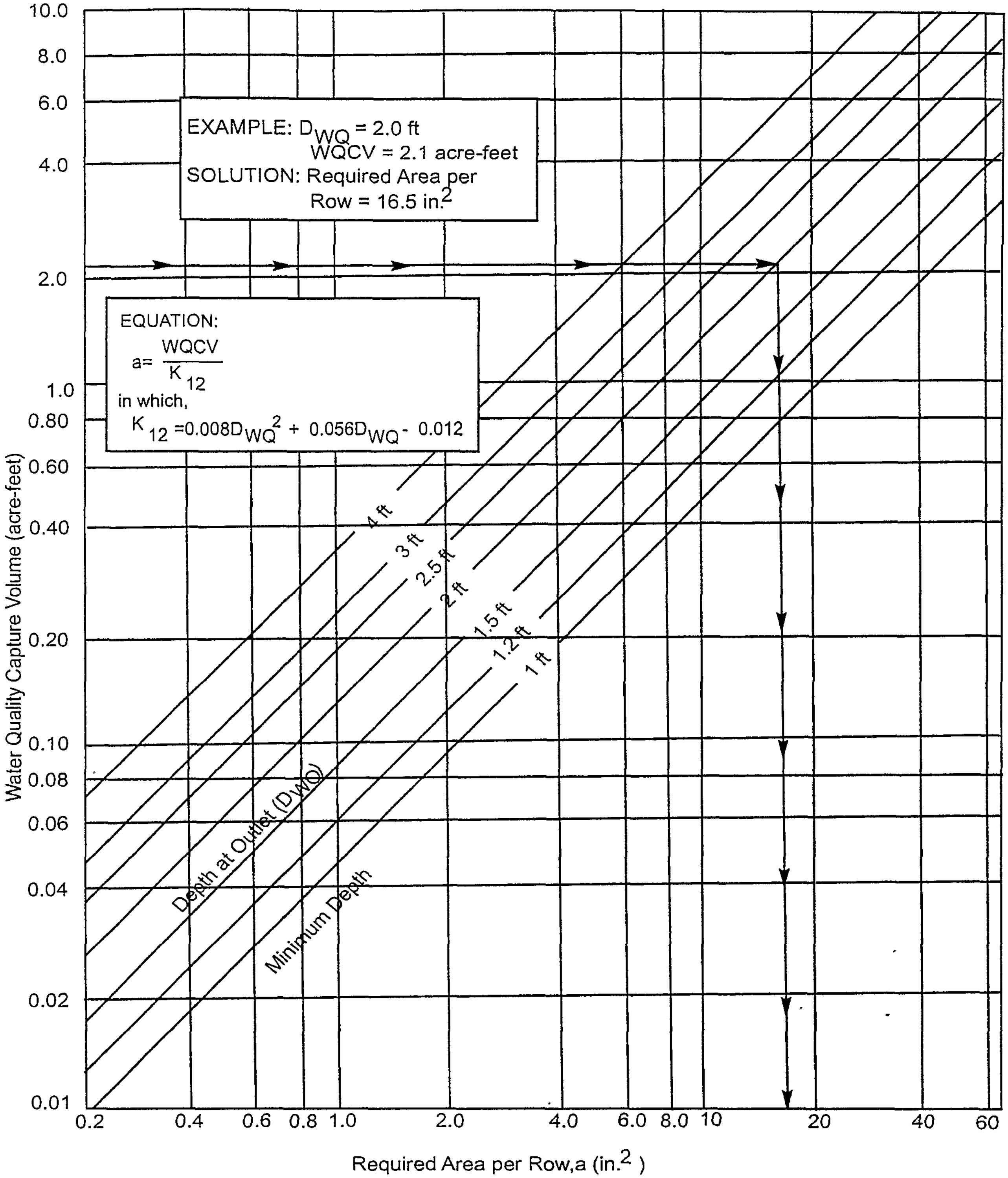


FIGURE RP-2

Water Quality Capture Volume (WQCV), 80th Percentile Runoff Event



Source: *Douglas County Storm Drainage and Technical Criteria*, 1986.

FIGURE RP-3
Water Quality Outlet Sizing: Wet Extended Detention Basin Retention Pond With a 12-Hour Drain Time of the Capture Volume

R0017767

Design Procedure Form: Retention Pond (RP) - Sedimentation Facility (Sheet 1 of 3)

Designer: ______
Company: ______
Date: September 22, 1999
Project: ______
Location: ______

1. Basin Storage Volume	
A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	I_a = 50.00 % i = 0.50
B) Contributing Watershed Area (Area)	Area = 100.00 acres
C) Water Quality Capture Volume (WQCV) ($WQCV = 0.8 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)$)	WQCV = 0.17 watershed inches
D) Design Volume: Vol = (WQCV / 12) * Area	Vol = 1.38 acre-feet
2. Permanent Pool	
A) Volume: $Vol_{Pool} = (1.0 \text{ to } 1.5) * Vol$	1.40 acre-feet
B) Average Depth Zone 1 = Littoral Zone - 6 to 12 inches deep Zone 2 = Deeper Zone - 4 feet to 8 feet deep	0.75 feet Zone 2 6.00 feet
C) Maximum Zone 2 Pool Depth (not to exceed 12 feet)	Depth = 9.00 feet
D) Permanent Pool Water Surface Area (Estimated Minimum) (Zone 1 - Littoral Zone = 25% to 40% of the total surface area) (Zone 2 - Deeper Zone = 60% to 75% of the total surface area)	 % = 37.3 acres = 0.129 % = 62.7 acres = 0.217
Total Estimated Minimum Surface Area (A_{Total})	% = 100.0 acres = 0.346
3. Annual/Seasonal Water Balance (Q_{net} has to be positive)	Q_{inflow} 181.00 acre-feet/year Q_{evap} 1.30 acre-feet/year $Q_{seepage}$ 2.10 acre-feet/year $Q_{E.T.}$ 0.80 acre-feet/year Q_{net} 176.80 acre-feet/year
2. Outlet Works	
A) Outlet Type (Check One)	___ Orifice Plate X Perforated Riser Pipe ___ Other: ______
B) Depth at Outlet Above Lowest Perforation (H)	H = 4.00 feet
C) Required Maximum Outlet Area per Row, (A_o)	A_o = 1.99 square inches
D) Perforation Dimensions (**enter one only**): i) Circular Perforation Diameter **OR** ii) 2" Height Rectangular Perforation Width	 D = 1.1250 inches, **OR** W = ______ inches
E) Number of Columns (nc)	nc = 2 Number

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Design Procedure Form: Retention Pond (RP) - Sedimentation Facility (Sheet 2 of 3)

Designer: ____________
Company: ____________
Date: September 13, 1999
Project: .
Location: 0

F) Actual Design Outlet Area per Row (A_o)	A_o = 1.99 square inches
G) Number of Rows (nr)	nr = 12 Number
H) Total Outlet Area (A_{ot})	A_{ot} = 23.86 square inches
5. Trash Rack	
A) Needed Open Area: A_t = 0.5 * (Figure 7 Value) * A_{ot}	A_t = 799 square inches
B) Type of Outlet Opening (Check One)	X ≤ 2" Diameter **Round** ___ 2" High **Rectangular** ___ Other: ____
C) For 2", or Smaller, **Round Opening** (Ref.: Figure 6a):	
i) Width of Trash Rack and Concrete Opening (W_{conc}) from Table 6a-1	W_{conc} = 24 inches
ii) Height of Trash Rack Screen (H_{TR})	H_{TR} = 72 inches
iii) Type of Screen (Based on Depth H), Describe if "Other"	X S.S. #93 VEE Wire (US Filter) ___ Other: ____
iv) Screen Opening Slot Dimension, Describe if "Other"	X 0.139" (US Filter) ___ Other: ____
v) Spacing of Support Rod (O.C.) Type and Size of Support Rod (Ref.: Table 6a-2)	1 inches **TE 0.074 in. x 0.75 in.**
vi) Type and Size of Holding Frame (Ref.: Table 6a-2)	**1.00 in. x 1.50 in. angle**
D) For 2" High **Rectangular Opening** (Refer to Figure 6b):	
i) Width of Rectangular Opening form 4.D.ii. (W)	W = ____ inches
ii) Width of Perforated Plate Opening (W_{conc} = W + 12")	W_{conc} = ____ inches
iii) Width of Trash Rack Opening ($W_{opening}$) from Table 6b-1	$W_{opening}$ = ____ inches
iv) Height of Trash Rack Screen (H_{TR})	H_{TR} = ____ inches
v) Type of Screen (based on depth H) (Describe if "Other")	___ Klemp™ KPP Series Aluminum ___ Other: ____ 96.00
vi) Cross-bar Spacing (Based on Table 6b-1, Klemp™ KPP Grating). Describe if "Other"	___ inches ___ Other: ____

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Design Procedure Form: Retention Pond (RP) - Sedimentation Facility (Sheet 3 of 3)

Designer: ____________
Company: ____________
Date: September 22, 1999
Project: ____________
Location: ____________

vii) Minimum Bearing Bar Size (Klemp™ Series, Table 6a-2) (Base on depth of WQCV surcharge)	____________
6. Basin length to width ratio	1.80 (L/W)
7. Basin Side Slopes (Z:1) A) Above the Permanent Pool: Z= B) Below the Permanent Pool Z= Z=	 5.0 (horizontal/vertical) Zone 1= 5.0 (horizontal/vertical) Zone 2= 3.0 (horizontal/vertical)
8. Dam Embankment Side Slopes Z=	4.0 (horizontal/vertical)
9. Vegetation (Check the type used or describe if "Other")	____ Native Grass X Irrigated Turf Grass X Emergent Aquatic Species* ____ Other: ____________ *Specify types and densities: **See attached specification**
12. Forebay Storage (5% to 10% of Design Volume in 1D)	Storage= 0.12 acre-feet
13. Underdrains	Yes yes/no

Notes: ____________

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10.0 CONSTRUCTED WETLANDS CHANNEL (CWC)— SEDIMENTATION FACILITY

10.1 Description

Constructed wetland-bottomed channels takes advantage of dense natural vegetation (rushes, willows, cattails, and reeds) to slow down runoff and allow time for settling out sediment and biological uptake. It is another form of a sedimentation facility and a treatment plant.

Constructed wetlands differ from "natural" wetlands as they are artificial and are built to enhance stormwater quality. Sometimes small wetlands that exist along ephemeral drainageways on Colorado's high plains may be enlarged and incorporated into the constructed wetland system. Such action, however, requires the approval of federal and state regulators.

Regulations intended to protect natural wetlands recognize a separate classification of wetlands constructed for a water quality treatment. Such wetlands generally are not allowed to be used to mitigate the loss of natural wetlands but are allowed to be disturbed by maintenance activities. Therefore, the legal and regulatory status of maintaining a wetland constructed for the primary purpose of water quality enhancement is separate from the disturbance of a natural wetland. Nevertheless, any activity that disturbs a constructed wetland should be first cleared through the U.S. Army Corps of Engineers to ensure it is covered by some form of an individual, general, or nationwide 404 permit.

10.2 General Application

Wetland bottom channels can be used in the following two ways:

- A wetland can be established in a totally man-made channel and can act as a conveyance system and water quality enhancement facility. This design can be used along wide and gently sloping channels.

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- A wetland bottom channel can be located downstream of a stormwater detention facility (water quality and/or flood control) where a large portion of the sediment load can be removed. The wetland channel then receives stormwater and base flows as they drain from the detention facility, provides water quality enhancement, and at the same time conveys it downstream. This application of a wetland channel is recommended upstream of receiving waters and within lesser (i.e., ephemeral) receiving waters, thereby delivering better quality water to the more significant receiving water system.

A CWC requires a net influx of water to maintain their vegetation and microorganisms. A complete water budget analysis is necessary to ensure the adequacy of the base flow.

10.3 Advantages/Disadvantages

10.3.1 General. Constructed wetlands offer several potential advantages, such as natural aesthetic qualities, wildlife habitat, erosion control, and pollutant removal. Constructed wetlands provide an effective follow-up treatment to onsite and source control BMPs that rely upon settling of larger sediment particles. In other words, they offer yet another effective BMP for larger tributary basins.

The primary drawback to wetlands is the need for a continuous base flow to ensure their presence. In addition, salts and scum can accumulate and unless properly designed and built, can be flushed out during larger storms.

Other disadvantages include the need for regular maintenance to provide nutrient removal. Regular harvesting and removal of aquatic plants, cattails, and willows is required if the removal of nutrients in significant amounts has to be assured. Even with that, recent data puts into question the net effectiveness of wetlands in removing nitrogen compounds and some form of phosphates. Periodic sediment removal is also necessary to maintain the proper distribution of growth zones and of water movement within the wetland.

10.3.2 Physical Site Suitability. A perennial base flow is needed to sustain a wetland, and should be determined using a water budget analysis. Loamy soils are needed in wetland bottom to permit plants to take root. Infiltration through a wetland bottom cannot be relied upon because the bottom is either covered by soils of low permeability or because the groundwater is higher than the wetland's bottom. Wetland bottom channels also require a near-zero longitudinal slope; drop structures are used to create and maintain a flat grade.

10.3.3 Pollutant Removal. Removal efficiencies of constructed wetlands vary significantly. Primary variables influencing removal efficiencies include design, influent concentrations, hydrology, soils, climate, and maintenance. With periodic sediment removal and plant harvesting, expected removal efficiencies for sediments, organic matter, and metals can be moderate to high; for phosphorous, low to moderate; and for nitrogen, zero to low. Pollutants are removed primarily through sedimentation and

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entrapment, with some of the removal occurring through biological uptake by vegetation and microorganisms. Without a continuous dry-weather base flow, salts and algae can concentrate in the water column and can be released into the receiving water in higher levels at the beginning of a storm event as they are washed out.

Harvesting aquatic plants and periodic removal of sediment also removes nutrients and pollutants associated with the sediment. Researchers still do not agree that routine aquatic plant harvesting affects pollutant removals. Until research documents these effects, periodic harvesting for the general upkeep of wetland, and not routine harvesting of aquatic plants, is recommended.

10.4 Design Considerations

Wetlands can be set into a drainageway to form a wetland bottom channel (see Figure CWC-1). The criteria for a wetland bottom channel presented in the following section differs somewhat from the criteria presented in Volume 2 of the *USDCM* under the *Major Drainage* chapter. This is because of the water quality focus of this BMP. An analysis of the water budget is needed so that the inflow of water throughout the year is sufficient to meet all the projected losses (such as evaporation, evapotranspiration, and seepage). An insufficient base flow could cause the wetland bottom channel to dry out and die.

10.5 Design Procedure and Criteria

The following steps outline the Constructed Wetlands Channel design procedure. Refer to Figure CWC-1 for its design components.

1. Design Discharge — Determine the 2-year peak flow rate in the wetland channel *without* reducing it for any upstream ponding or flood routing effects.

2. Channel Geometry — Define the newly-built channel's geometry to pass the design 2 -year flow rate at 2.0 feet per second with a channel depth between 2.0 to 4.0 feet. The channel cross-section should be trapezoidal with side slopes of 4:1 (Horizontal/Vertical) or flatter. Bottom width shall be no less than 8.0 feet.

3. Longitudinal Slope — Set the longitudinal slope using Mannings equation and a Mannings roughness coefficient of n=0.03, for the 2-year flow rate. If the desired longitudinal slope can not be satisfied with existing terrain, grade control checks or small drop structures must be incorporated to provide desired slope.

4. Final Channel Capacity — Calculate the final (or mature) channel capacity during a 2-year flood using a Mannings roughness coefficient of n=0.08 and the same geometry and slope used when initially designing the channel with n=0.03. The channel shall also provide enough capacity to contain the flow during a 100-year flood while maintaining one foot of free-board. Adjustment of the channel capacity may be done by increasing the bottom width of the channel. Minimum bottom width shall be 8 feet.

5. Drop Structures	Drop structures should be designed to satisfy the drop structure criteria of the *Major Drainage* chapter in Volume 2 of the *USDCM.*
6. Vegetation	Vegetate the channel bottom and side slopes to provide solid entrapment and biological nutrient uptake. Cover the channel bottom with loamy soils upon which cattails, sedges, and reeds should be established. Side slopes should be planted with native or irrigated turf grasses.
7. Maintenance Access	Provide access for maintenance along the channel length. Maximum grades for maintenance vehicles should be 10 percent and provide a solid driving surface.

10.6 Design Example

Design forms that provide a means of documenting the design procedure are included in the Design Forms section. A completed form follows as a design example.

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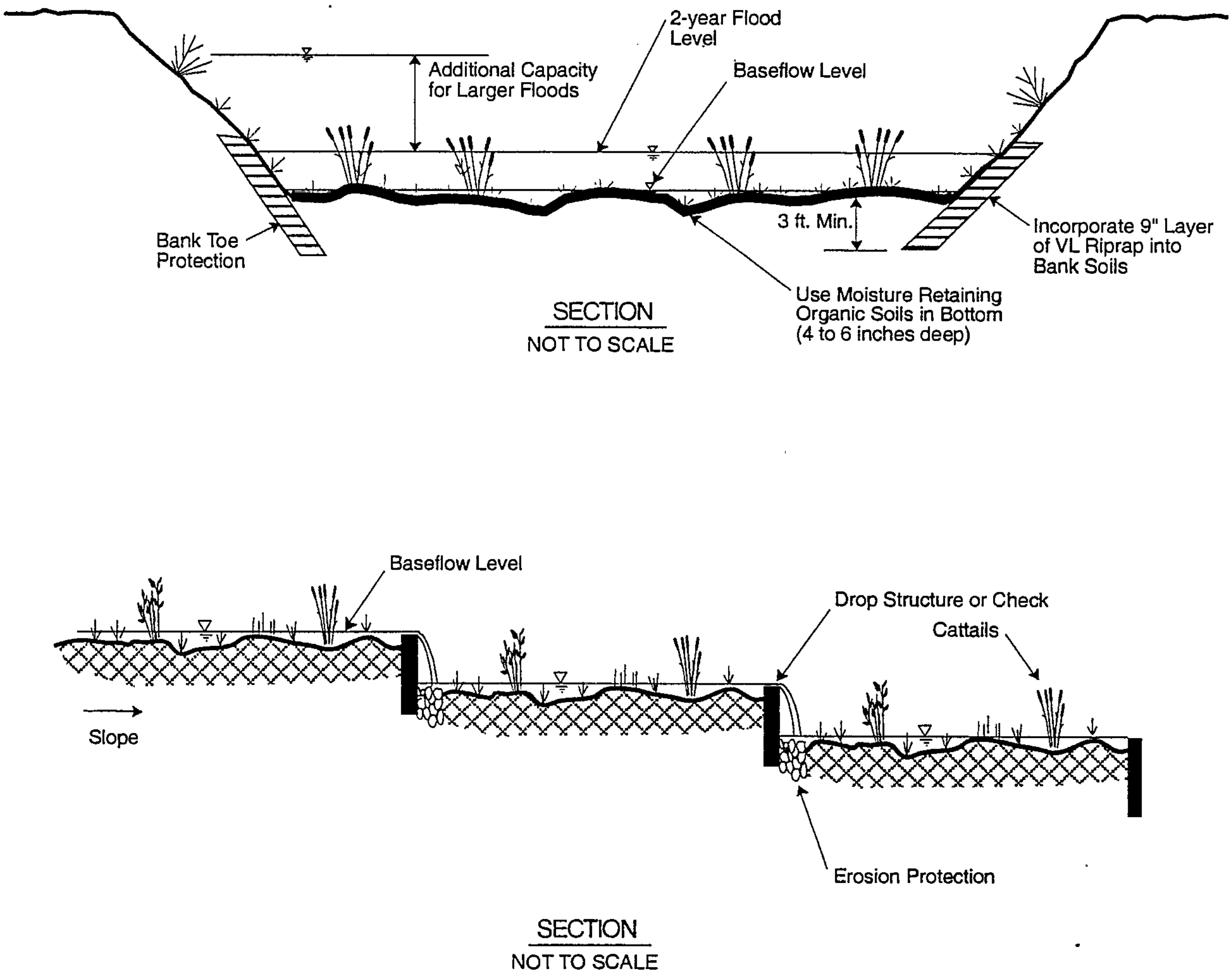

FIGURE CWC-1
Plan and Section of a Constructed Wetland Channel

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Design Procedure Form: Constructed Wetlands Channel (CWC) - Sedimentation Facility

Designer: ____________
Company: ____________
Date: September 22, 1999
Project: ____________
Location: ____________

1. Design Discharge (total)	Q_2 = 200 cfs Q_{100} = 1,600 cfs
2. Channel Geometry (New Channel - No Wetland Veg. in Bottom)	
A) Channel Side Slopes (Z:1, i.e., H/V) ($Z \geq 2.5$)	Z = 3.0 (horizontal/vertical)
B) 2-Year Design Flow Depth (D_2) Maximum D_2 = 4', Minimum D_2 = 2'	D_2 = 4.00 feet
C) Bottom width of the channel (B_2) - 8-foot minimum	B_2 = 8.0 feet
D) Top width of the 2-Year Design Water Surface (W_2)	W_2 = 32.0 feet
3. Longitudinal Slope (Based on a Manning's n = 0.03 for the 2-year Channel, velocity set to 2 fps)	S = 0.0005 feet/feet
4. Final Channel Goemetry - Wetland Vegetation in Bottom) (Based on a Manning's n = 0.08) A) Calculated channel geometry required to maintain design discharge during a 2-year event with mature vegetation	Z = 3.0 feet D_2 = 4.0 feet B_2 = 43.5 feet W_2 = 67.5 feet
B) Calculated discharge and velocity during a 2-year event with mature vegetation	Q_2 = 200 cfs V_2 = 0.9 fps
C) Geometry and velocity to use for the 100-year discharge if composite channel section is used.	D_{100} = 10.2 feet B_{100} = 43.5 feet W_{100} = 126.2 feet V_{100} = 2.2 fps
5. Number of grade control structures required	4 number
6. Vegetation (Check the type or describe "Other")	X Native Grass ___ Irrigated Turf Grass X Wetland Species ___ Other: ____________

Notes: ____________

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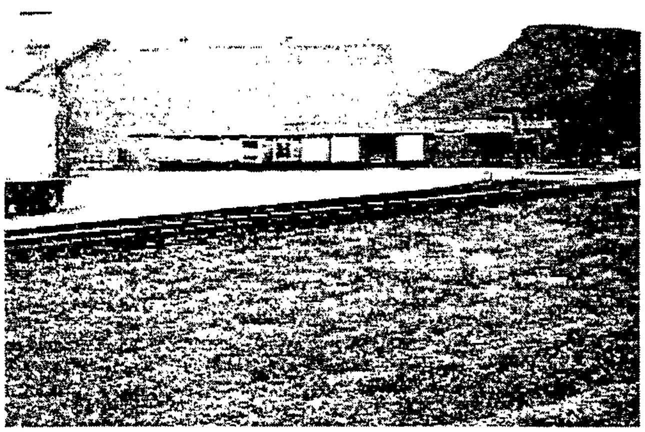
11.0 COVERING OF STORAGE/HANDLING AREAS



11.1 Description

Covering of areas for storage and for handling facilities associated with potential industrial or commercial pollutants, such as salt piles, oil products, pesticides, fertilizers, etc. will reduce the likelihood of storm water contamination and will prevent loss of material from wind or rainfall erosion. Coverings can be permanent or temporary and consist of tarpaulins, plastic sheeting, roofing, enclosed structures, or any other device that prevent rain and wind from spreading possible contamination.

11.2 General Application

Covering is appropriate for areas where solids (gravel, salt, compost, building materials, etc.) or liquids (oil, gas, tar, etc.) are stored, prepared, or transferred.

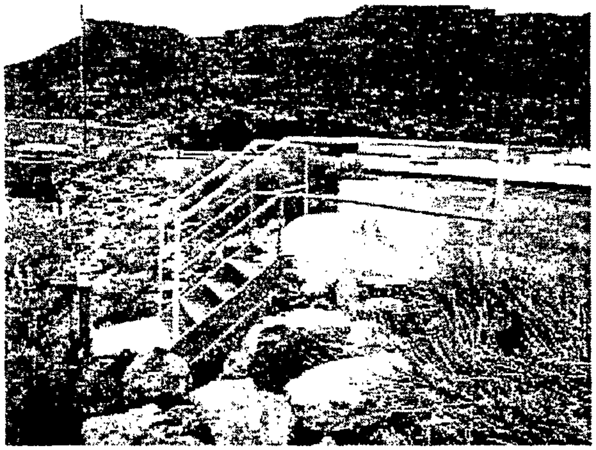
11.3 Advantages/Disadvantages

11.3.1 General. Coverings can be inexpensive and easy to install. When an enclosed structure is built, ventilation, lighting, and other issues must be accounted for. Less expensive coverings (tarpaulins, plastic sheeting, etc.) may require frequent inspection and maintenance.

11.3.2 Physical Site Suitability. The size of the area to be covered will determine the most efficient and cost effective type of covering. If the area is too large to be entirely covered, at a minimum the critical areas should be covered.

11.3.3 Pollutant Removal. Spill containment berming can be installed around the covered area to contain spills until proper removal and disposal can occur.

12.0 SPILL CONTAINMENT AND CONTROL



12.1 Description

Spill containment within industrial and some commercial sites consists of berming and gates that allow for the control of spilled material. Berming consists of temporary or permanent curbs or dikes that surround a potential spill site preventing spilled material from entering surface waters or storm sewer systems. The berm may be made concrete, earthen material, metal, synthetic liners, or any material that will safely contain the spill. A potential spill site is one that allows the storage or transfer of potential spill material. Spill material is that which is not allowed into surface waters or storm sewer systems according to local, state, or federal regulations. Spill control devices include valves, slide gates, or any other device which can contain material when required and then release the spilled material in a controlled fashion.

12.2 General Application

Two methods of berming can be used: 1) containment berming that contains an entire spill and 2) curbing that routes spill material to a collection basin. Containment berming should be of sufficient size to safely contain a spill from the largest storage tank, rail car, tank truck, or other containment device located inside the possible spill area. A small collection basin should be provided for removal of storm water and leaked material.

Curbing is used to route spill material to a large collection basin. The curb should be of sufficient size to safely route a spill from the largest storage tank, rail car, tank truck, or other containment device located inside the possible spill area. A containment device must be provided to safely store the spilled material until removal is possible.

If the capacity of the containment berming or the collection basin are exceeded, a spill control device must be used. The spill control device ideally would convey flow into a portable containment device for removal of the material. However, if material is escaping the berming area through the spill control

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device, two available means of controlling a spill are to use sorbents (adsorption and absorption through chemical processes) or gelling agents (physically or chemically gel the spill material; solidification eventually occurs).

12.3 Advantages/Disadvantages

12.3.1 General. The spill containment berm is an effective means to prevent spill material from entering surface waters or storm sewer systems. In some cases, the spill material may be collected and recycled. The cost of installation and maintenance will be a function of the type of berm used.

12.3.2 Physical Site Suitability. The spill area must have an impermeable floor (asphalt or concrete) so that contamination of groundwater does not occur. If the existing conditions are insufficient to prevent seepage, an impermeable floor or liner must be installed.

12.3.3 Pollutant Removal. In the event of a spill, a method of removal must be provided, such as application of sorbent materials and the use of a pump or vacuum truck. Any material removed from the spill site must be disposed of according to local, state, and federal standards. Recycling of the spill material may be possible if contact or uptake of foreign material is minimal. Water that collects within the berming due to rainfall or snowmelt must be treated to meet standards before release from the spill area.

TYPICAL STRUCTURAL BEST MANAGEMENT PRACTICES DETAILS

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Figure 7 ....Minimum Trash Rack Opening Area – Extended Range

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Typical Outlet Structure Notes:

1. The details shown are intended to show design concepts. Preparation of final design plans, addressing details of structural adequacy, excavation, foundation preparation, concrete work, reinforcing steel,backfill, metalwork, and appurtenances, including preparation of technical specifications, are the responsibility of the design engineer.

2. Alternate designs to the typical outlet structures shown may be considered; however, alternate designs must address the hydraulic and trash handling functional elements of the structures shown in the *Manual*.

3. Wingwalls shown are intended to enable the structure to be backfilled to be flush with the side slopes of the basin, which is the recommended geometry. Other geometries may be considered if their designs related to public safety, aesthetics, maintainability, and function are equal to or better than the designs shown in the *Manual*.

4. Permanent Water Surface shown refers to micro–pool for Extended Detention Basin or permanent pool for Constructed Wetland Basin or Retention Pond.

5. An orifice plate is shown as the outflow control; however, an upturned pipe, with orifices may also be used. See Figure 4 for orifice design information.

6. A Vertical Trash Rack option is generally shown; however, an Adverse–Slope Trash Rack may also be used. Continuous–Slope Trash Racks for use with WQCV outlets are not recommended. See figure 6 for trash rack design information.

7. References are made to 2– or 10–year detention above the WQCV; however, detention above the WQCV may be sized for any storm event, according to local criteria.

8. The underdrain, including a shutoff valve, from the perimeter of the pond is required for a Wetland Basin and a Retention Pond. An underdrain, without a shutoff valve, is optional for the micro–pool and may be used to help dry the micro–pool during dry–weather periods.

9. When outlet designs differ from those shown herein:

   a) Provide needed orifices that are distributed over the vertical height of the WQCV, with the lowest orifice located at 2'–6" or more above the bottom of the micro–pool.

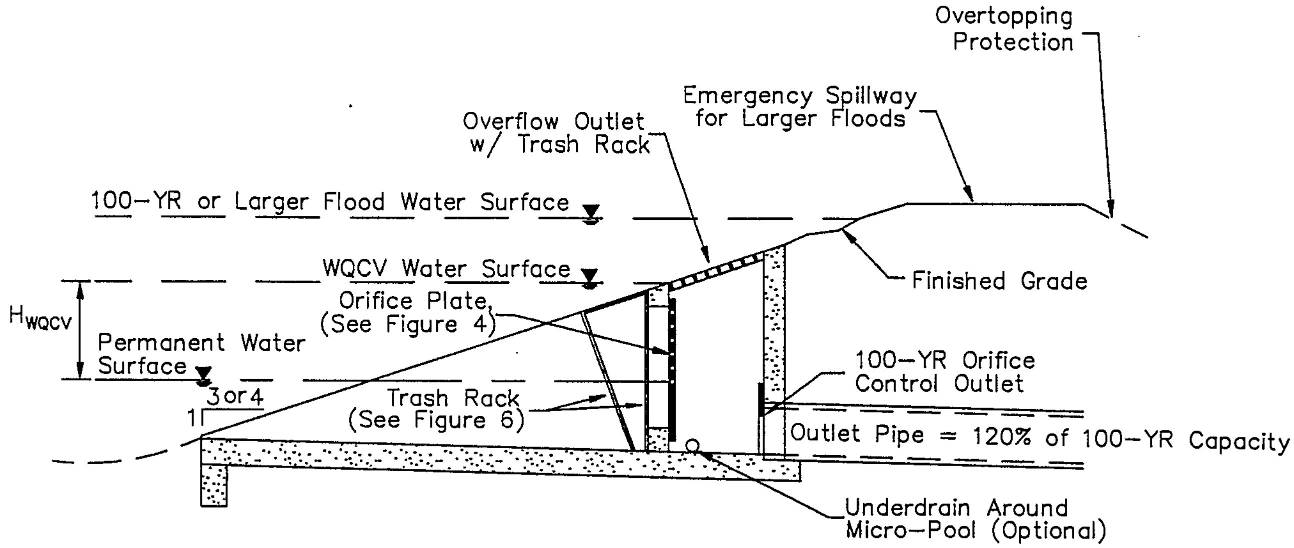
   b) Provide full hydraulic calculations demonstrating that the outlet will provide no less than the minimum required drain time of the Water Quality Capture Volume for the BMP type being designed.

   c) All outlet openings (i.e., orifices) shall be protected by a trash rack sized to provide a minimum net opening area called for by Figure 7, and all trash rack opening dimensions shall be smaller than the smallest dimension of the outlet orifices.

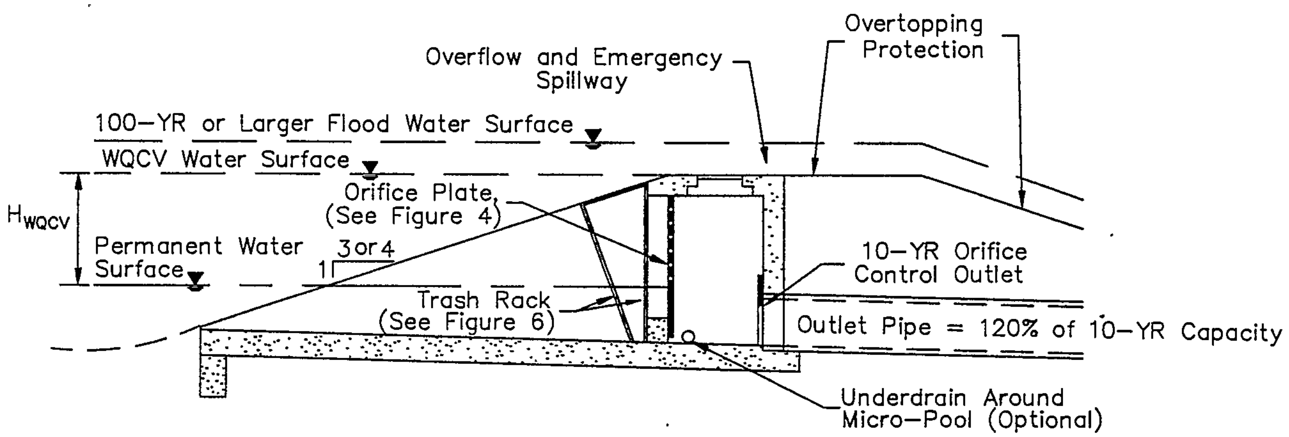
   d) Trash racks shall be manufactured from stainless steel or aluminum alloy structurally designed to not fail under a full hydrostatic load on the upstream side.

Urban Drainage and Flood Control District Drainage Criteria Manual (V.3) File: Details.dwg	Typical Outlet Structure General Notes

Note: Size 2– through 100–year overflow trash racks with the aid of figure 7.



Drop Box Outlet Option



Overtopping Spillway Option

Urban Drainage and Flood Control District Drainage Criteria Manual (V.3) File: Details.dwg	Figure 1 Typical WQCV Outlet Structure Profiles Including 100–Year Detention

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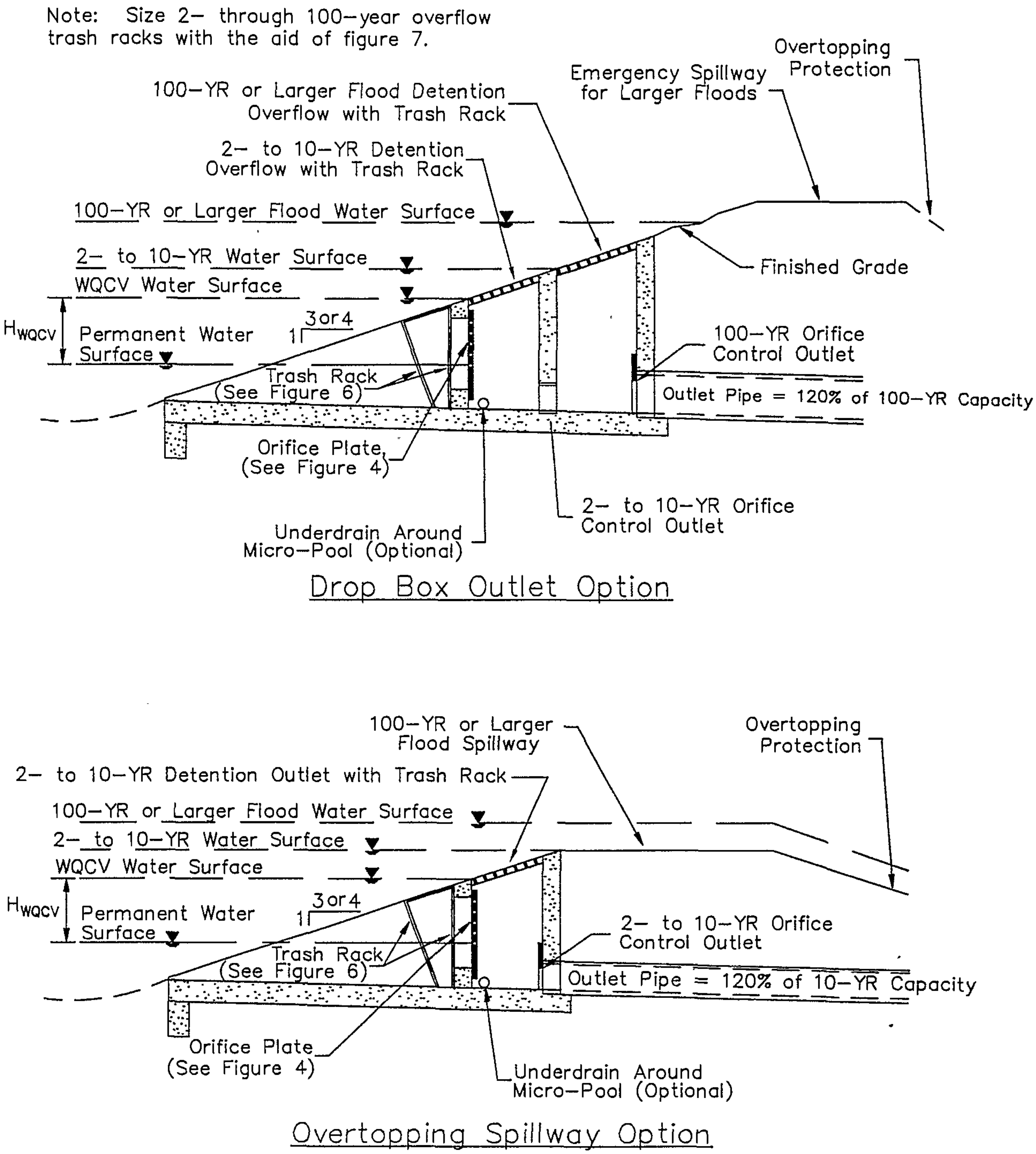
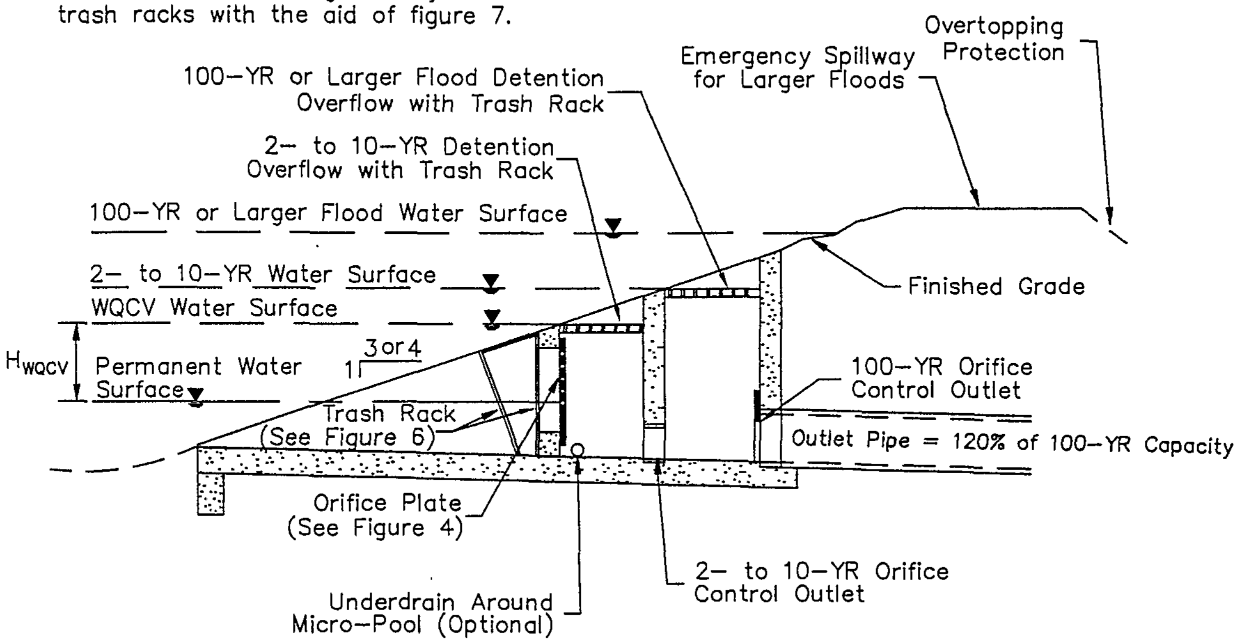


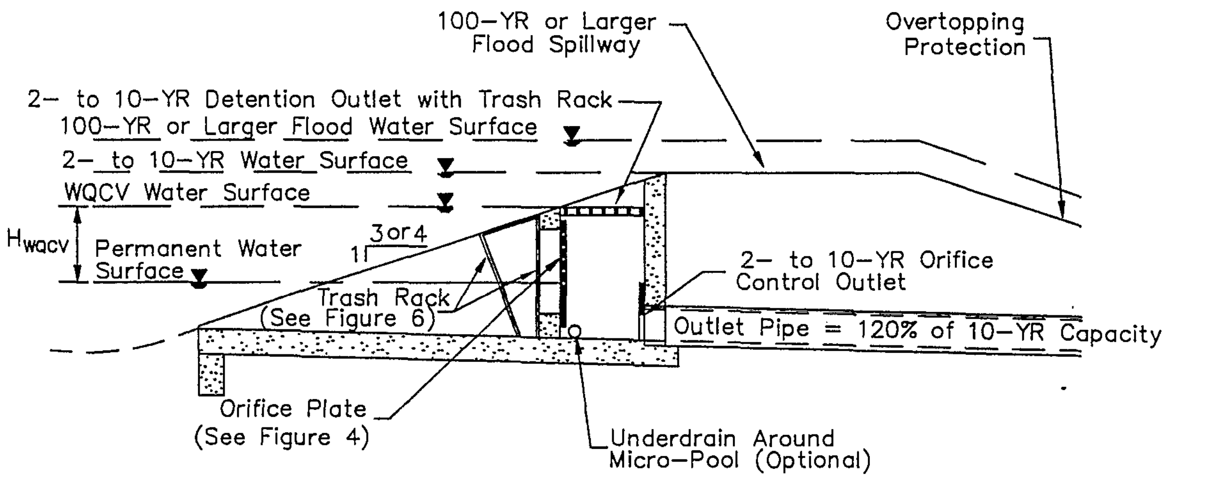
Urban Drainage and Flood Control District Drainage Criteria Manual (V.3) File: Details.dwg	Figure 2 Typical WQCV Outlet Structure Profiles Including 2– to 10–Year and 100–Year Detention

R0017783

Note: Size 2- through 100-year overflow trash racks with the aid of figure 7.



Drop Box Outlet Option



Overtopping Spillway Option

Urban Drainage and Flood Control District Drainage Criteria Manual (V.3) File: Details.dwg	Figure 2-a Alternate Typical WQCV Outlet Structure Profiles Including 2- to 10-Year and 100-Year Detention

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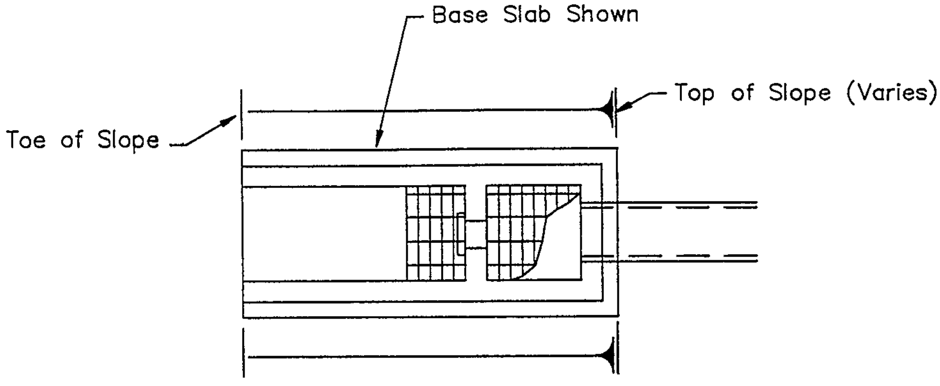
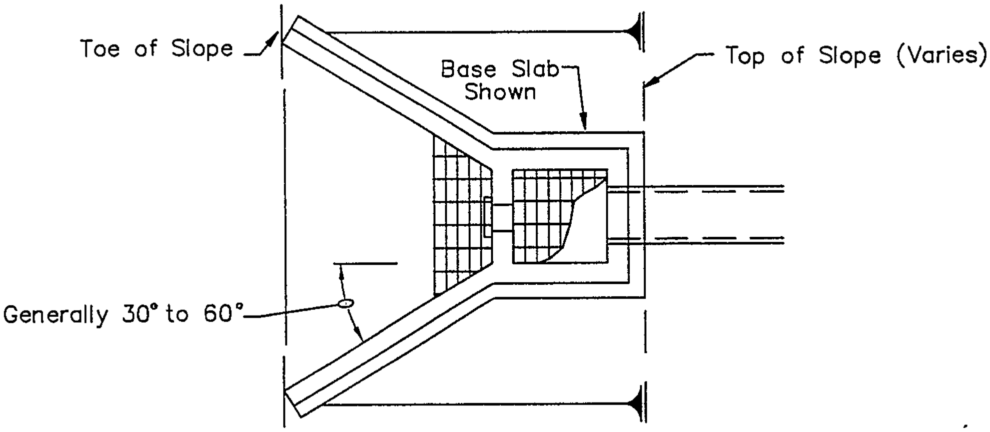


Plan View—Straight Wingwall Option



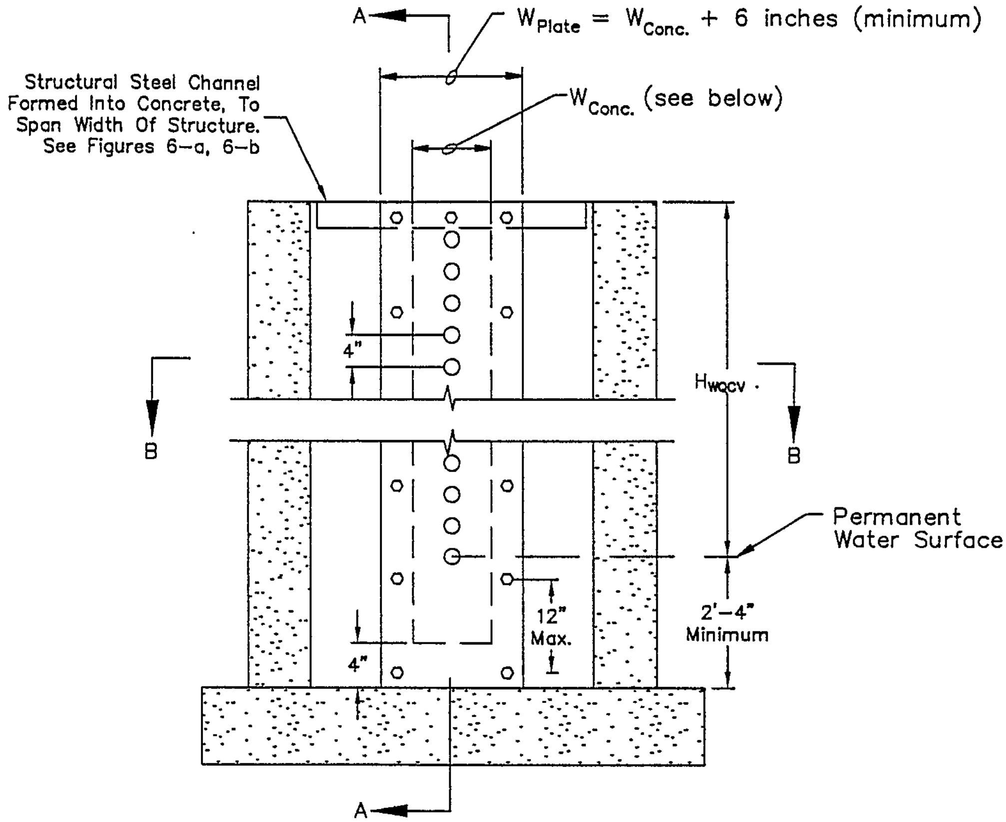
For either a Vertical or Adverse—Slope Trash Rack
a handrail may be required.

Plan View—Flared Wingwall Option

Urban Drainage and Flood Control District Drainage Criteria Manual (V.3) File: Details.dwg	Figure 3 Typical WQCV Outlet Structure Wingwall Configurations

R0017785

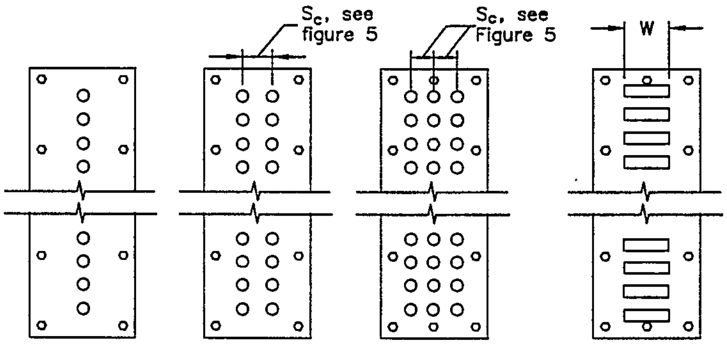
Orifice Perforation Details



Circular Openings: $W_{Conc.}$ Obtained From Table 6a–1

Rectangular Openings: $W_{Conc.}$ = (Width of Rectangular Perforation W) + 12"

Rectangular Openings: $W_{Opening}$ (see Figure 6–b) Obtained From Table 6b–1



Example Perforation Patterns

Note: The goal in designing the outlet is to minimize the number of columns of perforations that will drain the WQCV in the desired time. Do not, however, increase the diameter of circular perforations or the height of the rectangular perforations beyond 2 inches. Use the allowed perforation shapes and configurations shown above along with Figure 5 to determine the pattern that provides an area per row closest to that required without exceeding it.

Urban Drainage and Flood Control District Drainage Criteria Manual (V.3) File: Details.dwg	Figure 4 Orifice Details for Draining WQCV

R0017786

Orifice Plate Perforation Sizing

Circular Perforation Sizing

Chart may be applied to orifice plate or vertical pipe outlet.

Hole Dia (in) *	Hole Dia (in)	Min. Sc (in)	Area per Row (sq in)		
			n=1	n=2	n=3
1/4	0.250	1	0.05	0.10	0.15
5/16	0.313	2	0.08	0.15	0.23
3/8	0.375	2	0.11	0.22	0.33
7/16	0.438	2	0.15	0.30	0.45
1/2	0.500	2	0.20	0.39	0.59
9/16	0.563	3	0.25	0.50	0.75
5/8	0.625	3	0.31	0.61	0.92
11/16	0.688	3	0.37	0.74	1.11
3/4	0.750	3	0.44	0.88	1.33
13/16	0.813	3	0.52	1.04	1.56
7/8	0.875	3	0.60	1.20	1.80
15/16	0.938	3	0.69	1.38	2.07
1	1.000	4	0.79	1.57	2.36
1 1/16	1.063	4	0.89	1.77	2.66
1 1/8	1.125	4	0.99	1.99	2.98
1 3/16	1.188	4	1.11	2.22	3.32
1 1/4	1.250	4	1.23	2.45	3.68
1 5/16	1.313	4	1.35	2.71	4.06
1 3/8	1.375	4	1.48	2.97	4.45
1 7/16	1.438	4	1.62	3.25	4.87
1 1/2	1.500	4	1.77	3.53	5.30
1 9/16	1.563	4	1.92	3.83	5.75
1 5/8	1.625	4	2.07	4.15	6.22
1 11/16	1.688	4	2.24	4.47	6.71
1 3/4	1.750	4	2.41	4.81	7.22
1 13/16	1.813	4	2.58	5.16	7.74
1 7/8	1.875	4	2.76	5.52	8.28
1 15/16	1.938	4	2.95	5.90	8.84
2	2.000	4	3.14	6.28	9.42
n = Number of columns of perforations					
Minimum steel plate thickness			1/4 "	5/16 "	3/8 "

* Designer may interpolate to the nearest 32nd inch to better match the required area, if desired.

Rectangular Perforation Sizing

Only one column of rectangular perforations allowed.

Rectangular Height = 2 inches

$$\text{Rectangular Width (inches)} = \frac{\text{Required Area per Row (sq in)}}{2''}$$

Rectangular Hole Width.	Min. Steel Thickness
5"	1/4 "
6"	1/4 "
7"	5/32 "
8"	5/16 "
9"	11/32 "
10"	3/8 "
>10"	1/2 "

Urban Drainage and Flood Control District Drainage Criteria Manual (V.3) File: Details.dwg	Figure 5 WQCV Outlet Orifice Perforation Sizing

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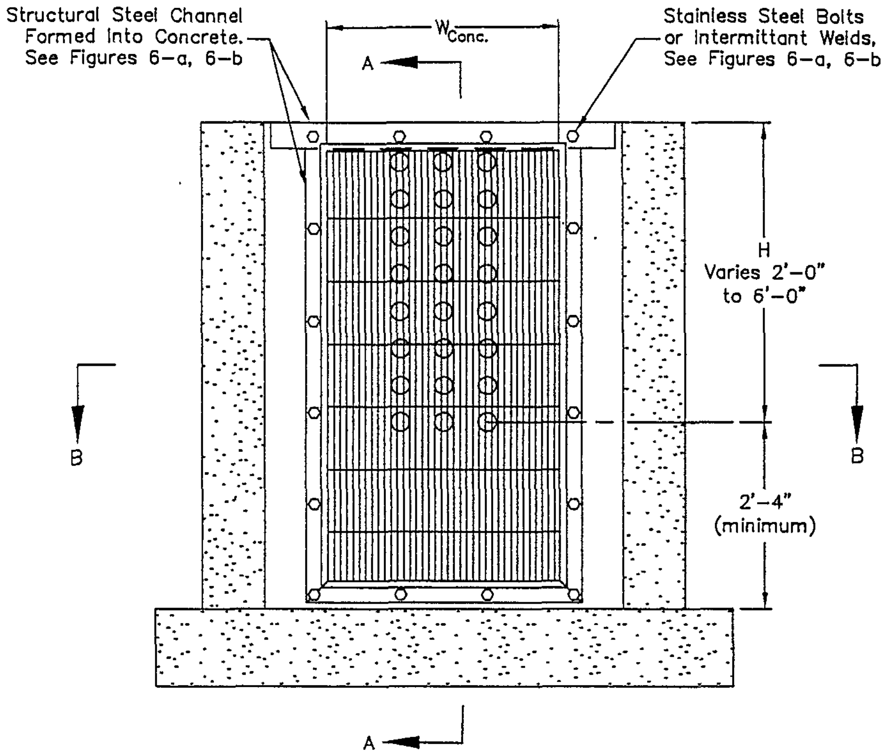
Note: Vertical WQCV Trash Racks are shown in Figures 6, 6–a, and 6–b for suggested standardized outlet design. Adverse–Slope Trash Rack design may be used for non–standardized designs, but must meet minimum design criteria.



Elevation

WQCV Trash Racks:

1. Well–screen trash racks shall be stainless steel and shall be attached by intermittant welds along the edge of the mounting frame.
2. Bar grate trash racks shall be aluminum and shall be bolted using stainless steel hardware.
3. Trash Rack widths are for specified trash rack material. Finer well–screen or mesh size than specified is acceptable, however, trash rack dimensions need to be adjusted for materials having a different open area/gross area ratio (R value)
4. Structural design of trash rack shall be based on full hydrostatic head with zero head downstream of the rack.

Overflow Trash Racks:

1. All trash racks shall be mounted using stainless steel hardware and provided with hinged and lockable or boltable access panels.
2. Trash racks shall be stainless steel, aluminum, or steel. Steel trash racks shall be hot dip galvanized and may be hot powder painted after galvanizing.
3. Trash Racks shall be designed such that the diagonal dimension of each opening is smaller than the diameter of the outlet pipe.
4. Structural design of trash rack shall be based on full hydrostatic head with zero head downstream of the rack.

Urban Drainage and Flood Control District Drainage Criteria Manual (V.3) File: Details.dwg	Figure 6 Suggested WQCV Outlet Standardized Trash Rack Design

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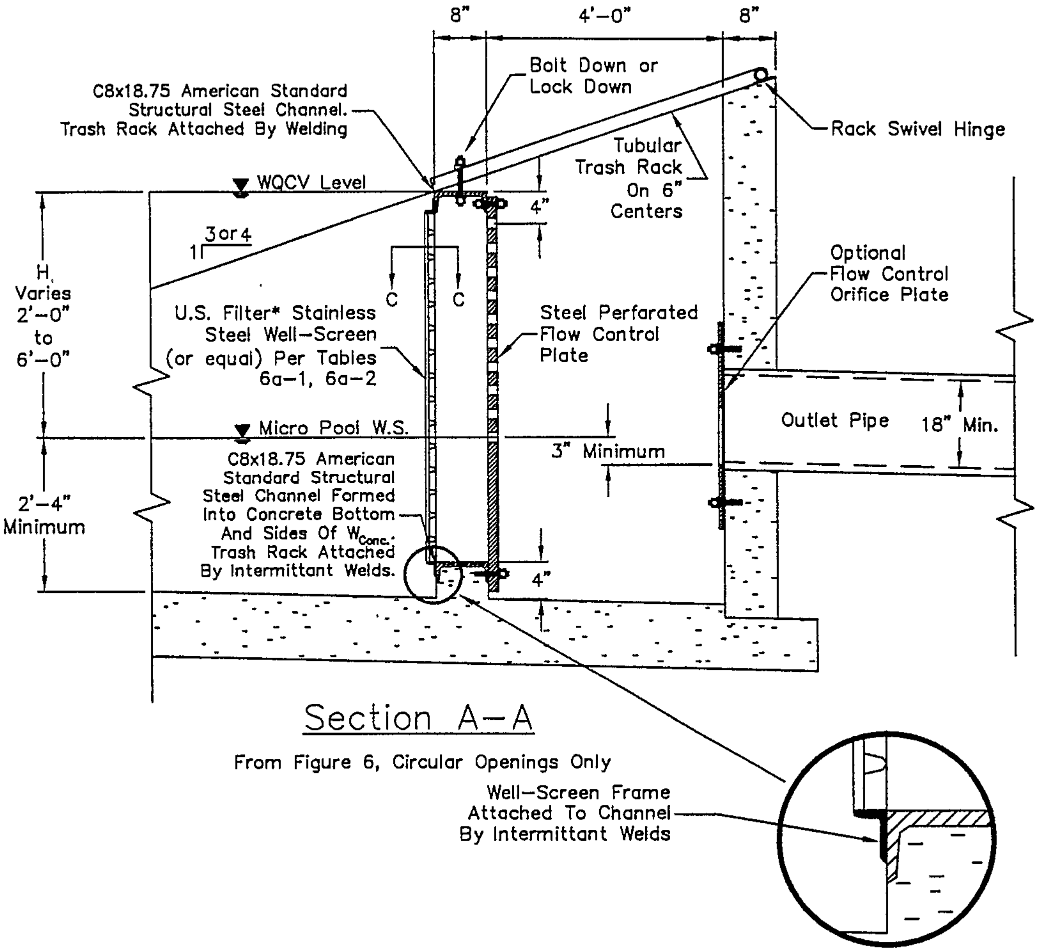
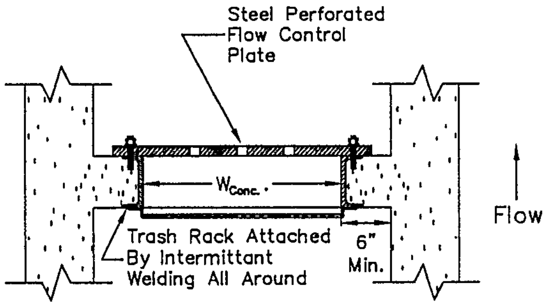
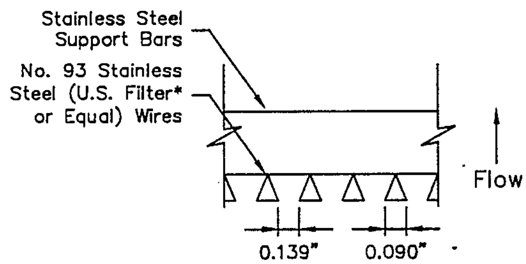


Section A-A

From Figure 6, Circular Openings Only





Section B-B - Plan View

From Figure 6, Circular Openings Only

Section C-C

From Figure 6, Circular Openings Only

Limits for this Standardized Design:

1. All outlet plate openings are circular.
2. Maximum diameter of opening = 2 inches.

*U.S. Filter, St. Paul, Minnesota, USA

R Value = (net open area)/(gross rack area) = 0.60

Urban Drainage and Flood Control District Drainage Criteria Manual (V.3) File: Details.dwg	Figure 6-a Suggested Standardized Trash Rack and Outlet Design For WQCV Outlets With Circular Openings

R0017789

Table 6a-1: Standardized WQCV Outlet Design Using 2" Diameter Circular Openings.
Minimum Width ($W_{conc.}$) of Concrete Opening for a Well-Screen-Type Trash Rack.
See Figure 6-a for Explanation of Terms.

Maximum Dia. of Circular Opening (inches)	Width of Trash Rack Opening ($W_{conc.}$) Per Column of Holes as a Function of Water Depth H					
	H=2.0'	H=3.0'	H=4.0'	H=5.0'	H=6.0'	Maximum Number of Columns
≤ 0.25	3 in.	3 in.	3 in.	3 in.	3 in.	14
≤ 0.50	3 in.	3 in.	3 in.	3 in.	3 in.	14
≤ 0.75	3 in.	6 in.	6 in.	6 in.	6 in.	7
≤ 1.00	6 in.	9 in.	9 in.	9 in.	9 in.	4
≤ 1.25	9 in.	12 in.	12 in.	12 in.	15 in.	2
≤ 1.50	12 in.	15 in.	18 in.	18 in.	18 in.	2
≤ 1.75	18 in.	21 in.	21 in.	24 in.	24 in.	1
≤ 2.00	21 in.	24 in.	27 in.	30 in.	30 in.	1

Table 6a-2: Standardized WQCV Outlet Design Using 2" Diameter Circular Openings.
US Filter™ <u>Stainless Steel</u> Well-Screen[1] (or equal) Trash Rack Design Specifications.

Max. Width of Opening	Screen #93 VEE Wire Slot Opening	Support Rod Type	Support Rod, On-Center, Spacing	Total Screen Thickness	Carbon Steel Frame Type
9"	0.139	#156 VEE	¾"	0.31'	⅜"x1.0"flat bar
18"	0.139	TE .074"x.50"	1"	0.655	¾" x 1.0 angle
24"	0.139	TE .074"x.75"	1"	1.03"	1.0" x 1½" angle
27"	0.139	TE .074"x.75"	1"	1.03"	1.0" x 1½" angle
30"	0.139	TE .074"x1.0"	1"	1.155"	1 ¼"x 1½" angle
36"	0.139	TE .074"x1.0"	1"	1.155"	1 ¼"x 1½" angle
42"	0.139	TE .105"x1.0"	1"	1.155"	1 ¼"x 1½" angle

[1] US Filter, St. Paul, Minnesota, USA

DESIGN EXAMPLE:

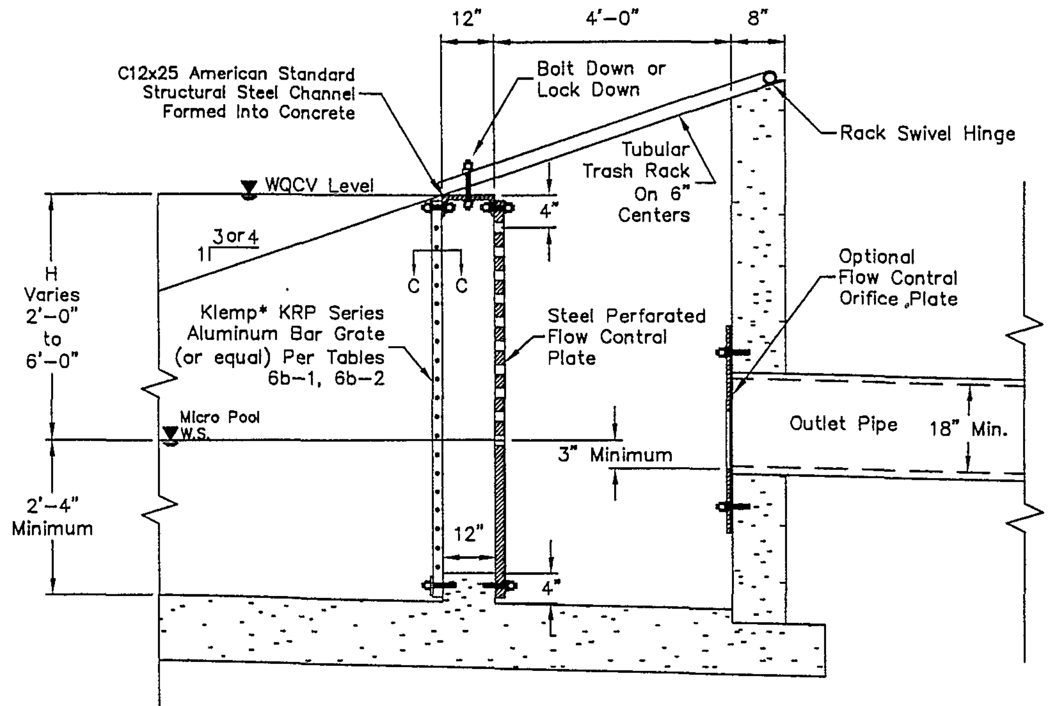
Given: A WQCV outlet with three columns of 5/8 inch (0.625 in) diameter openings. Water Depth H above the lowest opening of 3.5 feet.

Find: The dimensions for a well screen trash rack within the mounting frame.

Solution: From Table 6a-1 with an outlet opening diameter of 0.75 inches (i.e., rounded up from 5/8 inch actual diameter of the opening) and the Water Depth H = 4 feet (i.e., rounded up from 3.5 feet). The minimum width for each column of openings is 6 inches. Thus, the total width is $W_{conc.} = 3 \cdot 6 = 18$ inches. The total height, after adding the 2 feet below the lowest row of openings, and subtracting 2 inches for the flange of the top support channel, is 64 inches. Thus,

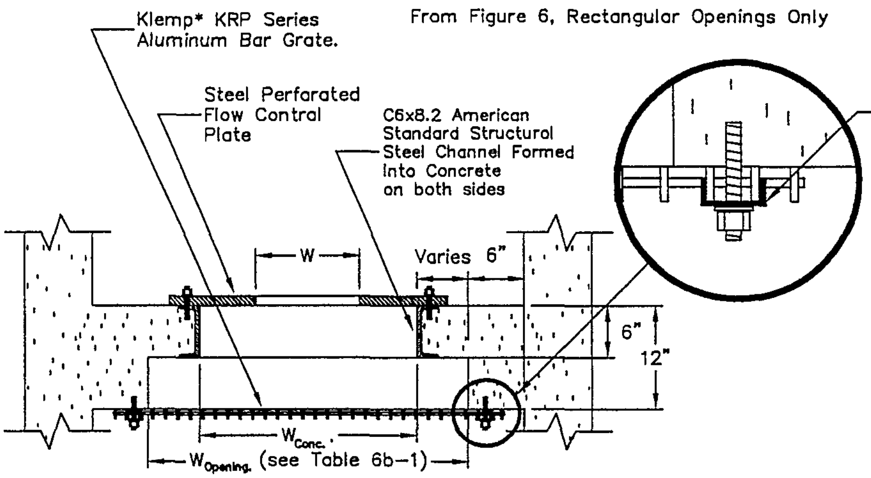
Trash rack dimensions within the mounting frame = 18 inches wide x 64 inches high

From Table 6a-2 select the ordering specifications for an 18", or less, wide opening trash rack using US Filter (or equal) stainless steel well-screen with #93 VEE wire, 0.139" openings between wires, TE .074" x .50" support rods on 1.0" on-center spacing, total rack thickness of 0.655" and ¾" x 1.0" welded carbon steel frame.



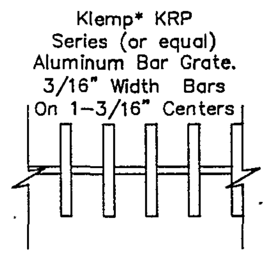
Section A–A

From Figure 6, Rectangular Openings Only



Section B–B – Plan View

From Figure 6, Rectangular Openings Only



Section C–C

From Figure 6, Rectangular Openings Only

Limits for this Standardized Design:

1. All outlet plate openings are rectangular.
2. Height of all rectangular openings = 2 inches.
3. For trash rack opening width ($W_{Opening}$), see Table 6b-1
4. Concrete opening for outlet plate ($W_{Conc.}$) = W + 12 inches

*Klemp Corporation, Orem, Utah, USA

R Value = (net open area)/(gross rack area)
= 0.71 for cross rods on 2" centers
= 0.77 for cross rods on 4" centers

Urban Drainage and Flood Control District Drainage Criteria Manual (V.3) File: Details.dwg	Figure 6–b Suggested Standardardized Trash Rack and Outlet Design For WQCV Outlets With Rectangular Openings

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Table 6b-1: Standardized WQCV Outlet Design Using 2" High Rectangular Openings.
Minimum Width ($W_{opening}$) of Opening for an Aluminum Bar Grate Trash Rack.
See Figure 6-b for Explanation of Terms.

Maximum Width W of 2" Height Rectangular Opening (inches)	Minimum Width of Trash Rack Opening ($W_{opening}$) as a Function of Water Depth H					
	H=2.0 ft.	H=3.0 ft.	H=4.0 ft.	H=5.0 ft.	H=6.0 ft.	Spacing of Bearing Bars, Cross Rods
≤ 2.0	2.0 ft.	2.5 ft.	2.5 ft.	2.5 ft.	3.0 ft.	1-3/16", 2"
≤ 2.5	2.5 ft.	3.0 ft.	3.0 ft.	3.5 ft.	3.5 ft.	1-3/16", 2"
≤ 3.0	3.0 ft.	3.5 ft.	3.5 ft.	4.0 ft.	4.0 ft.	1-3/16", 2"
≤ 3.5	3.5 ft.	4.0 ft.	4.5 ft.	4.5 ft.	5.0 ft.	1-3/16", 2"
≤ 4.0	3.5 ft.	4.5 ft.	5.0 ft.	5.0 ft.	5.5 ft.	1-3/16", 2"
≤ 4.5	4.0 ft.	4.5 ft.	5.0 ft.	5.5 ft.	5.5 ft.	1-3/16", 4"
≤ 5.0	4.0 ft.	5.0 ft.	5.5 ft.	6.0 ft.	6.0 ft.	1-3/16", 4"
≤ 5.5	4.5 ft.	5.5 ft.	6.0 ft.	6.5 ft.	7.0 ft.	1-3/16", 4"
≤ 6.0	5.0 ft.	6.0 ft.	6.5 ft.	7.0 ft.	7.5 ft.	1-3/16", 4"
≤ 6.5	5.5 ft.	6.5 ft.	7.0 ft.	7.5 ft.	8.0 ft.	1-3/16", 4"
≤ 7.0	6.0 ft.	7.0 ft.	7.5 ft.	8.5 ft.	8.5 ft.	1-3/16", 4"
≤ 7.5	6.0 ft.	7.5 ft.	8.5 ft.	9.0 ft.	9.5 ft.	1-3/16", 4"
≤ 8.0	6.5 ft.	8.0 ft.	9.0 ft.	9.5 ft.	10.0 ft.	1-3/16", 4"
≤ 8.5	7.0 ft.	8.5 ft.	9.5 ft.	10.0 ft.	N/A	1-3/16", 4"
≤ 9.0	7.5 ft.	9.0 ft.	10.0 ft.	N/A	N/A	1-3/16", 4"
≤ 9.5	8.0 ft.	9.5 ft.	N/A	N/A	N/A	1-3/16", 4"
≤ 10.0	8.5 ft.	10.0 ft.	N/A	N/A	N/A	1-3/16", 4"
≤ 10.5	8.5 ft.	N/A	N/A	N/A	N/A	1-3/16", 4"
≤ 11.0	9.0 ft.	N/A	N/A	N/A	N/A	1-3/16", 4"
≤ 11.5	9.5 ft.	N/A	N/A	N/A	N/A	1-3/16", 4"
≤ 12.0	10.0 ft.	N/A	N/A	N/A	N/A	1-3/16", 4"

Table 6b-2: Standardized WQCV Outlet Design Using 2" Height Rectangular Openings.
Klemp™ KRP Series <u>Aluminum</u> Bar Grate[1] (or equal) Trash Rack Design Specifications.

Water Depth Above Lowest Opening, H	Minimum Bearing Bar Size, Bearing Bars Aligned Vertically
2.0 ft.	1" x 3/16"
3.0 ft.	1-1/4" x 3/16"
4.0 ft.	1-3/4" x 3/16"
5.0 ft.	2" x 3/16"
6.0 ft.	2-1/4" x 3/16"

[1] Klemp Corporation, Orem, Utah, USA

DESIGN EXAMPLE:

Given: A WQCV outlet with 2" height by 6.5" width openings.
Water Depth H above the lowest opening of 4.5 feet.

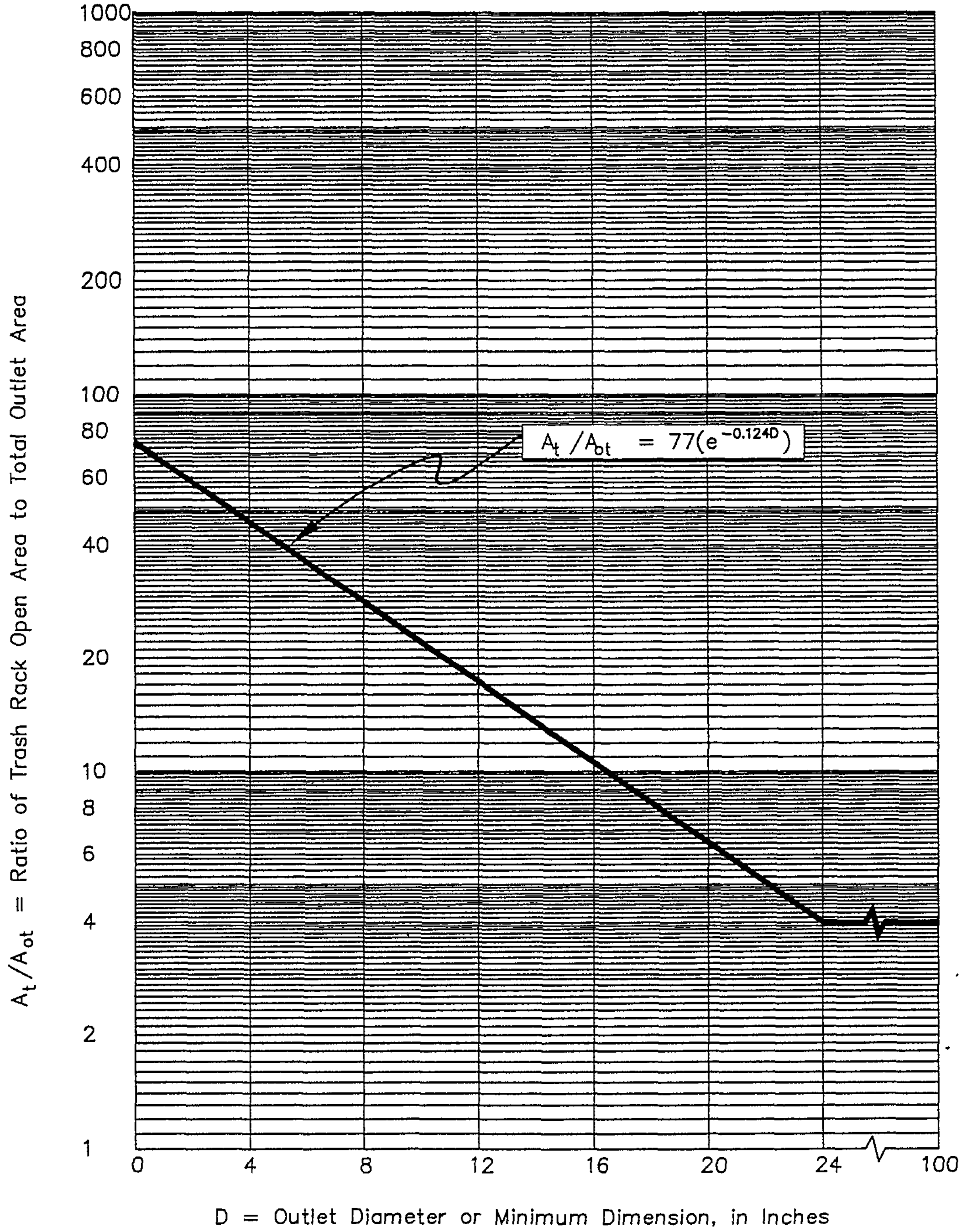
Find: The dimensions for an aluminum bar grate trash rack.

Solution: Using Table 6b-1 for openings having a width of 6.5 inches and Water Depth H = 5 feet (i.e., round up from 4.5 feet). The minimum width is 7'-6". The net height, after accounting for the 2 feet below the lowest opening, is 6'-6". An additional 6" must be added to the width and an additional 4" to the height to allow for mounting hardware. Thus, Trash rack dimensions = 8'-0" wide by 6'-10" high

Note also from Table 6b-1, that for orifice plate rectangular openings wider than 4", cross rod spacing of 4" is allowed.

From Table 6b-2, select the ordering specifications for H = 5.0 feet or less, a 8.0' wide by 6'-10" high trash rack using Klemp Corporation aluminum bar grate (or equal) with 2" by 3/16" bearing bars spaced 1-3/16" on-center, cross rods spaced 4" on-center. **Bearing bars are to be aligned vertically.**

Table 6b-1



Urban Drainage and Flood Control District Drainage Criteria Manual (V.3) File: Details.dwg	Figure 7 Minimum Trash Rack Open Area — Extended Range

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MAINTENANCE RECOMMENDATIONS

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1.0 GRASS BUFFER (GB)

Grass buffers require general maintenance of the turf grass cover and repair of any rill or gully development. Table GB-1 presents a summary of specific maintenance requirements and a suggested frequency of action.

TABLE GB-1
Irrigated Grass Buffer Strip Maintenance Considerations

Required Action	Maintenance Objective	Frequency of Action
Lawn mowing	Maintain a dense grass cover at a recommended length of 2 to 4 inches. Collect and dispose of cuttings offsite or use a mulching mower.	Routine – As needed or recommended by inspection.
Lawn care	Use the minimum amount of biodegradable, nontoxic fertilizers and herbicides needed to maintain dense grass cover, free of weeds. Reseed and patch damaged areas.	Routine – As needed.
Irrigation	Adjust the timing sequence and water cover to maintain the required minimum soil moisture for dense grass growth. Do not overwater.	As needed.
Litter removal	Remove litter and debris to prevent gully development, enhance aesthetics, and prevent floatables from being washed offsite.	Routine – As needed by inspection
Inspections	Inspect irrigation, turf grass density, flow distribution, gully development, and traces of pedestrian or vehicular traffic and request repairs as needed.	Annually and after each major storm (that is, larger than 0.75 inches in precipitation).

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TABLE GB-1
Irrigated Grass Buffer Strip Maintenance Considerations

Required Action	Maintenance Objective	Frequency of Action
Turf replacement	To lower the turf below the surface of the adjacent pavement, use a level flow spreader, so that sheet flow is not blocked and will not cause water to back up onto the upstream pavement.	As needed when water padding becomes too high or too frequent a problem. The need for turf replacement will be higher if the pavement is sanded in winter to improve tire traction on ice. Otherwise, expect replacement once every 5 to 15 years.

2.0 GRASS SWALES (GS)

Table GS-1 summarizes maintenance needs and related issues and shows the recommended frequency of various maintenance activities.

Healthy grass can generally be maintained without using fertilizers because runoff from lawns and other areas contains the needed nutrients. Occasionally inspecting the grass over the first few years will help to determine if any problems are developing and to plan for long-term restorative maintenance needs.

TABLE GS-1
Grass-Lined Swale Maintenance Considerations

Required Action	Maintenance Objective	Frequency of Action
Lawn mowing and Lawn care	Maintain irrigated grass at 2 to 4 inches tall and nonirrigated native grass at 6 to 8 inches tall. Collect cuttings and dispose of them offsite or use a mulching mower.	Routine – As needed.
Debris and Litter removal	Keep the area clean for aesthetic reasons, which also reduces floatables being flushed downstream.	Routine – As needed by inspection, but no less than two times per year.
Sediment removal	Remove accumulated sediment near culverts and in channels to maintain flow capacity. Replace the grass areas damaged in the process.	Routine – As needed by inspection. Estimate the need to remove sediment from 3 to 10 percent of total length per year, as determined by annual inspection.
Grass reseeding and mulching	Maintain a healthy dense grass in channel and side slope.	Nonroutine – As needed by annual inspection.
Inspections	Check the grass for uniformity of cover, sediment accumulation in the swale, and near culverts.	Routine – Annual inspection is suggested.

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3.0 MODULAR BLOCK POROUS PAVEMENT (MBP)

TABLE MBP-1
Modular Block Porous Pavement Maintenance Considerations

Requires Action	Maintenance Objective	Frequency of Action
Debris and litter removal	Accumulated material should be removed as a source control measure.	Nonroutine – As needed.
Sod maintenance	If sandy loam turf is used, provide lawn care, the irrigation system, and inlay depth maintenance as needed.	Routine – As dictated by inspection.
Inspection	Inspect representative areas of surface filter sand or sandy turf for accumulation of sediment or poor infiltration.	Routine and during a storm event to ensure that water is not bypassing these surfaces by not infiltrating.
Replacement of Surface Filter Layer	Remove, dispose, and replace surface filter media by pulling out turf plugs and by vacuuming out sand media from within the annular spaces of the blocks. Replace with fresh ASTM C-33 sand and, if appropriate, sandy loam turf plugs.	Nonroutine – when it becomes evident that runoff does not rapidly infiltrate into the surface. May be as often as every year or as little as every 5 to 10 years.

4.0 POROUS PAVEMENT DETENTION (PPD)

TABLE PPD-1
Porous Pavement Detention Maintenance Considerations

Requires Action	Maintenance Objective	Frequency of Action
Debris and litter removal	Accumulated material should be removed as a source control measure.	Nonroutine – As needed.
Inspection	Inspect representative areas of surface filter sand accumulation of fine sediment.	Routine and during a storm event to ensure that water is not bypassing these surfaces or taking too long to drain out.
Replacement of Surface Filter Layer	Using a power vacuum remove all sand media within the annular spaces of the concrete blocks. Replace with fresh ASTM C-33 sand, vibrate into place and remove excess.	Nonroutine – when it becomes evident that runoff does not rapidly infiltrate into the surface, namely, the ponded water does not drain within one hour. May be as often as once a year or as little as once every 5 to 10 years.

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5.0 POROUS LANDSCAPE DETENTION (PLD)

TABLE PLD-1
Porous Landscape Detention Maintenance Considerations

Required Action	Maintenance Objectives	Frequency
Lawn mowing and vegetative care	Occasional mowing of grasses and weed removal to limit unwanted vegetation. Maintain irrigated turf grass as 2 to 4 inches tall and nonirrigated native turf grasses at 4 to 6 inches.	Routine – Depending on aesthetic requirements.
Debris and litter removal	Remove debris and litter from detention area to minimize clogging of the sand media.	Routine – depending on aesthetic requirements
Landscaping removal and replacement	The sandy loam turf and landscaping layer will clog with time. This layer will need to be removed and replaced, along with all turf and other vegetation growing on the surface, to rehabilitate infiltration rates.	Every 5 to 10 years, depending on infiltration rates needed to drain the WQCV in 12-hours or less. May need to do it more frequently if exfiltration rates are too low to achieve this goal.
Inspections	Inspect detention area to determine if the sand media is allowing acceptable infiltration.	Routine – bi-annual inspection of hydraulic performance

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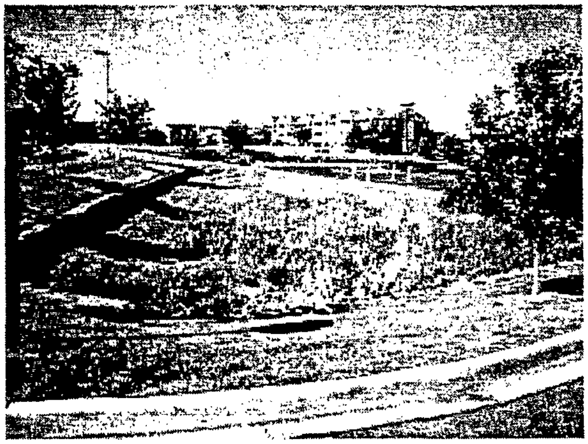
6.0 EXTENDED DETENTION BASINS (EDB)



Extended detention basins have low to moderate maintenance requirements. Routine and nonroutine maintenance is necessary to assure performance, enhance aesthetics, and protect structural integrity. The dry basins can result in nuisance complaints if not properly designed or maintained. Bio-degradable pesticides may be required to limit insect problems. Frequent debris removal and grass-mowing can reduce aesthetic complaints. If a shallow wetland or marshy area is included, mosquito breeding and nuisance odors could occur if the water becomes stagnant. Access to critical elements of the pond (inlet, outlet, spillway, and sediment collection areas) must be provided. The basic elements of the maintenance requirements are presented in Table EDB-1.

TABLE EDB-1
Extended Detention Basin Maintenance Considerations

Required Action	Maintenance Objective	Frequency of Action
Lawn mowing and lawn care	Occasional mowing to limit unwanted vegetation. Maintain irrigated turf grass as 2 to 4 inches tall and nonirrigated native turf grasses at 4 to 6 inches.	Routine – Depending on aesthetic requirements.
Debris and litter removal	Remove debris and litter from the entire pond to minimize outlet clogging and improve aesthetics.	Routine – Including just before annual storm seasons (that is, April and May) and following significant rainfall events.
Erosion and sediment control	Repair and revegetate eroded areas in the basin and channels.	Nonroutine – Periodic and repair as necessary based on inspection.
Structural	Repair pond inlets, outlets, forebays, low flow channel liners, and energy dissipators whenever damage is discovered.	Nonroutine – Repair as needed based on regular inspections.

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TABLE EDB-1
Extended Detention Basin Maintenance Considerations

Required Action	Maintenance Objective	Frequency of Action
Inspections	Inspect basins to insure that the basin continues to function as initially intended. Examine the outlet for clogging, erosion, slumping, excessive sedimentation levels, overgrowth, embankment and spillway integrity, and damage to any structural element.	Routine – Annual inspection of hydraulic and structural facilities. Also check for obvious problems during routine maintenance visits, especially for plugging of outlets.
Nuisance control	Address odor, insects, and overgrowth issues associated with stagnant or standing water in the bottom zone.	Nonroutine – Handle as necessary per inspection or local complaints.
Sediment removal	Remove accumulated sediment from the forebay, micro-pool, and the bottom of the basin.	Nonroutine – Performed when sediment accumulation occupies 20 percent of the WQCV. This may vary considerably, but expect to do this every 10 to 20 years, as necessary per inspection if no construction activities take place in the tributary watershed. More often if they do. The forebay and the micro-pool will require more frequent cleanout than other areas of the basin, say every 1 or 2 years.

7.0 SAND FILTER EXTENDED DETENTION BASIN (SFB)

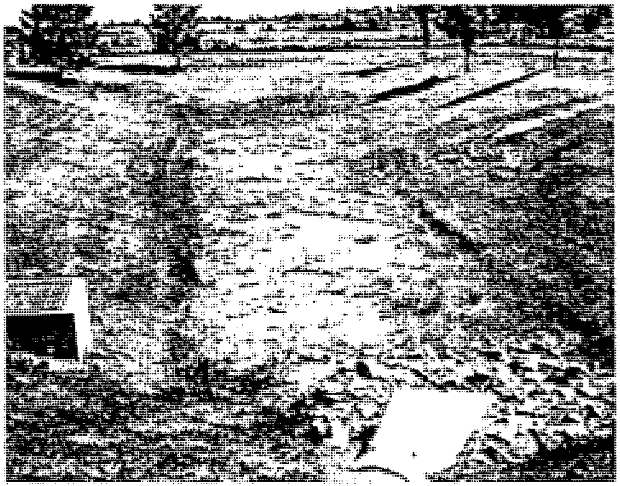

TABLE SFB-1
Sand Filter Detention Basin Maintenance Considerations

Required Action	Maintenance Objectives	Frequency
Debris and litter removal	Remove debris and litter from detention area to minimize clogging of the sand media.	Routine – depending on aesthetic requirements
Landscaping removal and replacement	If the sand filter is covered with rock mulch, bluegrass, or other landscaping covers, the cover must be removed to allow access to the sand media. Replace landscaping cover after maintenance of sand media is complete.	Every 2 to 5 years
Scarify Filter Surface	Scarify top 3 to 5 inches by raking the filter's surface.	Once per year or when needed to promote drainage.
Sand filter removal	Remove the top 3 inches of sand from the sand filter. After a third removal, backfill with 9 inches of new sand to return the sand depth to 18 inches. Minimum sand depth is 12 inches.	If no construction activities take place in the tributary watershed, every 2 to 5 years depending on observed drain times, namely when it takes more than 24 hours to empty 3-foot deep pool. Otherwise more often. Expect to clean out forebay every 1 to 5 years.
Inspections	Inspect detention area to determine if the sand media is allowing acceptable infiltration.	Routine – bi-annual inspection of hydraulic performance, one after a significant rainfall.

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8.0 CONSTRUCTED WETLANDS BASIN (CWB)

To achieve and maintain a healthy wetland for water quality enhancement, the proper depth and the spatial distribution of growth zones must be maintained. Table CWB-2 summarizes suggested activities and their frequencies to maintain an operational wetland.

TABLE CWB-1
Constructed Wetlands Maintenance Considerations

Required Action	Maintenance Objective	Frequency of Action
Lawn mowing and lawn care	Mow occasionally to limit unwanted vegetation. Maintain irrigated turf grass at 2 to 4 inches tall and nonirrigated native turf grasses at 4 to 6 inches.	Routine – Depending on aesthetic requirements.
Debris and litter removal	Remove debris and litter from entire pond to minimize outlet clogging and aesthetics. Include removal of floatable material from the pond's surface.	Routine – Including just before annual storm seasons (that is, in April and May) and following significant rainfall events.
Sediment removal	Remove accumulated sediment and muck along with much of the wetland growth. Re-establish growth zone depths and spatial distribution. Revegetate with original wetland species.	Nonroutine – Every 10 to 20 years as needed by inspection if no construction activities take place in the tributary watershed. More often if they do. Expect to clean out forebay every 1 to 5 years.
Aquatic plant harvesting	Cut and remove plants growing in wetland (such as cattails and reeds) to remove nutrients permanently with manual work or specialized machinery.	Nonroutine until further evidence indicates such action would provide significant nutrient removal. In the meantime, perform this task once every 5 years or less frequently as needed to clean the wetland zone out.

TABLE CWB-1
Constructed Wetlands Maintenance Considerations

Required Action	Maintenance Objective	Frequency of Action
Inspections	Observe inlet and outlet works for operability. Verify the structural integrity of all structural elements, slopes, and embankments.	Routine – At least once a year, preferably once during one rainfall event resulting in runoff.

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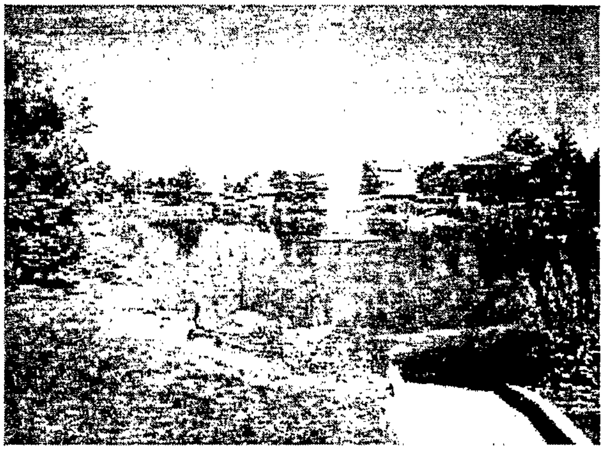
9.0 RETENTION POND (RP)



The amount of construction activity within a basin, the erosion control measures implemented, and the size of the basin will influence the frequency of sediment removal from the pond. With aggressive erosion control is practiced in the tributary watershed, it is estimated that accumulated sediment will need to be removed at 5- to 20-year intervals. Table RP-1 summarizes the required maintenance activities and their frequency for retention ponds.

TABLE RP-1
Retention Pond Basin Maintenance Considerations

Required Action	Maintenance Objective	Frequency of Action
Lawn mowing and lawn care	Mow occasionally to limit unwanted vegetation. Maintain irrigated turf grass 2 to 4 inches tall and non-irrigated native turf grasses at 4 to 6 inches.	Routine – Depending on aesthetic requirements.
Debris and litter removal	Remove debris and litter from the entire pond to minimize outlet clogging and aesthetics. Include the removal of floatable material from the pond's surface.	Routine – Including just before annual storm seasons (that is, April and May) and following significant rainfall events.
Erosion and sediment control	Regrade and revegetate eroded and slumped areas above the pond and along channels. Repair damaged inlet and outlet energy dissipators.	Nonroutine – Periodic and repair as necessary based on inspection.
Inspections	Inspect the retention pond for functioning as initially intended. Pay attention to outlet clogging. Also note erosion, slumping, sedimentation levels, overgrowth, embankment and spillway integrity, and damage to structural elements of the facility.	Routine – Annual inspection of hydraulic and structural facilities. Biannual performance and maintenance inspections.
Nuisance control	Address odor issues, insects, and overgrowth with appropriate measures.	Nonroutine – As necessary per inspection or local complaints.

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TABLE RP-1
Retention Pond Basin Maintenance Considerations

Required Action	Maintenance Objective	Frequency of Action
Structural repairs	Repair such items as inlet/outlet works and energy dissipator liners. Stabilize banks and berms. Repair damage caused by larger storm events.	Nonroutine – As necessary per inspection.
Sediment removal	Empty the pond, divert the base flow, and dry out bottom sediments in fall and winter months to allow access with backhoe. Remove accumulated sediment along with aquatic growth overlaying them. Re-establish original design grades and volumes and replant aquatic vegetation.	Nonroutine – As indicated per inspections and sediment accumulation. Expect to do this every 10 to 20 years if no construction activities take place in the tributary watershed. More often if they do. Expect to clean out the forebay every 1 to 5 years.
Aquatic Growth Harvesting	Remove aquatic plants such as cattails or reeds, which also permanently removes nutrients. Use an aquatic harvester and dispose of the material offsite.	Nonroutine – Perform every 5 to 15 years or as needed to control their accumulation.

10.0 CONSTRUCTED WETLANDS CHANNEL (CWC)

To achieve and maintain a healthy wetland for water quality enhancement, the proper depth and the spatial distribution of growth zones must be maintained. Table CWC-1 summarizes suggested activities and their frequencies to maintain an operational wetland.

TABLE CWC-1
Constructed Wetlands Maintenance Considerations

Required Action	Maintenance Objective	Frequency of Action
Lawn mowing and lawn care	Mow occasionally to limit unwanted vegetation. Maintain irrigated turf grass at 2 to 4 inches tall and nonirrigated native turf grasses at 4 to 6 inches.	Routine – Depending on aesthetic requirements.
Debris and litter removal	Remove debris and litter from the channel.	Routine – Including just before annual storm seasons (that is, in April and May) and following significant rainfall events.
Sediment removal	Remove accumulated sediment and muck along with wetland vegetation growing on top of it. Re-establish growth zone depths and revegetate with original wetland species.	Nonroutine – Every 10 to 20 years as needed by inspection if no construction activities take place in the tributary watershed. More often if they do.
Aquatic plant harvesting	Cut and remove plants growing in wetland (such as cattails and reeds) to remove nutrients permanently with manual work or specialized machinery.	Nonroutine until further evidence indicates such action would provide significant nutrient removal. In the meantime, perform this task once every 5 years or less frequently as needed to clean the wetland zone out.
Inspections	Observe inlet and outlet works for operability. Verify the structural integrity of all structural elements, slopes, and embankments.	Routine – At least once a year, preferably once during one rainfall event resulting in runoff.

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INDUSTRIAL AND COMMERCIAL BEST MANAGEMENT PRACTICES

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1.0 INTRODUCTION

1.1 Overview

This chapter contains guidance for incorporation of BMPs for controlling stormwater discharges at industrial and commercial facilities. The guidance addresses:

- Planning Considerations for establishment of BMPs for new and existing facilities.
- An evaluation of the possible pollutant sources that are found at industrial and commercial sites.
- Recommendations on structural and nonstructural controls for stormwater discharges from these facilities.

1.2 Applicability

The BMPs described in this section are applicable to many different circumstances that occur at industrial and commercial locations. While this section is directed toward application to smaller industries and any size commercial facility, many of the practices are applicable to any size of facility. It is anticipated that the majority of industries that may develop BMPs will be manufacturers of different products.

Commercial sites which may find this information of value are those that store materials outside, use or store large quantities of hazardous or toxic chemicals as part of their business or perform activities that could result in discharges into the storm sewer such as vehicle maintenance and painting.

The requirement to develop and implement best management plans is usually a result of the regulatory requirement that industries obtain NPDES stormwater permits. In some cases, specific local governments may require implementation of BMPs to address water quality. Some local governments may wish to receive copies of stormwater management plans developed by industries. It is recommended that local governments be contacted for additional requirements.

2.0 PLANNING CONSIDERATIONS

There are many different measures that can be taken to minimize the impact on water quality from commercial and industrial facilities. These measures are called best management practices (BMPs). They are usually divided into structural practices, which involve the construction of a system to remove contaminants to nonstructural. The latter includes those measures which are aimed at controlling the "human factor". They are procedural in nature.

Incorporation of structural BMPs is most easily done prior to construction of the facility when site layout is still under design. Many practices, such as providing coverage and containment around potential pollutant sources can be incorporated during the design of buildings or layout of the site. At the planning stage, it is possible to incorporate the different elements that can address both stormwater and other regulatory concerns with out the need for later plant modifications.

For existing facilities, it is necessary for the owner/operator to evaluate the current activities that take place on site. Based on this evaluation, it may be necessary to retrofit existing structures as part of the incorporation of best management practices. Other concerns regarding existing facilities include that there may be significant limitations in trying to find room for structural BMPs that require large amounts of land (for example, detention basins). Structural BMPs that do not require significant amounts of land such as infiltration basins are more likely to be incorporated into existing facilities. Nonstructural BMPs have no problems being implemented into existing facilities and developed areas.

The first step in planning for the inclusion of best management practices at new or existing sites is to evaluate what activities take place at the site and the possible pollutant sources may be at the site. Once the sources are identified, best management practices that address them can be determined. The assessment and evaluation process is:

1.) Assess the activities on the site that could be potential sources of storm water pollution from the facility because of the material that is used in the process or because of the byproducts/products of the process. Activities to assess include the storage of materials or equipment, waste disposal practices, formation of products from raw materials, coating of materials, generation of power, etc.

2.) Based on the assessment of activities, conduct a material inventory to determine what materials are kept on the site that could cause a problem if they were discharged from the site. It is important also to evaluate the quantities of these materials. Some materials may be of concern only if stored or used in significant quantities.

3.) For existing facilities, evaluate past spills and leaks to determine if there are any materials or activities that create chronic stormwater runoff pollution problems. Inadequate clean up of spills can result in contamination.

4.) Evaluate the data gathered and determine where potential pollutant sources or potentially polluting activities (i.e., fueling) are located. This could be done by the creation of a map. Based on the results, a determination on what structural or nonstructural measures are required can be made. Potential sources can be addressed singularly or in combination.

5.) For existing sites, once the sources have been determined, a review of the site and current practices should occur to determine if present practices/measures are adequate to protect water quality.

6.) Evaluate existing conditions at the site. A determination should be made of storm water drainage patterns.

7.) Determine the BMPs that are best for your site. It is important that each source be addressed by a BMP or a group of BMPs. Where possible, a single BMP can be used to address multiple sources. Factors which should be evaluated in choosing BMPs are:

- Pollutants Controlled: BMPs which address sediment may not control oils.
- Effectiveness of BMPs: Each control measure should provide a sufficient pollutant control to warrant its inclusion.
- Reliability/Sustainability: Measures should be effective over an extended time and be able to be properly implemented over time.
- Implementation Cost: Control measures with low planning, design, and land acquisition, construction, and equipment costs should be chosen.
- Maintenance Costs: Control measures with low operation, maintenance, repair, support service, and replacement costs should be preferred.
- Public Acceptability: BMPs should be assessed on the expected response from the public.
- Agency Acceptability: BMPs should be evaluated on the expected response of agencies which will oversee the measures taken and their relationship to regulatory requirements.
- Risk Liability: Control measures should be evaluated in terms of the risks or liabilities which occur during implementation.

8.) Once the BMPs are implemented it will be necessary to ensure that structural BMPs are properly operated and maintained and that employees are carrying out nonstructural type BMPs. This may involve making checks on BMPs, designation of responsible individuals for BMPs and education of employees in your pollution prevention efforts.

9.) It is important following implementation of BMPs that they be re-evaluated. Changes in the business may result in the ability to discontinue certain BMPs and implementation others.

3.0 POLLUTANT SOURCES

To develop a useful evaluation of the potential risk of stormwater pollutant sources it is necessary to review the use of the site, pollutant sources, the topography of the site, the locations of activities and material storage and to understand where spills are likely to occur.

3.1 Topography

As discussed above, a review of the site drainage patterns should be made to determine where runoff from potential sources of pollutants drains. This is important for several reasons. Drainage patterns are useful in determining where structural controls can be established, where different run-on sources commingle, and it may also show where it is possible to grade a site to prevent run-on from offsite drainage areas that have a high potential for polluting stormwater.

3.2 Activities That Pose a Potential Stormwater Impact

The following activities have the potential to cause an impact on stormwater runoff quality from an industrial or commercial sites:

3.2.1 Fueling Areas. When stormwater mixes with fuel spilled or leaked onto the ground, it becomes polluted by petroleum based materials that are harmful to humans, fish, and wildlife. Fuel overflows during storage tank filling can be a major source of contamination. This could occur at large industrial sites or at small commercial sites such as gas stations, convenience stores, strip malls or garages. Sources of contaminates typically are:

- Spills and leaks during fueling or oil delivery,
- Spills caused by "topping off" fuel tanks,
- Allowing rainfall to run onto the fuel area,
- Hosing or washing down of the fuel area, or
- Mobile fueling operations.

3.2.2. Vehicle and Equipment Maintenance and Storage. Vehicle and equipment maintenance operations use materials and create wastes that can be harmful to humans and the environment if not property handled. Stormwater runoff from these areas can become polluted with a variety of contaminates including solvents and degreasing products, waste automotive fluids, oils and greases, acids and caustic wastes. Sources of contaminates typically are:

- Parts cleaning,
- Shop cleanup,
- Spilled fuel, oil, or other materials such as battery acid,

- Replacement of fluids, such as oil, oil filters, hydraulic fluids, transmission fluid and radiator fluids,
- Dripping fluids from vehicles and equipment, and
- Disposal of greasy rags, oil filters, air filters, batteries, battery fluids, spent coolant, degreasers, oils, etc.

3.2.3 Painting. Many painting operations use materials or create wastes that are harmful to humans and the environment. Paint solvents used to remove or thin paint and dusts from sanding and grinding operations contain toxic metals like cadmium and mercury. These can pollute stormwater and create significant water quality impacts. Sources of contamination typically are:

- Painting and chemical paint removal,
- Sanding or paint stripping
- Spills of paint or paint thinner,
- Sand blasting residue, or
- Equipment painting.

3.2.4 Washing. Washing vehicles and equipment outdoors or in areas where wash water flows onto the ground can pollute stormwater. Vehicle wash water is considered process water not stormwater. Operators must have a NPDES/CDPS permit to discharge vehicle wash water. Wash waters can contain high concentrations of oil and grease, solvents, phosphates, and high-suspended solids loads. Sources of washing contamination typically include:

- Outside equipment or vehicle cleaning (washing, degreasing, or steam cleaning),
- Wash water discharge to the ground or directly to storm drain,
- Mobile fleet washing, or
- Pressure washing of buildings.

Other types of washing include spraying down concrete and asphalt surfaces such as those outside of commercial sites where sales of products may have occurred, areas where dirt and mud have accumulated, loading dock areas, or parking and sidewalk areas that have accumulated wastes. These activities must have an NPDES or ICDPS permit. In some cases, these types of discharges are incorporated into the municipality stormwater permit. These areas also need to be taken into consideration with the possibility of potentially polluting stormwater.

3.2.5 Loading and Unloading. Loading and unloading operations usually take place outside on docks, truck, terminals or outside storage or staging areas at both industrial and commercial sites. Materials spilled, leaked or lost during loading and unloading may collect in the soil or other surfaces and be

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carried away by runoff, or when the area is cleaned. Rainfall may wash pollutants off machinery used to unload and load materials. Typically sources of contamination include:

- Pumping of liquids or gases to or from a truck or rail car into a storage facility,
- Pneumatic transfer of dry chemicals to or from the vehicles,
- Transfer by mechanical conveyor systems, or
- Transfer of bags, boxes, drums, or other containers by forklift, trucks, or other material handling equipment.

3.2.6 Above Ground Tanks— Liquid Storage Accidental releases of chemicals from above ground liquid storage tanks can contaminate storm water with many different pollutants. Materials spilled, leaked, or lost from storage tanks may accumulate in soils or on other surfaces and be carried away by runoff. Typical causes of contamination from accidental releases include:

- External corrosion and structural failure,
- Installation problems,
- Spills and overfills due to operator error,
- Failure of piping systems including pipes, pumps, flanges, couplings, hoses, and valves, or
- Leaks or spills during pumping of liquids or gases from trucks or rail cars to a storage facility or vice versa.

3.2.7 Outside Manufacturing. Outside manufacturing activities can also contaminate stormwater runoff. Activities such as parts assembly, rock grinding or crushing, metals painting or coating, grinding or sanding, degreasing, parts cleaning or operations that use hazardous materials are of concern. Metal and wood shavings, excess lubricants, and other residuals resulting from outside manufacturing that are left on the ground can also be washed into the drainage system. Typical contaminate sources include:

- Processes or equipment that generate dust, vapors or other emissions,
- Outside storage of hazardous materials and raw materials,
- Dripping or leaking fluids from equipment or processes,
- Liquid wastes discharged directly onto the ground or into the storm sewer, or
- Concrete manufacturing (pipes, inlets, etc.).

3.2.8 Waste Management. Areas where industrial or chemical waste is stored, treated or disposed of can cause stormwater pollution. Wastes spilled, leached, or lost from management areas or outside manufacturing activities may build-up in soils or on other surfaces and be carried away by rainfall runoff. There is also the potential for liquid wastes from lagoons or surface impoundments to overflow to surface waters or soak the soil where they can be picked up by runoff. Possible stormwater contaminants include toxic compounds, oil and grease, oxygen-demanding organics, paints and solvents, heavy metals and high levels of suspended solids.

In addition to the management of wastes from industrial facilities, the management of solid wastes at commercial sites is also of concern. Improper disposal of liquid wastes in a solid waste dumpster can result in the liquids draining out of the container and into the stormwater system. Lack of coverage of waste receptacles can result in rainwater seeping through the material and collecting contaminants or the material being blow around the site and into the stormwater collection system.

Typical contaminate sources include:

- Landfills,
- Waste Piles,
- Wastewater and solid waste treatment and disposal,
- Land application sites,
- Dumpsters, or
- Unlabeled 55-gallon drums.

3.2.9 Outside Storage of Materials. Raw materials, by-products, finished products, containers, and materials storage areas exposed to rain and/or runoff can pollute storm water. Stormwater can become contaminated by a wide range of contaminates (e.g. metals, oils and grease, sediment) when solid materials wash off or dissolve into water, or by spills or leaks. Typical contaminate sources include:

- Fuels,
- Raw materials,
- By-products,
- Intermediates,
- Final products,
- Process residuals, or
- Wind-blown debris.

3.2.10 Salt Storage. Salt left exposed to rain or snow may migrate to the stormsewer or contaminate soils. Salt spilled or blown onto the ground during loading or unloading will dissolve in stormwater runoff. Stormwater contaminated with salt in high concentrations can be harmful to vegetation and aquatic life. Salty stormwater runoff soaking into the ground may contaminate ground water, thus making the groundwater unsuitable as a drinking water supply. Typical contaminate sources include:

- Salt stored outside in piles or bags that are exposed to rain or snow,

- Salt loading and unloading areas located outside or in areas where spilled salt can contaminate stormwater, or
- Salt/sand storage piles used for deicing operations.

3.2.11 Parking. Areas where customers park can also be a source of contamination. Typical sources of contamination can include:

- Improper disposal of trash
- Leaky vehicles can result in oils and other contaminants being deposited in the parking lot and then washed to the stream during a storm event.

3.2.12 Bare Soil. Bare soil areas occur at industrial and commercial sites where no pavement has been laid or adjacent to areas where pavement has been laid. They occur most often in areas that are under development. Bare soil areas can be caused by individuals that repeatedly park on these areas, use the areas as exits or a different route to another area, or even from repeated pedestrian walking. The sediment in the area that will be contaminated by the activities that occur on the area, therefore, the following can be practiced to remedy the problems. Typical sources of contamination include:

- Sediment from stormwater runoff, or
- Improper disposal of trash.

3.2.13 Landscaping Practices. Chemicals used to maintain landscaping areas can have a significant impact on the water quality of stormwater runoff. Herbicides, pesticides, and fertilizers can be washed into create impacts if they are not applied correctly. Contaminant sources include:

- Improper storage of chemicals,
- Improper storage cleaning equipment used to apply these chemicals, or
- Improper application.

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4.0 ASSESSMENT AND SELECTION OF BEST MANAGEMENT PRACTICES

Once information has been gathered on the sources of potential pollutants, it is necessary to determine the suitable BMPs to be used. To do this, it is necessary to first screen the BMPs, then rank them.

4.1 Screening Best Management Practices

Once the potential sources have been identified, one of the next steps is to determine what BMPs would be appropriate for the types of pollutants. A list of the various structural and non-structural BMPs that are effective for addressing the pollutants should be developed. As part of this process, obviously inappropriate practices are eliminated. Criteria to be used includes primary pollutants removed, drainage area served, soil conditions, land requirements, and institutional structure. It is important to understand BMP effectiveness.

4.1.1 Non-Structural BMPs. Since the number of possible BMPs is large, initial screening will reduce the number of prior to final screening. Practices can be divided into subpractices. For example, a solid waste practice could be divided into management of leaves, litter, and yard waste.

To screen BMPs, one could develop a matrix. For example, one axis would list the BMPs while the other, the criteria. The BMP would be rated on a range of 1 to 5 for each criteria. Criteria which may be appropriate for non-structural BMPs include:

- Pollutant Removal: Different source control practices are designed to address different pollutants. BMPs which address the pollutants of primary concern should receive the highest ranking.
- Existing Business Structure: Some practices implemented require a specific structure to work effectively. For example, delaying on inspections may not be practical if there are insufficient resources or knowledge to perform the inspection.
- Acceptance: Employees need to understand and accept the requirements to modify their behavior. Practices which meet with resistance will not be implemented and should be eliminated.
- Authority: Employees implementing the practices need the authority to require that certain actions occur, and to take appropriate follow-up when problems occur. Practices which require levels of authority to be implemented which do not exist should be eliminate.
- Technical Feasibility: BMPs which require large expenditures or extensive efforts might not be suitable for small industries which lack resources.
- Pollutants Controlled: BMPs which address sediment may not control oils.

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- Effectiveness of BMPs: Each control measure should provide a sufficient pollutant control to warrant its inclusion.
- Reliability/Sustainability: Measures should be effective over an extended time and be able to be properly implemented over time.
- Implementation Cost: Control measures with low planning, design, and land acquisition, construction, and equipment costs should be chosen.
- Maintenance Costs: Control measures with low operation, maintenance, repair, support service, and replacement costs should be preferred.
- Public Acceptability: BMP should be assessed on the expected response from the public.
- Agency Acceptability: BMPs should be evaluated on the expected response of agencies which will oversee the measures taken and their relationship to regulatory requirements.
- Risk Liability: Control measures should be evaluated in terms of the risks or liabilities which occur during implementation.

Based on the results of this screening, a list of potential BMPs would be determined.

An additional review would be done of those BMPs which were found to be the most desirable. An option for selection of the BMPs is to divide them into source controls, hydraulic controls, and treatment options. The development of alternatives which mix the various BMPs would be the next step. These alternatives could be ranked based on cost and implementability. The best alternative would then be implemented.

5.0 STRUCTURAL CONTROLS

Table IC-1 provides a listing of structural controls that could be applied to the various sources to address stormwater runoff from industrial and commercial sites. A detailed description of the control can be found in the chapter on Structural BMPs.

TABLE IC-1
Suggested Structural Controls

Control	Sources	Applicability
Grass Buffer	Parking Areas	Applicable to Industrial and Commercial Operations
Grass Swale	Parking Areas	Applicable to Industrial and Commercial Operations
Modular Block Parsons Pavement	Parking Areas	Applicable to Industrial and Commercial Operations
Pavement Micro-Detention	Parking Areas	Applicable to Industrial and Commercial Operations
Landscape Micro-Detention	Parking Areas	Applicable to Industrial and Commercial Operations
Extended Detention Basin	Parking Areas	Applicable to Industrial and Commercial Operations
Constructed Wetlands	Parking Areas	Applicable to Industrial and Commercial Operations
Retention Pond	All Sources	Associated with Industrial or commercial operations with storage of large quantities of toxic pollutants.
Constructed Wetlands Channel	Parking Areas	Applicable to Industrial and Commercial operations
Spill Containment and Control (Containment Diking, Curbing, Installation of spill and overflow protection)	Liquid Storage, Washing, Manufacture, Outside Storage, Waste Management, Fueling Areas, Loading and Unloading	Applicability to all Industrial and Commercial operations
Covering of Storage/Handling Facilities	Fueling Areas, Loading and Unloading, Liquid Storage, Material Storage, Outside Manufacturing, Waste Management	Applicability to all Industrial and Commercial operations

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6.0 NONSTRUCTURAL CONTROLS

Table IC-2 provides a listing of nonstructural controls that could be applied to potential pollutant sources to address stormwater runoff from industrial and commercial sites. A detailed description of the control can be found in the Chapter on Nonstructural BMPs.

TABLE IC-2
Summary of Nonstructural BMPs

BMP	Source	Applicability
Household Wastes and Toxics	Litter	Most likely associated with Commercial operations such as fast food restaurants.
	Used Oil and Automotive Fluids	Associated with Commercial operations that perform vehicle maintenance such as gasoline stations, quick lube shops, etc.
	Toxic Wastes	Associated with Commercial and Industrial facilities. Toxic wastes are used everywhere.
Pesticides, Herbicides, and Fertilizer	Application to Landscaping	Associated with Commercial and Industrial facilities which must maintain open areas. Pesticides may also be used at sites to control insects such as office buildings and restaurants.
Illicit Discharge Controls	Accidental Spill Response	Associated with Commercial or Industrial sites which transport, store, or dispose of toxic substances.
	Illicit Connections	Associated most closely with old industrial sites where the plumbing system is not well known.
Good Housekeeping Mitigation	Operation and Maintenance	Associated with Commercial and Industrial sites which store materials or equipment outside.
	Material Storage Practices	Associated with Industries which keep a large amount of materials onsite.
Preventative Maintenance	Vehicles and Equipment	Associated with medium to large Industrial facilities. Also associated with commercial operations which perform vehicle maintenance such as fleet operations.
	Building and Grounds	Associated with large Commercial or Industrial facilities.
Spill Prevention and Response, Minimization of Exposure	Spill Prevention Measures, Identification of Spill Areas, Spill Response Procedures	Associated with Commercial operations which are automotive related, and industries.
Painting Operations	Painting, Sand Blasting, and Cleanup	Associated with Commercial operations which perform painting or stripping of painted objects, specifically operations which finish metal such as auto painting.

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TABLE IC-2
Summary of Nonstructural BMPs

BMP	Source	Applicability
Above Ground Storage Tanks	Tanks	Associated with Industrial facilities or large commercial operations with above ground tanks for the storage of oils or other liquids used in bulk.
BMP Loading and Unloading	Docks	Associated with Industrial sites and large or medium Commercial operations which receive materials in bulk. Examples include stores which receive landscaping chemicals, paints, solvents.
	Tanker Trucks to Tanks	Associated with Industries and medium or large commercial operations and gasoline stations of any size.
Fuel Operations	Fuel Dispensing Area, General Facility	Associated with Industrial and Commercial operations which have fueling operations such s transportation fleets or gasoline stations.
Outside Material Storage	Outside Materials	Associated with Industrial or Commercial operations which store materials outside.
Vehicle and Equipment Washing	Vehicle and Equipment Washing	Applies to Industrial and Commercial operations which wash vehicles or equipment outside.
Dead-end Sumps	Liquid storage, Loading and unloading	Associated with Industrial operations.
Oil/Water Separators	Fueling, Maintenance, Washing	Associated with Industrial operations and commercial operations which deal with large quantities of oils.
Impervious Liners	Liquid Storage, Salt Storage	
Drip Pans	Maintenance areas, Fueling areas, Loading and Unloading (liquids)	Applicable to Commercial operations such as vehicle maintenance operations

NONSTRUCTURAL BEST MANAGEMENT PRACTICES

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1.0 INTRODUCTION TO NONSTRUCTURAL BMPs

1.1 Overview

This section contains guidance on the evaluation, selection and use of nonstructural Best Management Practices (BMPs). Each BMP is described and discussed as to its general application in an urban area. The following is a list of major areas of nonstructural BMPs that are considered to be appropriate and effective in stormwater quality improvement and are described in following sections of this chapter.

- Disposal of Household Waste and Toxics.
- Use of Pesticides, Herbicides and Fertilizer.
- Illicit Discharge Controls.
- Spill Prevention and Response.
- Preventative Maintenance.
- Painting Operations.
- Outside Material Storage.
- Stormwater Prevention Education.
- Mitigation.
- Vehicle Washing.
- Above Ground Storage Tanks.
- Good Housekeeping.
- Loading and Unloading.
- Fueling.
- Exposure Minimization.
- Outside Manufacturing.

Nonstructural BMPs are intended to prevent or reduce the contamination of stormwater runoff. They are applicable to a variety of different sources or activities. By reducing pollutant generation, adverse water quality impacts are reduced from potential pollutant sources. Preventing and controlling the sources of these pollutants requires a change in behavior. Some municipalities or industrial facilities will have already implemented many of the nonstructural practices as a means to address other concerns such as to control product loss, minimize waste production, accident and fire prevention, worker health and safety, site security, or to comply with other environmental regulations rather than for stormwater quality purposes.

1.2 Advantages of Nonstructural BMPs

Pollution of stormwater originates from many sources in urban areas. Structural controls reduce the amounts of pollutants that migrate off the urban landscape by reducing runoff and by providing facilities

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to remove pollutants from stormwater. Nonstructural BMPs prevent or limit the entry of pollutants into stormwater at their source. Prevention is desirable and can be cost effective because it minimizes pollution in the first place and thereby reduces the amounts that need to be removed by subsequent treatment. In urbanized portions of the municipality or existing facilities, it may be one of the few affordable methods for stormwater quality enhancement.

The advantages of nonstructural BMPs, among others, are:

- The quality of stormwater runoff is improved.
- The volume of sediment, debris, oils, chemicals and other pollutants deposited in receiving waterbodies is reduced.
- Frequency of needed maintenance of structural controls is reduced.
- Additional benefits to air quality, ground water quality, and solid waste control are realized.
- The public awareness of water-quality problems and involvement in solutions is heightened.
- Increased public awareness of stormwater quality issues.
- Most require only a modification of existing practices, are simple to understand, and make good sense.
- Implementation can occur rapidly.
- Does not require major capital construction financing.

1.3 Disadvantages of Nonstructural BMPs

Because nonstructural BMPs are tied closely to peoples'activities and behavior, their effectiveness depends on the peoples' attitude, their willingness to accept information, and their willingness to put BMPs into practice. Low participation will result in little or no benefit. A high percentage of participation has the potential for noticeable improvements in water quality.

Disadvantages to the use of nonstructural BMPs include:

- Public information is expensive to develop and distribute, and must be updated and redistributed on an ongoing basis.
- Effectiveness of good housekeeping measures is determined primarily by voluntary participation and consistency of activities.

- Initial public/private funding partnerships are needed to ensure participation and to encourage development of information and infrastructure improvements such as recycling centers and household toxics, and hazardous waste collection programs.
- Requires a dedicated workforce and funding to maintain viable programs and to continue citizen participation.
- Effects on stormwater quality from nonstructural BMPs are virtually impossible to quantify and to measure accurately without long-term data. On the other hand, the amounts of materials collected and recycled are quantifiable and could serve as an indirect measure of overall success.

2.0 USE OF NONSTRUCTURAL BMPS

2.1 Objectives in the Use of Nonstructural BMPs

Nonstructural BMPs are used to complement structural BMPs or as the only available control method in existing developed areas where retrofit construction of structural BMPs is not cost effective. Implementation of only nonstructural efforts, however, may or may not achieve measurable water quality benefits.

As part of the development of the *Manual*, a number of nonstructural BMPs were identified for potential use by municipalities and industrial /commercial areas. A group of local government representatives recommended the following as the nonstructural BMPs for inclusion in the *Manual* after evaluating these for effectiveness, feasibility of implementation, cost, and maintenance. Additional nonstructural measures will be examined in the future, and if they prove to be promising in reducing the amount of pollutants being delivered by stormwater to the receiving water system, they will be included in the future editions of the *Manual*.

This list includes nonstructural BMPs which are applied to various different types of sites. Nonstructural BMPs are implemented by various entities. Because they rely on actions and not structures, nonstructural BMPs must be implemented constantly and repetitively over time.

Other nonstructural BMPs were considered for inclusion in the *Manual*, but were deemed at this time to be inappropriate to use, for local governments to require their use by others, or were judged to be not effective enough in controlling sources of pollution. There are two main objectives of using nonstructural BMPs. These are:

(1) Reduce or eliminate the pollutants that impact water quality at their source, thus reducing the need for structural control requirements. For example, nonstructural BMPs implemented at an industrial site may result in elimination or reduction of the introduction of oils and greases into the stormwater. This could result in the better efficiency of a infiltration basin or the elimination of the need for additional treatment for oils.

(2) Address water quality concerns that are not cost effectively handled by structural controls. An example is an effective system for determining illicit discharges or connections into a stormwater system. It would not be practical for all stormwater to be collected and treated to address water quality impacts from such discharges. It is more effective to develop and implement a program for finding these sources and addressing them.

2.2 Nonstructural BMP Effectiveness

To be effective, nonstructural BMPs need to prevent or reduce the sources of stormwater pollution. They fall into the general categories of prevention and source controls. Preventing and controlling the source of pollutants that come in contact with stormwater requires a change in the behavior of the urban population and in the waste disposal practices they employ.

The objectives for promoting the use of nonstructural BMPs are as follows:

- Improve the quality of receiving waters.
- Increase consistency with stormwater quality objectives.
- Increase consistency with structural BMPs.
- Improve cost effectiveness.
- Widespread applicability in all urban areas.
- Widespread public acceptance.

The effectiveness of nonstructural BMPs is difficult, if not impossible, to quantitatively assess. For example, to determine the effectiveness of a public education program on chemical usage, it would be necessary to have data on the residential and commercial chemical usage in the area, the amounts of chemicals which enter the storm sewer system that is attributable to improper usage and/or disposal, and the amount washed off by stormwater before and after the implementation of the program.

The recommendations for the use of nonstructural practices included in the *Manual* are based more on an intuitive presumption that some level of improvement will be realized if the practices are implemented. Preventing or reducing the amount of pollutants at the source is usually more cost effective than structural controls that remove pollutants after they have entered stormwater.

It can also be argued that aggressive use of nonstructural measures will reduce concentrations and loads of various pollutants in stormwater being conveyed to downstream structural BMPs or to the receiving waters. This is especially the case in existing urban areas where structural controls cannot be easily built, or are extremely expensive to retrofit into the fully-developed urban landscape.

2.3 Pollutant Removal Mechanisms

Nonstructural BMPs can, to some degree, prevent the deposition of pollutants on the urban landscape or remove pollutants at their source. The source of pollutants for assimilation into stormwater is the land surface itself, especially the impervious surfaces in the urban area. Thus, it is expected that when nonstructural measures are effectively implemented, they will reduce the amount of pollutants being deposited on land surfaces for eventual contact with stormwater and transported to the receiving water system.

2.4 Nonstructural BMP Selection and Use Guidelines

Most nonstructural BMPs are applicable for use in residential, commercial, and industrial areas. This can be said for newly developing areas, recently developed areas, and old neighborhoods as well.

For newly developing and redeveloping areas, nonstructural BMPs include municipal programs to ensure that new urban development and redevelopment incorporates appropriate temporary erosion and sediment control during construction and also permanent structural BMPs as a part of the development. Such municipal programs include institutional mechanisms that require the proponents of a new development to prepare and submit stormwater quality control management plans in accordance with the municipality's stormwater BMP design criteria and standards, including the erosion control and stormwater management during construction. These programs need adequate staff and fiscal resources to review and approve development plans and to ensure that the approved stormwater quality provisions of these plans are properly implemented.

The remaining nonstructural BMPs described in the *Manual*, are targeted at developed areas and industrial/commercial sites. Most rely primarily on public education, and procedural changes and possible enforcement programs. In selecting the appropriate nonstructural pollutant reduction programs to adopt, each manager facility needs to evaluate its current land-use condition and the potential for removal of pollutants offered by each of these practices. The specifics for selection and use of each nonstructural BMP effort are described for each management practice.

Nonstructural BMPs fall into several categories which include:

- Waste Minimization - Source Control
- Good Housekeeping
- Preventative Maintenance
- Minimization of Exposure
- Spill Minimization and Prevention
- Public Education
- Mitigation

Within these categories, some BMPs are more appropriate for industrial/commercial sites while others apply to construction sites. In some cases the BMP may be applicable to residents and thus are best addressed by local or state government.

In determining which nonstructural BMPs should be implemented, it is recommended that as part of the overall planning process an evaluation be made of the potential sources of pollutants and the best means of addressing them. For example, if the concern is bacteria loadings, then a program on pet litter may be appropriate. If the problem is oil and grease in the runoff from a gasoline station or autoshop, then nonstructural controls dealing with spill prevention may be appropriate. Thus, once the source or activities are determined the list of BMPs should be consulted to determine the most applicable practices.

3.0 DISPOSAL OF HOUSEHOLD WASTE AND TOXICS

3.1 Primary Users

These best management practices apply to municipalities, civic groups, commercial businesses, and industry.

3.2 Description

Improperly disposed waste materials are a source of stormwater pollution. These wastes can include household chemicals, pet waste, yard waste, litter, automotive maintenance waste and others. This is especially true when wastes are placed on impervious surfaces or directly into the storm drainage system, such as streets, alleys, parking lots and sidewalks, and pervious structures such as ditches, drainageways, gulches, etc.

The development of education programs and dissemination of information that promotes proper disposal of household (solid) waste, litter, pet waste, yard waste, used oil, and toxic waste is a nonstructural Best Management Practice (BMP). The passage of laws, rules, or ordinances prohibiting improper disposal of these materials, and their enforcement, is another step in this management practice. An on-going education program, along with facilities for such disposal, has been judged to be most effective at this time.

3.3 Application

Waste materials deposited on the urban landscape, especially the impervious surfaces, can be washed off by stormwater runoff and delivered to the receiving water system. Thus, all measures that help to minimize the presence of these materials on the urban landscape can improve water quality. Proper disposal of household waste and toxics can reduce the deposition of solids, organics, nutrients, oxygen-demanding substances, solvents, caustics, paints, automotive fluids, toxic substances and fecal matter on the land and reduce their presence in stormwater reaching the receiving waters.

3.3.1 Public Education. Public education can be used to explain to the general public how improper disposal of wastes can degrade stormwater quality, and how proper disposal can help to protect the quality of receiving waters. Public education is also a means to show how water quality personally affects each of us (e.g., higher treatment costs, health, etc.) Several categories of waste materials were identified where public education can be effective in reducing the amounts of pollutants entering municipal stormwater runoff. Each of these are discussed below.

3.3.1.1 Household Waste. Household waste includes materials discarded on the land surface or into the stormwater system from residential and commercial areas. Wastes from commercial businesses are generated by stores, restaurants, hotels, offices, and other non-manufacturing activities. Commercial waste is considered to be similar to residential waste and is addressed collectively under this definition. Toxic wastes from residential and commercial areas are considered a subcategory of household waste.

Refuse is solid waste that is contained, whereas litter is uncontained. Refuse is controlled through existing programs of solid waste collection and disposal. The goal of household waste disposal is to contain all refuse, reduce litter, and encourage proper waste disposal through public education.

Examples are:

<u>3.3.1.2 Litter</u>. Most litter is biodegradable and can create an oxygen demand in water as it decomposes. Examples of litter are paper products, used diapers, etc. Research by Keep America Beautiful, Inc. (1990) has shown that people litter where litter has already accumulated. Also according to Keep America Beautiful, Inc. (1987), pedestrians and motorists account for less than 25% of litter, the other sources being household waste, commercial and industrial waste, haulage vehicles, loading docks, and construction sites. Reduction of litter through proper disposal can reduce its accumulation on the urban landscape and its eventual entry into the stormwater system.

<u>3.3.1.3 Pet Waste</u>. Pet waste deposited on impervious surfaces can be transported by the stormwater drainage system to receiving waters. Fecal matter potentially contains pathogenic viruses and bacteria, and also creates an oxygen demand in water.

The majority of improperly disposed pet waste occurs in public areas, such as streets and parks. Pet waste ordinances are common in municipalities, however, these are difficult to enforce especially with limited municipal resources. Public education can help bring this problem to the public's attention, and can thereby reduce deposition of pet waste on urban surfaces.

<u>3.3.1.4 Yard Waste</u>. Yard waste is also a category of household waste. Examples of yard waste include leaves and grass clippings. It is distinguished from other categories of household waste in that it can be disposed of by composting. Composting is the aerobic decomposition of plant and other organic materials.

Yard waste accounts for 18% of the municipal waste stream on a weight basis (Keep America Beautiful, 1987). Fallen tree leaves, grass clippings and garden debris can become water pollutants when they are disposed of in alleys, driveways, parking lots, streets, street gutters, irrigation ditches, and drainage channels. Public education efforts on the benefits of composting and on proper disposal of yard waste can help to reduce the volume of yard waste entering the stormwater system and receiving waters.

<u>3.3.1.5 Used Oil and Automotive Fluids</u>. Used oil and automotive fluids including antifreeze, brake fluid, transmission fluid, grease, other lubricants, and petroleum-based cleaning solvents are wastes generated during automobile maintenance by residential households and commercial businesses. These can enter the storm drainage system if poured directly into storm inlets or from residual on concrete or asphalt exposed to precipitation.

Improper disposal of used oil and automotive fluids cause receiving waters to become contaminated with hydrocarbons and residual metals that can be toxic to stream organisms. Used oil and other petroleum products can be recycled. A number of different recycling centers presently exist in the metropolitan area. Public education on the location of these centers, the benefits of recycling, prevention of fluid leaks, and the importance of proper disposal for improving stormwater quality, can reduce the amounts of oil and used automotive fluids reaching receiving waters.

3.3.1.6 Toxic Wastes. Toxic wastes are generated by residential households and commercial businesses. These primarily consist of certain types of used and unused consumer products. Included among these are paint, solvents, putties, cleaners, waxes, polishes, oil products, aerosols, acids, caustics, pesticides, herbicides, and certain medicines or cosmetics. These products and their containers should always be disposed of properly. Some of these unused toxic materials can also be recycled.

Improper disposal of toxic substances cause stormwater to become contaminated by these wastes. This occurs when toxic substances are dumped into street gutters or storm inlets. This also happens when stormwater comes in contact with toxic substances or where they have been improperly disposed on land surfaces.

There is no need for improper disposal of toxic substances since, according to legislation passed by the U.S Congress (1976), small amounts of toxic materials can legally be disposed of in landfills. Educational efforts to heighten public awareness of the environmental damage due to improper disposal, and to encourage proper disposal and recycling can reduce the amountsof these pollutants entering stormwater, provided the public as a whole actively participates.

3.3.1.7 Cost Considerations. Collection and disposal of household wastes can be expensive. Where hazardous/toxic wastes are involved there is a need for operators to be adequately trained, analysis to be done of unknown materials, safe transport and containers, and extensive recordkeeping.

There are also regulatory requirements on how wastes can be disposed. Disposal or hazardous wastes must follow the requirements outlined in the Resource Conservation and Recovery Act and associated regulations.

3.4 Implementation

The implementation of a public education and information program can include one or more of the following general approaches:

- Development, publication and distribution of brochures
- Utility bill inserts, flyers and handbills
- Newspaper articles and/or advertisements
- Development and distribution of educational videos

- Public workshops, including field demonstrations
- Developing school curricula, and
- Developing and installing posters and signs

The following are specific examples that may be considered for use:

- Signs, including graphics, on dumpsters and other locations encouraging proper waste disposal
- Brochures and utility bill inserts on separation of wastes and recycling
- Advertising the locations of existing toxic disposal sites and waste recycling centers
- Advertising the locations of existing automobile fluids and used oil disposal sites
- Establishing and maintaining household toxics disposal sites
- Annual or curbside collection of household toxics
- Signs in parks and along streets on pet waste control and ordinances
- Pet waste disposal bags in public parks
- Voluntary neighborhood clean-up efforts
- Waste containers in problem litter areas
- Requiring waste-haulage truck covers
- Seasonal collection programs for tree branches and leaves
- On-going collection program, or disposal sites, for grass clippings and other yard waste
- Distribution programs to recycle compost as mulch
- Advertisements or notices of private locations accepting yard waste for composting
- Information on backyard or neighborhood composting and proper disposal of yard waste

All of these examples are not likely to be used by a municipality at any given time. Local conditions, public attitudes, and fiscal constraints will determine what combination is most appropriate and effective for use in each municipality.

3.5 Advantages and Disadvantages

It is unknown at present the extent of runoff contamination due to improper disposal of various household waste materials. The amount of water quality improvement that can result from public education on proper disposal methods and opportunities for recycling have yet to be quantified. Intuitively, there should be some benefit if the amount of these wastes is reduced.

3.5.1 Advantages. Major advantages of public education on proper disposal of household waste and toxics can include:

- Reduction in the quantities of solids, metals, floatable materials, oxygen-consuming materials, nutrients, fecal matter, oil and toxic substances transported by stormwater to receiving waters
- Improved aesthetics of parks and public areas.

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- Appropriate disposal of more wastes at landfills.
- Reduced littering on the urban landscape.
- Increased recycling and resource recovery.
- Heightened awareness and public understanding of how each person can pollute receiving waters and how each person can help to prevent their pollution.

3.5.2 Disadvantages. Some disadvantages associated with the use of this BMP include:

- Its success and effectiveness depends on voluntary efforts.
- Places an increased demand on recycling facilities and products.
- Extremely difficult to quantify pollutant load reduction.
- Requires an on-going effort to continuously provide public education through distribution of educational materials and a means to respond to questions the public may have relative to disposal.
- May require ordinances and enforcement actions in some cases to address the more difficult and persistent activities generating pollutants.

4.0 USE OF PESTICIDES, HERBICIDES AND FERTILIZER

4.1 Primary Users

This BMP applies to commercial applicators and municipalities and industries who apply their own pesticides, herbicides and fertilizers.

4.2 Description

Pesticides, herbicides, and fertilizers are used to maintain landscaping in residential, commercial and industrial areas. These substances are usually toxic and can contaminate surface runoff if not properly used. This nonstructural BMP consists of the development and dissemination of information to the public that encourages proper use and application of pesticides, herbicides, and fertilizers.

4.3 Application

Pesticides, herbicides, and fertilizers are chemicals used in landscape maintenance. Pesticides are used for insect control, herbicides are used for weed control, and fertilizers are used to promote growth of grasses, flowers, trees, shrubs, and other vegetation. While pesticides and herbicides are toxic to aquatic life at low concentrations, fertilizers are usually only toxic at high concentrations. Fertilizers, however, are more commonly a problem because of their nutrient-enrichment effect on receiving waterbodies. An oversupply of phosphorus and nitrogen will promote alga growth that can lead to a depletion of dissolved oxygen needed for fish and other aquatic organisms. These chemicals are applied on urban landscape areas and, when improperly applied or used, can be transported to receiving waters in surface runoff.

The rate and timing of application of pesticides, herbicides, and fertilizer are important to minimize transport by surface runoff, as well as to optimize their intended purpose in landscape maintenance. Overapplication and overspraying of pesticides, herbicides, and fertilizers onto impervious areas, such as streets and sidewalks, need to be avoided as well as excessive or too frequent use of these chemicals. Use of these chemicals in accordance with manufacturer's recommendations can prevent most of the surface water contamination being attributed to their use.

Public education can be an effective method of ensuring proper use of these chemicals. Raising the general level of understanding of how individual action in the use of these chemicals can contaminate surface runoff and the receiving waterbodies can make each person aware of the problem. Whether this awareness will translate into an improved use of these products will then depend on individual attitudes. Thus, dissemination of information to the public on the impacts of improper use and how to use landscape maintenance chemicals is the basis for this nonstructural BMP.

4.4 Implementation

The development of an ongoing educational program is the basis of this nonstructural BMP. The audience to be targeted is residential homeowners and small businesses.

As a first step, technical information on pesticides, herbicides and fertilizers and their proper use must be developed. The following sources can be consulted:

- Existing state regulations on pesticide application, certification, and weed control,
- Federal legislation, regulations and technical reports,
- Chemical manufacturer's technical manuals, product labels and use directions, storage and proper disposal guidelines, and material safety data sheets,
- Sprayer manufacturer's calibration guides,
- Sorbent manufacturer's spill management guides,
- University and County Agricultural Extension Service horticultural guides,
- Rocky Mountain Poison Center safety guidelines, and
- Other studies and available information.

One method being used by some is Integrated Pest Management (IPM). This is best applicable to commercial, agricultural and other large scale users of pesticides. IPM is a decision-making process for pest management whose goal is an intelligent, environmentally sound control of pests. It uses biological, chemical, and genetic information to determine the best type of control, the timing and extent of chemical applications and whether non-chemical means can attain an acceptable level of pest control.

IPM is a preventive measure aimed at knowing the exact pest(s) being targeted for control, the locations and times when pests will pose problems, the level of pest-induced damage that can be tolerated without taking action, the most vulnerable life stage, and control actions that are least damaging to the environment. The major components of IPM are as follows: monitoring and inventory of pest populations, determination of pest-induced injury and action levels, identification of priority pest problems, selection and timing of least toxic management tools, site-specific treatment with minimized chemical use, and evaluation and adjustment of pesticide applications. Monitoring of pest populations is a key to successful IPM implementation. Pest problems are universally easier to control if the problem can be discovered early. With IPM pesticides are used only as a last resort; maximization of natural controls, including biological controls and removal of pests by hand, is a guiding rule.

Methods available for public education on the use of pesticides, herbicides and fertilizers are very similar to those described in Section 4.4 of this chapter and the reader is referred to that section for details.

Methods available for public education on the use of pesticides, herbicides and fertilizers are very similar to those described in Section 4.4 of this chapter and the reader is referred to that section for details.

4.5 Advantages and Disadvantages

Although it is possible to quantify the amounts of pesticides, herbicides, and fertilizers used by residential, commercial, and industrial areas within a geographic location, it is not known what part of that quantity is improperly used. There should be some amount of overall benefit, however, if educational efforts result in a general increase in the number of people properly using and applying these chemicals in urban areas.

4.5.1 Advantages. Major advantages of the use of this BMP include:

- Can reduce the source of pesticides, herbicides and fertilizers eventually entering receiving waters.
- Can help reduce the level of phosphorus and nitrogen in receiving waters, thereby positively affecting the problem of nuisance growth of algae, and eutrophication of small lakes and tributary streams.
- Encourage the use of less toxic or substitute methods of pest and weed control that, if followed, further reduce the supply of pesticides and herbicides for contact with surface runoff.
- Heighten the awareness and public understanding of how individual actions can add to or reduce stormwater pollution.

4.5.2 Disadvantages. Some disadvantages associated with the use of this BMP include:

- Difficult to reach and influence all commercial and residential users of these chemicals.
- Difficult to present technical information in simplified form to all users.
- Extremely difficult to quantify extent of how implementation of this BMP translates into water quality effects in receiving waters.
- Requires on-going educational activities and the distribution of information.

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5.0 ILLICIT DISCHARGE CONTROLS

5.1 Primary Users

This BMP applies primarily to municipalities. It could also be applicable to large commercial enterprises or industry, such as office parks, which have multiple activities occurring at its site.

5.2 Description

Activities that reduce the entry of pollutants into the municipal storm sewer system from physical connections to the storm drain system of sanitary sewers and floor drains, or from illicit discharges, accomplished through regulation, inspection, testing, and education can enhance the quality of receiving waters. These include controls on illegal dumping of toxic substances and petroleum products, responses to contain accidental spills, measures to locate and disconnect illicit connections of sanitary sewers to storm sewers, and measures to prevent additional illicit sanitary sewer connections in the future. To their credit, many municipalities already have programs in place to address all of these concerns. Measures that limit these types of illicit discharges to the storm drainage system are considered nonstructural best management practices (BMPs).

5.2.1 Illegal Dumping. Illegal dumping occurs whenever toxic substances or other pollutants are dumped into or disposed of directly into storm inlets, other storm drainage facilities, or onto the urban landscape. Prohibitions against such activity have been enacted by many municipalities, however, enforcement is difficult because of the often clandestine nature of illegal dumping and the large areas over which such activities can take place.

Nonstructural BMPs that can be considered for implementation by local municipalities are based on efforts to increase surveillance of illegal dumping. These include developing educational materials for the public about these illegal practices and the hazards they create to the public health and the environment, encouraging increased public reporting, possibly establishing a "hotline" telephone number for citizens to call to report dumping incidents, or making illegal dumping a part of the 911 reporting network. Strong enforcement action against violations, accompanied by publicity, could discourage such activities by others.

5.2.2 Accidental Spill Response. The storage, transport and disposal of hazardous and toxic substances is a regulated activity under state and federal laws. Response procedures for management of accidental spills of pollutants are practiced presently by many municipalities. As a result, many local police, fire, or other departments are equipped to respond to such spills. Nevertheless, most spills have the potential to contaminate receiving waters via transport by the storm sewer system.

Additional measures that might be considered by local governments include mapping of storm sewer systems and detention ponds to identify the locations of stormwater inlets for drainage system. Such maps can then be used by the emergency response crews to help identify which inlets, areas, or sewers to protect or block off in the event of a spill. Once a spill occurs, it should be monitored to determine when the area of the spill has been adequately cleaned up. All of these measures, as well as on-going practices, need periodic updating and refresher training to be current. Training, updating of procedures, field exercises and proper equipment are all part of a spill response program.

5.2.3 Illicit Connections. Illicit connections of sanitary sewers to the stormwater runoff system in new developments can be prevented by an aggressive and competent inspection program by municipal or utility personnel. Illicit connections can exist, however, in older developments. Some municipalities have taken steps in the past to identify these and have disconnected those that were found. A well-organized program to find illicit sanitary connections also requires accurate mapping of the sanitary and storm sewer systems and a thorough understanding of these systems. Program elements may include:

- Ensure that existing building and plumbing codes prohibit physical connections of nonstormwater discharges to the storm drain system.
- Require visual inspection of new developments or redevelopments during the construction phase.
- Develop documentation and recordkeeping protocols to track inspections and catalog the storm drain system.
- Use techniques such as zinc chloride smoke testing, fluorometric dye testing, and television camera inspection to verify physical connections.

To isolate likely sources, personnel first need to look for visual signs of illicit connections at storm sewer outfalls, relying on sight and smell. If the initial screening indicates a possible illicit connection, random dry-weather sampling and testing for indicator constituents can help to further identify if there may be illicit connections in the system. These then need to be investigated further with a well-planned "seek and destroy" effort that is designed to address the specific nature of the storm drainage and wastewater systems. Occasional random dry-weather screening can also be conducted, especially in areas where the greatest potential exists for illicit connections, however, these are of limited usefulness for detecting illicit discharges. These tests may identify illicit connections that discharge occasionally and in a random manner, a typical scenario for individual wastewater discharges. Excavation of sewer lines at the point of connection, and reconnection of the sanitary sewer line to the appropriate system is the final step to correct the problem.

5.3 Implementation

Public awareness is the key to implementation of this BMP. Awareness that discharges enter the stormwater system, that separate systems exist for stormwater and sanitary wastewater, and that illicit discharges to the stormwater system are not treated may be sufficient to limit these discharges in the future.

The following actions, if not already in place, can be considered for use by local jurisdictions:

- Enactment of ordinances prohibiting illegal dumping and illicit connections.
- Developing a public education program advising the residents of potential problems that can result from illegal dumping, illicit connections and accidental spills. Educate the public about an existing or new anti-dumping ordinance.
- Install a "hotline" telephone number, or make 911 a part of this program to handle calls from citizens reporting illegal dumping or accidental spills.
- Review and update training procedures, equipment and material inventories, and administrative procedures for spill containment and management.
- Conduct random field screening of stormwater outfalls to find illicit wastewater connections to storm drainage systems. Illicit connections that are discovered should be plugged or tapped into the sanitary sewer or other acceptable or legal disposal systems. This may include obtaining an NPDES permit.
- Train field inspectors and develop field inspection procedures that prevent new illicit connections of sanitary sewer lines to storm sewers.
- Have a program in place to review and approve any proposed connection into a storm sewer.

5.4 Advantages and Disadvantages

The question of whether actions to reduce illegal dumping, contamination from accidental spills and illicit discharges have advantages or disadvantages is immaterial. This is evidenced by the fact that many municipalities have one or more programs currently in place. Pollutants entering the storm sewer systems by illegal dumping, spills, and illicit connections can contribute to public health problems that deserve on-going attention. Thus, mitigation efforts can provide benefits to water quality in the receiving system while protecting public health and welfare. However, there are costs associated with these activities. Possible limitations for this BMP include the fact that proper connections can be altered after initial connection, the cost of equipment for monitoring and inspection can be expensive, and improper physical connections to the storm drain system can occur in many different ways such as overflow of cross connection and floor drains from businesses such as autoshops and restaurants.

6.0 GOOD HOUSEKEEPING

6.1 Primary Users

These BMPs involve three key audiences: municipal employees, the general public, and small businesses.

6.2 Descriptions

Good housekeeping requires keeping potential areas where pollutants exist clean and orderly.

6.3 Application

Good housekeeping practices are designed to maintain a clean and orderly work environment. The most effective first steps towards preventing pollution in stormwater from work sites simply involves using good common sense to improve the facility's basic housekeeping methods. Poor housekeeping practices result in more waste being generated than necessary and an increased potential for stormwater contamination.

A clean and orderly work site reduces the possibility of accidental spills caused by mishandling of chemicals and equipment and should reduce safety hazards to personnel. A well-maintained material and chemical storage area will reduce the possibility of stormwater mixing with pollutants.

Some simple procedures a facility can use to promote good housekeeping are: improved operation and maintenance of machinery and processes, material storage practices, material inventory controls, routine and regular clean-up schedules, maintaining well organized work areas, signage, and educational programs for employees and the general public about all of these practices.

6.4 Implementation

These BMPs are applicable to the following areas: operation and maintenance, material storage, material inventory, and training and participation.

6.4.1 Operation and Maintenance. To ensure that equipment and work related processes are working well the following practices can be implemented:

- Maintain dry and clean floors and ground surfaces by using brooms, shovels, vacuum cleaners or cleaning machines rather than wet clean-up methods.
- Regularly pickup and dispose of garbage and waste material.
- Make sure all equipment and related processes are working properly and preventative maintenance is kept up with on both.

- Routinely inspect equipment and processes for leaks or conditions that could lead to discharges of chemicals or contact of stormwater with raw materials, intermediate materials, waste materials, or products used on site.
- Ensure all spill clean up procedures are understood by employees. Training of employees on proper clean up procedures should be implemented.
- Designate separate areas of the site for auto parking, vehicle refueling and routine maintenance.
- Clean up leaks, drips and other spills immediately.
- Cover and maintain dumpsters and waste receptacles.

6.4.2 Material Storage Practices. Improperly storing of material on site can lead to the release of materials and chemicals that can cause stormwater runoff pollution. Proper storage techniques include the following:

- Provide adequate aisle space to facilitate material transfer and ease of access for inspection.
- Store containers, drums, and bags away from direct traffic routes to prevent accidental spills.
- Stack containers according to manufacturer's instructions to avoid damaging the containers from improper weight distribution.
- Store containers on pallets or similar devices to prevent corrosion of containers that results from containers coming in contact with moisture on the ground.
- Store toxic or hazardous liquids within curbed areas or secondary containers.
- Assign responsibility of hazardous material inventory to a limited number of people that are trained to handle such materials.

6.4.3 Material Inventory Practices. An up-to-date inventory kept on all materials (both hazardous and non-hazardous) present on site will help keep material costs down caused by overstocking, track how materials are stored and handled onsite, and identify which materials and activities pose the most risk to the environment. The following description provides the basic steps in completing a material inventory:

- Identify all chemical substances present at work site. Perform a walk through of the site, review purchase orders, list all chemical substances used and obtain Material Safety Data Sheets (MSDS) for all chemicals.

- Label all containers. Labels should provide name and type of substance, stock number, expiration date, health hazards, handling suggestions, and first aid information. This information can also be found on a MSDS.
- Clearly mark on the hazardous materials inventory which chemicals require special handling, storage, use and disposal considerations.

Institute a shelf-life program to improve material tracking and inventory that can reduce the amount of materials that are overstocked and ensure disposal of out-dated materials. Careful tracking of materials ordered can result in more efficient materials use. Decisions on the amounts of hazardous materials that are stored on site should include an evaluation of any emergency control systems that are in place. All storage areas should be designed to contain any spills.

6.4.4 Training and Participation. Frequent and proper training in good housekeeping techniques reduces the possibility of chemicals or equipment that will be mishandled. Reducing waste generation is another important pollution prevention technique. The following are ways to get people involved in good housekeeping practices:

- Provide information sessions on good housekeeping practices in training programs.
- Discuss good housekeeping at meetings.
- Publicize pollution prevention concepts through posters or signs.
- Post bulletin boards with updated good housekeeping procedures, tips and reminders.

6.5 Advantages and Disadvantages

An advantage of Good Housekeeping BMPs is that they are inexpensive to implement. The primary cost is staff time. Benefits of a clean and orderly site can go beyond stormwater quality improvement. This could include a more accurate inventory of materials on site or reduction in worker injuries, for example, slips on wet surfaces.

A disadvantage of this BMP is that, like many nonstructural BMPs, employee awareness and education is key. Continued awareness training is necessary to ensure that positive behaviors are maintained.

7.0 PREVENTATIVE MAINTENANCE

7.1 Primary Users

This BMP is applicable to industrial and commercial sites.

7.2 Description

Preventative maintenance involves the regular inspection and testing of plant equipment and operational systems. These inspections should uncover conditions such as cracks or slow leaks which could cause breakdowns or failures that result in discharges of chemicals to surface waters either by direct overland flow or through storm drainage systems. The purpose of the preventative maintenance program should be to prevent breakdowns and failures by adjustment, repair, or replacement of equipment before a major breakdown or failure can occur.

Preventative maintenance has been practiced predominantly where excessive down time is extremely costly. As a stormwater best management practice (BMP), preventative maintenance should be used selectively to eliminate or minimize the spill of contaminants to receiving waters. For many facilities, this would simply be an extension of the current plant preventative maintenance program to include items to prevent stormwater runoff contamination.

For sites that have storm drainage facilities, proper maintenance is necessary to ensure that the drainage facilities serve their intended function. Without adequate maintenance, sediment and other debris can quickly clog facilities and render them useless. Typically, a preventative maintenance program should include inspections of conveyance channels, storm sewers, inlets, catch basins, stormwater detention areas, and other water quality treatment systems.

Most plans already have preventative maintenance programs that provide some degree of environmental protection. This program could be expanded to include stormwater considerations, especially the upkeep and maintenance of storage tanks, valves, pumps, pipes, and other process-water or chemical feed devices.

7.3 Application

Preventative maintenance procedures and activities are applicable to almost every facility. Preventative maintenance should be part of a general good housekeeping program designed to maintain a clean and orderly work environment. Often the most effective first step towards preventing stormwater pollution from sites simply involves good common sense to improve the facility preventative maintenance and general good housekeeping methods.

7.4 Implementation

Elements of good preventative maintenance program should include:

- Identification of equipment or systems which may malfunction and cause spills, leaks, or other situations that could lead to contamination of stormwater runoff. Typical equipment to inspect include pipes, pumps, storage tanks and bins, pressure vessels, pressure release valves, process and material handling equipment, and stormwater management devices.
- Once equipment and areas to be inspected have been identified at the facility, establish schedules and procedures for routine inspections.
- Periodic testing of plant equipment for structural soundness is a key element in a preventative maintenance program.
- Promptly repair or replace defective equipment found during inspection and testing.
- Keep spare parts for equipment that needs frequent repair.
- Replace parts that are severely worn prior to failure.
- It is important to include a record keeping system for scheduling tests and documenting inspections in the preventative maintenance program.
- Record test results and follow-up with corrective action taken. Make sure records are complete and detailed. These records should be kept with other visual inspection records.

The key to properly tracking a preventative maintenance program is through the continual updating of maintenance records. Records should be updated immediately after preventative maintenance, or when any repair has been performed on any item in the plant. An annual review of these records should be conducted to evaluate the overall effectiveness of the preventative maintenance program. Refinements to the preventative maintenance procedures and tasking should be implemented as necessary.

Maintenance activities associated with vehicle and equipment include the following:

- Maintain clean equipment, no excessive amounts of oil and grease buildup.
- Use drip pans or absorbents where repairs are performed outside and in potential problem areas.
- Use appropriate facilities to perform repairs involving exchange of fluids and lubricants and lot painting.
- Drain and crush oil filters before recycling or disposal.
- Clean any catch basins that receive runoff from a maintenance area.

- Do not hose down work areas or use concrete cleaning products; use mops or dry sweeping compound. Store mechanical parts and equipment under cover.
- Drain all fluids and remove batteries from salvage vehicles and equipment.
- Recycle or dispose of the following in the correct manner: greases, oils, antifreeze, brake fluid, all cleaning solutions, hydraulic fluid, batteries, transmission fluid, worn parts, filters and rags.
- Use recycled products and substitute materials with less hazardous properties where feasible.
- Provide employee awareness training.
- Store solvents, greases, oils, hydraulic fluids, paints, thinners and hazardous materials indoors.
- Store used oil for recycling in self-contained labeled tanks.
- Keep spill response information and spill cleanup materials on the site and readily available.
- Located used oil tanks and drums away from the nearest inlet to the storm drainage system, flowing streams and preferably indoors if possible.

Maintenance activities associated with building and grounds include:

- Chemical applicators should be required to adhere to all regulations regarding handling, storage and application of herbicides, insecticides, fungicides and rodenticides.
- All chemicals should be handled and stored in compliance with their Material Safety Data Sheets (MSDS).
- All chemicals should have their associated MSDS information sheets logged on the inevntory maintained by the site administrator responsible for stormwater management.
- All materials should be stored as described in the Outdoor Materials Storage BMPs.
- Where possible, leave native vegetation undisturbed, and plant native vegetation in disturbed soil areas, to reduce irrigation, fertilizer and pesticide needs.
- Sweeping of paved surfaces.
- Cleaning of stormwater drainage systems should occur at appropriate intervals.
- Proper disposal of wash water, sweepings and sediments should occur.

7.5 Advantages and Disadvantages

There are several advantages associated with preventative maintenance. These include:

- Reduction in the amount of down time due to unanticipated equipment breakage.
- Planned equipment down time.

Disadvantages associated.with preventative maintenance include:

- Additional costs.
- Availability of trained preventative maintenance staff.

8.0 SPILL PREVENTION AND RESPONSE

8.1 Primary Users

Owners and operators of commercial and industrial facilities that store, process or refine liquid products.

8.2 Description

This BMP includes measures to be taken to ensure that spills do not result in water quality impacts.

Spills and leaks together are one of the largest sources of stormwater pollutants, and in most cases are avoidable.

8.3 Application

The primary objective of the following BMPs is the prevention and reduction of discharges of pollutants to stormwater as a result of spilled products and materials.

8.4 Implementation

8.4.1 Spill Prevention Measures. For industrial facilities and automotive related industries the following preventative strategies are:

- Identify all equipment that may be exposed to stormwater, pollutants that may be generated, and possible sources of leaks or discharges.
- Perform regular maintenance of each piece of equipment to check for: proper operation, leaks, malfunctions, and evidence of leaks or discharge (stains). Develop a procedure for spill reporting, clean up, and repair.
- Drain or replace motor oil or other automotive fluids in an area away from streams or storm or sanitary sewer inlets. Collect spent fluids and recycle or dispose of properly.
- In fueling areas, clean up spills with dry clean up methods (absorbents), and use damp cloths on gas pumps and damp mops on floors instead of a hose.

An important part of spill prevention is employee training. Make sure employees are trained in spill prevention practices and adhere to them.

The best way to prevent pollutants from entering the storm drains is to prevent stormwater from contacting equipment or surfaces that may have oil, grease, or other pollutants. Some good activities to help prevent negative impacts on stormwater quality include:

- Dispose of stormwater that has collected in containment areas properly (may need permit if contaminated).

- Adopt effective housekeeping practices.
- Ensure adequate security.

8.4.2 Identification of Spill Areas. It is important to identify potential spill areas and their drainage points to determine preventative measures and spill response actions. Areas and activities that are most vulnerable to spills include transportation facilities where vehicle spills could be a problem:

- Loading and Unloading areas
- Storage Areas
- Process Activities
- Dust or Particulate Generating Processes
- Waste Disposal Activities

In addition to these areas, evaluate spill potential in other areas (access roads, parking lots, power generating facilities, etc.). It is also important to estimate the possible spill volume and drainage paths.

8.4.3 Material Handling Procedures. For industrial facilities recommended outdoor materials handling procedures include:

- Keep bulk solid materials (including raw materials, sand, gravel, topsoil, compost, concrete, packing materials, metal products) covered and protected from stormwater.
- When possible, store materials on a paved surface.
- Hazardous materials must be stored according to federal, state, and local HazMat requirements.
- Leaks and spills from liquid containers must be contained so it is not exposed to stormwater. This includes placement on an impermeable surface, within a curb wall, and/or under a cover.
- Try to recycle, reuse or reclaim process materials to reduce the volume brought into the facility. Adopt a materials flow/plant layout (i.e. do not store bags that are easily punctured in high traffic areas). Add a waste-capture circuit (e.g., collection pans for lubricating fluids).
- Adopt procedures that reduce the chance of spills or leaks during filling or transfer of materials.
- Substitute less or non-toxic materials for toxic materials.

8.4.4 Spill Response Procedures and Equipment. For industrial facilities and automotive-related industries the recommended immediate response actions are:

- Wipe up small spills with a shop rag, store shop rags in covered rag container, and dispose of properly (or take to professional cleaning service and inform them of the materials on the rag).
- Contain medium-sized spills with absorbents (kitty litter, sawdust, etc.) and use inflatable berms or absorbent "snakes" as temporary booms for the spill. Store and dispose of absorbents properly. Wet/dry vacuums may also be used, but not for volatile fluids.
- For large spills, first contain the spill and plug storm drain inlets where the liquid may migrate off-site, then clean up the spill.

8.4.5 Spill Plan Development. A spill prevention and control plan may need to be developed and implemented for certain products that are stored, processed and refined. A Spill Prevention Plan identifies areas where spills can occur onsite, specifies materials handling procedures, storage requirements, and identifies spill cleanup procedures. The purpose of this plan is to establish standard operating procedures, and the necessary employee training to minimize the likelihood of accidental releases of pollutants that can contaminate stormwater runoff. Spill prevention is prudent from both an economic as well as environmental standpoint because spills increase operating costs and lower productivity.

Stormwater contamination assessment, flow diversion, record keeping, internal reporting, employee training, and preventative maintenance are associated BMPs that should be incorporated into a comprehensive Spill Prevention Plan.

A Spill Prevention Plan is applicable to facilities that transport, transfer, and store hazardous materials, petroleum products, and fertilizers that can contaminate stormwater runoff. An important factor of an effective spill prevention plan is quick notification of the appropriate emergency response teams. In some plants, each area or process may have a separate team leader and team experts.

Emergency spill cleanup plans should include the following information:

- A description of the facility including the nature of the facility activity, and general types and quantities of chemicals stored at the facility.
- A site plan showing the location of storage areas of chemicals, the location of storm drains, site drainage patterns, fire-fighting equipment and water source locations, and the location and description of any devices used to contain spills such as positive control valves.
- Notification procedures to be implemented in the event of a spill such as phone numbers of key personnel and appropriate regulatory agencies.

- Instructions regarding cleanup procedures.
- Designated personnel with overall spill response cleanup responsibility.

A summary of the plan should be written and posted at appropriate points in the building (i.e., lunch rooms, cafeteria, and areas with a high spill potential), identifying the spill cleanup coordinators, location of cleanup kits, and phone numbers of regulatory agencies to be contacted in the event of a spill.

Cleanup of spills should begin immediately. No emulsifier or dispersant should be used.

In fueling areas, absorbent should be packaged in small bags for easy use and small drums should be available for storage of absorbent and/or used absorbent. Absorbent materials shall not be washed down the floor drain or into the storm sewer.

Emergency spill containment and cleanup kits should be located at the facility site. The contents of the kit should be appropriate to the type and quantities of chemicals or goods stored at the facility.

The following procedures should be followed when implementing an emergency spill cleanup plan:

- Key personnel should receive formal training in plan execution with additional training to the people who are likely to be the first on the site. All employees should have a basic knowledge of spill control procedures.
- A plan summary should be posted at appropriate site locations. The summary should include the identification of the spill cleanup coordinators, location of cleanup equipment, and phone numbers of site personnel and regulatory agencies to be contacted in the event of a spill.
- Perform the following notifications in the event of a spill:
  - Fire Department
  - Colorado Department of Public Health and Environment
  - State Office of Emergency Services
  - National Response Center (only if spill exceeds the reportable quantity)
  - Designated Stormwater Coordinator
- Containment and cleanup of any spills should begin immediately.
- Absorbents should be readily used in fueling areas.
- An inventory of cleanup materials should be maintained onsite and strategically deployed based on the type and quantities of chemicals present.

8.5 Advantages and Disadvantages

Table NS-1 lists the advantages and disadvantages of different BMPs for spills.

Limitations

Spill prevention planning can be limited by the following:

- Lack of employee motivation to implement plan.
- Lack of commitment from senior management.
- Key individuals identified in the Spill Prevention Plan may not be properly trained in the areas of spill prevention, response, and cleanup.

TABLE NS-1
Advantages and Disadvantages of BMPs for Spill Prevention and Response BMPs

Best Management Practice	Advantages	Disadvantages
Drip pans – pans used to contain small volumes of leaks	Inexpensive; simple installation and operation; possible reuse/recycle of material; empty/ discarded containers can be used as drip pans	Small volumes; inspected and cleaned frequently; must be secured during poor weather conditions, personnel must be trained in proper disposal methods
Covering –enclosure of outdoor materials, equipment, containers, or processes	Simple and effective; usually inexpensive	Frequent inspection, possible health/ safety problems if built over certain activities, large structures can be expensive
Vehicle positioning – locating trucks or rail cars to prevent spills during transfer of materials	Inexpensive, easy, effective	May require redesign of loading and unloading areas, requires signage to designated areas
Loading/Unloading by Air Pressure or Vacuum – for transfer of dry chemicals or solids	Quick and simple; economical if materials can be recovered; minimize exposure of pollutants to stormwater	Costly to install and maintain; may be inappropriate for denser materials, site-specific design; dust collectors may need permit under Clean Air Act
Sweeping – with brooms to remove small quantities of dry chemicals/ solids exposed to precipitation	Inexpensive, no special training; recycling opportunities	Labor-intensive; limited to small releases of dry materials, requires disposal to solid waste container
Shoveling – for removal of large quantities of dry materials, wet solids and sludge	Inexpensive; recycling opportunities, remediate larger releases; wet and dry releases	Labor-intensive; not appropriate for large spills, requires backfill of excavated areas to maintain grade
Excavation – by plow or backhoe for large releases of dry material and contaminated areas	Cost effective for cleaning up dry materials release; common and simple	Less precise, less recycling and reuse opportunities, may require imported material for backfill

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TABLE NS-1
Advantages and Disadvantages of BMPs for Spill Prevention and Response BMPs (continued)

Best Management Practice	Advantages	Disadvantages
Dust Control (Industrial) – water spraying, negative pressure systems, collector systems, filter systems, street sweeping	May reduce respiratory problems in employees around the site; may cause less loss of material and save money; efficient collection of larger dust particles	More expensive than manual systems; difficult to maintain by plant personnel; labor and equipment intensive; street sweepers may not be effective for all pollutants
Signs and Labels	Inexpensive and easily used	Must be updated/maintained so they are legible, subject to vandalism and loss
Security – to prevent accidental or intentional release of materials	Preventative safeguard; easier detection of vandals, thieves, spills, leaks, releases; prevents spills with better lighting, no unauthorized access to facility	May not be feasible for smaller facilities; may be costly; may increase energy costs due to increased lighting; dispersed locations require individuals enclosures, requires maintenance
Area Control Measures – good housekeeping measures, brushing off clothing before leaving area, etc.	Easy to implement; results in cleaner facility and improved work environment	May be seen as tedious by employees and may not be followed
Preservation of Natural Vegetation	Can handle more stormwater runoff than newly seeded areas; effective immediately; increases filter capacity; enhances aesthetics; provides areas for infiltration; wildlife can remain undisturbed; provides noise buffers; less maintenance than new vegetation	Planning required to preserve and maintain existing vegetation; may not be cost effective with high land costs; may constrict area available for construction activities, may require signage or fencing, subject to disturbance
Temporary seeding – short-term vegetative cover on disturbed areas	Inexpensive and easy to do; establishes plant cover quickly in good conditions; stabilizes soils well; aesthetic; sedimentation controls for other site areas; helps reduce maintenance costs of other controls	Requires soil preparation, may require mulching or reseeding of failed areas, seasonally limited, may require signage or fencing, subject to disturbance

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1.0 INTRODUCTION

This section of the *Manual* provides a set of criteria and technical guidance for erosion and sediment control at construction sites. In addition, it describes best management practices (BMPs) for drainageway protection, utility construction, and non-sediment material storage. Also, provided are suggested plan submittal requirements, planning considerations, general exemptions, and variances that cities and counties may wish to follow. The practices contained in this document should be viewed as suggested minimum requirements. A model erosion control ordinance is included in Appendix A. An example erosion and sediment control plan is included in Appendix B. A glossary of terms is also provided in Appendix C.

1.1 General

These criteria were developed to help mitigate the increased soil erosion and subsequent deposition of sediment off-site during the period of construction from start of earth disturbance until final landscaping and stormwater quality measures are effectively in place.

An *Erosion and Sediment Control Plan* must be developed and submitted to the local jurisdiction to obtain a construction or site grading permit. Site planning and drainage planning should, whenever possible, occur concurrently with site grading and erosion control planning. When site grading precedes final development, an erosion and sediment control plan for site grading must be submitted. This plan may have to be modified at the time a final site development plan is prepared. This modified plan must be submitted for review and approval prior to final development.

Implementation and maintenance of erosion control measures are ultimately the responsibility of the property owner. Because site conditions will affect the suitability and effectiveness of erosion control measures, a plan specific to each site is required. In addition, should the approved plan not function as intended, and it is determined by the city or county that additional measures are needed, the owner will have to provide additional measures needed to reduce soil erosion and sediment discharged from the construction site.

Nothing in these criteria limit the right of individual cities and counties to impose additional or more stringent standards.

1.2 Performance Objectives

The objectives for erosion control during construction include the following:

1. Conduct all land disturbing activities in a manner that effectively reduces accelerated soil erosion and reduces sediment movement and deposition off-site.
2. Schedule construction activities to minimize the total amount of soil exposed at any given time to reduce the period of accelerated soil erosion.
3. Establish temporary or permanent cover on areas that have been disturbed as soon as possible after final grading is completed.
4. Design and construct all temporary or permanent facilities for the conveyance of water around, through, or from the disturbed area to limit the flow of water to non-erosive velocities.
5. Remove sediment caused by accelerated soil erosion from surface runoff water before it leaves the site.
6. Stabilize the areas of land disturbance with permanent vegetative cover or stormwater quality control measures.

1.3 Erosion and Sediment Control Plan

An *Erosion and Sediment Control Plan* consisting of a written narrative report and a site plan map must be submitted to the appropriate local government for review and approval. Figures C-1 and C-1A provide standard symbols that can be used on such plans. An example plan is given in Appendix B.

1.3.1 Narrative Report. The narrative report must contain, or refer to, the drainage report and should contain the following:

1. Name, address, and telephone number of the applicant. The name, address, and telephone number of the professional engineer preparing the *Erosion and Sediment Control Plan* should also be included if different from the applicant.
2. Project description - A brief description of the nature and purpose of the land disturbing activity, the total area of the site, the area of disturbance involved, and project location including township, range, section, and quarter-section, or the latitude and longitude, of the approximate center of the project.
3. Existing site conditions - A description of the existing topography, vegetation, and drainage; and a description of any wetlands on the site.

EROSION CONTROL PLAN SYMBOLS

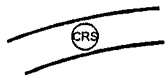
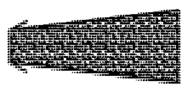
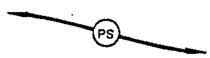
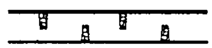
TITLE	KEY	SYMBOL
CHECK DAM	CD	
CONSTRUCTION ROAD STABILIZATION	CRS	
CURB SOCK INLET PROTECTION	CS	
TEMPORARY DIVERSION DIKE	DD	
TEMPORARY CHANNEL DIVERSION	DV	
STORM DRAIN INLET PROTECTION	IP	
MULCHING	MU	
OUTLET PROTECTION	OP	
PAVED FLUME	PF	
PERMANENT SEEDING	PS	
ROUGH CUT STREET CONTROL	RCS	

FIGURE C-1

Map Symbols

EROSION CONTROL PLAN SYMBOLS

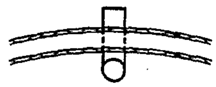
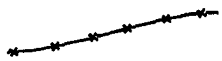
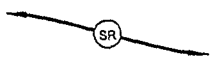
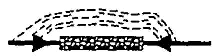
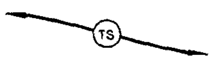
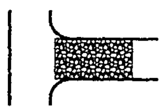
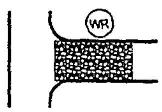
TITLE	KEY	SYMBOL
SEDIMENT BASIN	SB	
TEMPORARY STREAM CROSSING	SC	
SILT FENCE	SF	
SURFACE ROUGHENING	SR	
SEDIMENT TRAP	ST	
STRAW BALE BARRIER	STB	
TEMPORARY SEEDING	TS	
TEMPORARY SLOPE DRAIN	TSD	
VEHICLE TRACKING CONTROL	VTC	
VEHICLE TRACKING CONTROL WITH WASH RACK	WR	

FIGURE C-1A

Map Symbols (Continued)

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4. Adjacent areas - A description of neighboring areas such as streams, lakes, residential areas, roads, etc., which might be affected by the land disturbance.

5. Soils - A brief description of the soils on the site including information on soil type and names, mapping unit, erodibility, permeability, hydrologic soil group, depth, texture, and soil structure. (This information may be obtained from the soil report for the site, or, if available, from soils reports from adjacent sites if acceptable to the local jurisdiction).

6. Areas and Volumes - An estimate of the quantity (in cubic yards) of excavation and fill involved, and the surface area (in acres) of the proposed disturbance.

7. Erosion and sediment control measures - A description of the methods described in this chapter of the *Manual* which will be used to control erosion and sediment on the site.

8. Timing schedule indicating the anticipated starting and completion time periods of the site grading and/or construction sequence, including the installation and removal time periods of erosion and sediment control measures, and the time of exposure of each area prior to the completion of temporary erosion and sediment control measures.

9. Permanent stabilization - A brief description, including specifications, of how the site will be stabilized after construction is completed.

10. Stormwater management considerations - Explain how stormwater runoff from and through the site will be handled during construction. Provide a brief description of the post-construction stormwater quality control measures to be included as a part of the site development.

11. Maintenance - A schedule of regular inspections during construction and repair of erosion and sediment control structures should be described. A description of routine sediment basin maintenance should also be included.

12. The estimated total cost (installation and maintenance) of the required temporary soil erosion and sediment control measures to assist the city or county determine surety or bonding requirements for the proposed plan.

13. Calculations - Any calculations made for the design of such items as sediment basins, diversions, waterways; and calculations for runoff and stormwater detention basin design (if applicable).

14. Other information or data as may be reasonably required by the local jurisdiction.

15. A surety, bond, letter-of-credit, escrow account or other financial arrangement acceptable to the local jurisdiction submitted in an amount sufficient to install and maintain for a period of one year the temporary and permanent erosion and sediment control measures described in the plan.

16. The following note - "This *Erosion and Sediment Control Plan* has been placed in the (insert name of local jurisdiction) file for this project. The plan appears to fulfill the Urban Drainage and Flood Control District's technical criteria and the criteria for erosion control and requirements of (insert name of local jurisdiction). I understand that additional erosion control measures may be needed if unforeseen erosion problems occur or if the submitted plan does not function as intended. The requirements of this plan shall run with the land and be the obligation of the land owner until such time as the plan is properly completed, modified or voided.".

17. Signature page for owner/developer acknowledging the review and acceptance of responsibility, and a statement by the Professional Engineer acknowledging responsibility for the preparation of the *Erosion and Sediment Control Plan*.

1.3.2 Site Plan. The site plan must show:

1. A general location map at a scale of 1-inch to 1000-feet to 1-inch to 8000-feet indicating the general vicinity of the site location.

2. The property lines for the site on which the work will be performed.

3. The *Erosion and Sediment Control Plan* at a scale of 1-inch to 20-feet up to 1-inch to 200-feet. The plan may be placed on the site drainage plan if it can be clearly presented. The plan must include:

    a. Existing topography at one- or two-foot contour intervals. The map should extend a minimum of 100-feet beyond the property line.

    b. Proposed topography at one- or two-foot contour intervals. The map should show elevations, dimensions, location, extent, and the slope of all proposed grading, including building site and driveway grades, if known.

    c. Location of any existing structures or hydrologic features on the site.

    d. Location of all structures or natural features on the land adjacent to the site and within a minimum of 100 feet of the site boundary line. The map must show the location of the street gutter, storm sewer, channel, or other waters receiving storm runoff from the site.

    e. Location of all proposed structures and development on the site, if known.

    f. Limits of clearing and grading - Areas which are to be cleared and graded.

    g. Location of soil stockpiles - Areas designated for topsoil and subsoil storage.

    h. Location of storage areas - Areas designated for equipment, fuel, lubricants, chemical and waste storage.

i. Location of temporary roads designated for use during the construction period.

j. Plans of all drainage features, paved areas, retaining walls, cribbing, planting, temporary or permanent soil erosion control measures, or other features to be constructed in connection with, or as a part of, the proposed work together with a map showing the drainage area of land tributary to the site and estimated 2-year runoff of the area served by all drains. All erosion control measures should be depicted using the standard map symbols given in Figures C-1 and C-1A.

k. Detail drawings - Design drawings of sediment controls, temporary diversions, and any practices used that are not referenced in these criteria.

l. Other information or data as may be reasonably required by the local jurisdiction.

m. The following note: "This *Erosion and Sediment Control Plan* has been placed in the (insert name of local jurisdiction) file for this project and appears to fulfill applicable erosion control criteria. I understand that additional erosion control measures may be required of the owner and his or her agents due to unforeseen erosion problems or if the submitted plan does not function as intended. The requirements of this plan shall run with the land and be the obligation of the land owner until such time as the plan is properly completed, modified or voided".

n. Signature block for owner (or agent) acknowledging the review and acceptance of responsibility, and a signed and stamped statement by the Professional Engineer acknowledging responsibility for the preparation of the *Erosion and Sediment Control Plan*.

1.3.3 Approval of Erosion and Sediment Control Plan. An *Erosion and Sediment Control Plan* must be approved prior to issuance of an Overlot Grading or Site Disturbance Permit by the city or county. The final *Erosion and Sediment Control Plan* must be consistent with a Drainage Report considered acceptable to the approving jurisdiction. Approval of the *Erosion and Sediment Control Plan* does not imply acceptance or approval of Drainage Plans, Utility Plans, Street or Road Plans, Design of Retaining Walls, or any other aspect of site development.

1.3.4 Exemptions and Variances. A provision for exemptions and variances may be provided by a city or county. These are generally processed according to the applicable subdivision regulations and reviewed on a case-by-case basis.

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1. Exemptions from the erosion control planning process will be considered for any of the following; however, exempting the owner from preparing an erosion control plan and applying for a grading permit does not exempt the owner from controlling erosion of soil at each construction site through the use of the techniques described in the *Manual*:

   a. Agricultural use of land.

   b. Grading or an excavation below finished grade for basements, footings, retaining walls, or other structures on plots zoned R1 - R3 of less than five (5) acres in size unless required otherwise.

   c. A sidewalk or driveway authorized by a valid permit.

   d. Land-disturbing activities involving less than five (5) acres of disturbed area. Individual lots involving less than five (5) acres of disturbed area in a larger subdivision project shall not be considered separate development projects, but rather as a part of the subdivision development as a whole. It will be the responsibility of the homeowner or homebuilder to conform to all requirements of the locally-approved *Erosion and Sediment Control Plan* for the subdivision. As part of any Building Permit for which a specific erosion control plan is not required, the following statement must be included: "We have reviewed the *Erosion and Sediment Control Plan* for (subdivision name) and agree to conform to all requirements contained therein and all erosion control requirements of the (insert name of local jurisdiction). We further agree to construct and maintain all erosion and sediment control measures required on the individual lot(s) subject to this Building Permit and/or in accordance with the provisions of the Erosion Control section of the *Manual* of the Urban Drainage and Flood Control District."

   e. Underground utility construction including the installation, maintenance, and repair of all utilities under hard-surfaced roads, streets, or sidewalks provided such land-disturbing activity is confined to the area which is hard-surfaced and provided that runoff and erosion from soil stockpiles are confined and will not enter the drainage system.

   f. Gravel, sand, dirt or topsoil removal as authorized pursuant to approval of the Colorado Mined Land Reclamation Board, provided said approval includes an erosion and sediment control plan that meets the minimums specified.

   g. Projects having a period of exposure (from time of land disturbance until permanent erosion control measures are installed) of less than 14 days.

   h. Where the owner certifies in writing to local jurisdiction and the local jurisdiction agrees in writing that the planned work and the final structures or topographical changes will not result in or contribute to soil erosion or sedimentation and will not interfere with any existing drainage course in such a manner as to cause damage to any adjacent property or result in the deposition of debris or sediment on any public way, will not present any hazard to any persons or property, and will have no detrimental influence upon the public welfare or upon the total development of the watershed.

2. Variances - Cities and counties may consider waiving or modifying any of the criteria which are deemed inappropriate or too restrictive for site conditions by granting a variance. Variances may be granted at the time of plan submission or request for plan revision. Variances must be requested in accordance with the subdivision regulations and must define:

   a. The criteria from which the applicant seeks a variance.

   b. The justification for not complying with the criteria.

   c. Alternate criteria or standard measures to be used in lieu of these criteria. The criteria and practices specified within this section of the *Manual* relate to the application of specific erosion and sediment control practices. Other practices or modifications to specified practices may be used if approved by the local jurisdiction prior to installation. Such practices must be thoroughly described and detailed to the satisfaction of the local city or county reviewing and approving the erosion control plan.

To expedite the review and decisions on variance requests, it is suggested that a variance request be included with, or submitted prior to, the initial *Erosion and Sediment Control Plan* submittal.

2.0 EROSION CONTROL PLANNING

2.1 Erosion and Sedimentation

2.1.1 Erosion. Soil erosion is the process by which the land surface is worn away by the action of wind, water, ice, and gravity. This section of the *Manual* addresses erosion caused by wind and water. Erosion is a natural process and has occurred since the earth was formed. The shape of the land as we know it was created, in large part, by erosional processes. The natural rate of erosion is increased greatly by many urban activities--especially construction activities. Any activity that disturbs the natural soil and vegetation has the potential to increase erosion because bare, loose soil is easily moved by wind or water.

Wind erosion is caused when winds of sufficient velocity create movement of soil particles. The potential for wind erosion is dependent upon soil cover, soil particle size, wind velocity, duration of wind, and unsheltered distance. Within the Denver metropolitan area winds often exceed 60 miles per hour (mph), and occasionally exceed 100 mph. Wind erosion can begin at a wind velocity as low as 10 mph, and can even result from turbulence created by passing vehicles.

Water erosion has five primary mechanisms: raindrop erosion, sheet erosion, rill erosion, gully erosion, and channel erosion. Raindrops detach soil particles and splash them into the air. These detached particles are then vulnerable to stormwater runoff or snowmelt. Shallow surface flows rarely move as a uniform sheet for more than several feet before concentrating in surface irregularities, known as rills. As the flow changes from a shallow sheet to a deeper rill flow, the velocity and turbulence of the flow increase. The energy of the concentrated flow is able to detach and transport soil particles. This action begins to cut into the soil mantle and form tiny to large channels. Rills are small, but well-defined channels which are only a few inches deep. Gullies occur as the flows in rills come together into larger and larger channels. The major difference between rill and gully erosion is size. Rills caused by erosion can be smoothed out by standard surface treatments such as harrowing. Gully erosion on the other hand cannot be repaired with standard farming equipment and requires heavy equipment to regrade and stabilize the gullies.

2.1.2 Sedimentation. During a rainstorm, runoff normally builds up rapidly to a peak and then diminishes. Because the amount of sediment a watercourse can carry is dependent upon the velocity and volume of runoff, sediment is deposited as runoff decreases. The deposited sediments may be resuspended when future runoff events occur. In this way, sediments are moved progressively downstream in the waterway system.

Windblown silt and sand particles are deposited whenever the force of the wind lessens. Much of the wind-eroded material is deposited behind fences, in landscaped areas or downwind of buildings or other obstructions to the wind. (Dust will form "drifts" just like snow.) Materials transported by bouncing or creeping along the surface are often trapped in surface irregularities near the point of initial movement.

2.1.3 Factors Influencing Erosion. Factors affecting the erosion potential of any site include soil type, geology, vegetative cover, topography, climate, and land use. Physical properties of soils such as particle size, cohesiveness, and density affect its erodibility. Loose silt and sand-sized particles are more susceptible to erosion than "sticky" clay soils. Rocky soils are also less susceptible to wind erosion, but are often found on steep slopes that are subject to water erosion. Most of the soil types found locally are calcareous in nature and are susceptible to either wind or water erosion, or both.

When surface cover and soil structure are disturbed, the soil's erodibility potential increases. Construction activities disrupt the soil structure and it's vegetative cover. Examples are excavation and grading for construction of homes, roads, utilities, commercial and industrial areas. In some parts of the Denver metropolitan area, overgrazing by livestock also contributes to increased erosion.

Vegetation plays an extremely important role in controlling erosion. Roots bind particles together and the leaves or blades of grass reduce raindrop impact forces on the soil. Grass, forest floor litter and other ground cover traps rain which allows infiltration and reduces runoff velocity. Vegetation reduces wind velocity at the ground surface, and provides a rougher surface which will trap particles moving along the ground. Once vegetation is removed, erosion can proceed unchecked.

2.1.4 Principles of Erosion and Sediment Control. The objective of erosion control is to limit the amount and rate of erosion occurring on disturbed areas. The objective of sediment control is to capture the soil that has been eroded before it leaves the construction site. Despite the use of both erosion control and sediment control measures, it is recognized that some amount of sediment will remain in runoff leaving the construction site.

An erosion and sediment control plan is comprised of three major elements:

1. The erosion control measures that will be used to limit erosion of soil from disturbed areas at a construction site;
2. The sediment control measures that will be used to limit transport of sediment to off-site properties and downstream receiving waters; and,
3. The drainageway protection measures that will be used to protect streams and other drainageways located on the construction site from erosion and sediment damages.

Erosion controls are surface treatments that stabilize soil exposed by excavation or grading. Erosion control measures, or Best Management Practices (BMPs) are variously referred to as source controls, vegetative controls or non-structural controls.

Sediment controls capture soil that has been eroded. Soil particles suspended in runoff can be filtered through a porous media or deposited by slowing the flow and allowing the natural process of sedimentation to occur. Sediment controls (or BMPs) are facilities built to perform this function, and are also referred to as structural controls.

Drainageway control measures (or BMPs) protect channels or storm sewers during site construction. This can be accomplished by limiting equipment travel across a stream, constructing a temporary channel crossing, or diverting a stream into a temporary channel while work is done on the permanent channel. Where storm sewers are used, sediment can be filtered prior to entry of runoff into the storm drainage system.

Non-sediment impacts to water quality can be managed by controls (or BMPs) on equipment, material storage, or use of chemicals at construction sites. These additional practices are included for discussion in the *Manual* because they occur commonly at construction sites.

2.2 Summary of Criteria

The list below is a summary of erosion and sediment control activities as described in the *Manual*:

- Erosion Control. Permanent or temporary soil surface stabilization must be applied to disturbed areas and soil stockpiles as soon as possible but no later than 14 days after final grade is reached on any portion of the site. Soil surface stabilization should also be applied within 14 days to disturbed areas that may not be at final grade but will remain dormant (undisturbed) for longer than an additional 30 days. (Section 3.0).
- Surface Roughening. Surface roughening should be performed after final grading to create depressions two to four inches deep and four to six inches apart. (Section 3.1).
- Mulching. All disturbed areas must be properly mulched, or seeded and mulched, within 14 days after final grade is reached on any portion of the site not otherwise permanently stabilized. (Section 3.2).
- Revegetation. A viable vegetative cover should be established within one year on all disturbed areas and soil stockpiles not otherwise permanently stabilized. Vegetation is not considered established until a ground cover is achieved which, in the opinion of the city or county of jurisdiction, is sufficiently mature to control soil erosion and can survive severe weather conditions. (Section 3.3).
- Temporary Revegetation. Temporary revegetation is required on all disturbed areas having a period of exposure prior to final stabilization of one year to two years. All temporary seeding shall be properly mulched. (Section 3.3.2).
- Permanent Revegetation. Permanent revegetation is required on all disturbed areas having a period of exposure greater than two years, or for an indeterminate length of time. A perennial grass mix should be planted and mulched. (Section 3.3.3).
- Roads and Soil Stockpiles. Road cuts, road fills, and parking lot areas should be covered as early as possible with the appropriate aggregate base course where this is specified as part of

the pavement. This practice is not needed when final construction of roads will take place within 30 days of reaching final subgrade level.

All non-paved portions of roads should be seeded and mulched as soon as possible after final grading has occurred, but in no case later than 14 days after grading has been completed.

Soil stockpiles expected to be in place longer than 60 days should be seeded with a temporary grass cover and mulched within 14 days after completion of stockpile construction.

If stockpiles are located within 100 feet of a drainageway, additional sediment controls, such as a diversion dike or silt fence, should be provided. (Section 3.4).

- Sediment Control. Properties and roadways adjacent to a construction site should be protected from eroded sediment being transported to them. (Section 4.0).
- Vehicle Tracking. Whenever construction vehicles enter onto paved roads, provisions must be made to prevent the transport of sediment (mud and dirt) by vehicles tracking onto the paved surface. Whenever sediment is transported onto a public road, regardless of the size of the site, the roads shall be cleaned at the end of each day. (Section 4.1).
- Slope Diversion Dikes. Temporary diversion dikes shall be provided as required by the provisions of Section 4.2. Diversion dikes located above disturbed areas may be discharged to a permanent or temporary channel. Diversion dikes located midslope on a disturbed area must discharge to temporary slope drain. Diversion dikes located at the base of a disturbed area must discharge to a sediment trap or basin. (Sections 4.2.1 and 4.3).
- Roads and Roadside Swales. For road areas that are not paved within 30 days of final grading, and have not received early application of roadbase, rough-cut street controls should be provided. (Section 4.2.2).
- Sediment Entrapment Facilities. Sediment entrapment facilities include straw bale barriers, silt fences, and sediment basins. The criteria for selection and use of sediment entrapment facilities are given in Table C-2 and design criteria are described in Section 4.3.

  All runoff leaving a disturbed area shall pass through at least one sediment entrapment facility before it exits the site. (Section 4.3).
- Working Within or Crossing a Waterway. Construction vehicles shall be kept out of waterways to the maximum extent practicable. Where an actively-flowing watercourse must be crossed regularly by construction vehicles, a temporary stream crossing or channel diversion must be provided. (Sections 5.1 and 5.2).

- Outlet Protection. The outlets of temporary slope drains, culverts, sediment traps, and sediment basins must be protected from erosion and scour. (Section 5.3).
- Inlet Protection. All storm sewer inlets made operable during construction must have sediment entrapment facilities installed to prevent sediment-laden runoff from entering the inlet. (Section 5.4).
- Chemicals, Oils and Material Storage. Areas used for storage of chemicals, petroleum-based products and waste materials, including solid and liquid waste, shall be designed to prevent discharge of these materials in the runoff from a construction site. (Section 6).
- Underground Utility Construction. Construction of underground utility lines that are not exempted is subject to the provisions of Section 7. (Section 1.3.4 for exemptions and Section 7).
- Disposition of Temporary Measures. All temporary erosion and sediment control measures shall be removed within 30 days after final stabilization is achieved, or after the temporary measures are no longer needed, whichever occurs earliest, or as authorized by the city or county of local jurisdiction. (Section 8).
- Maintenance. All temporary and permanent erosion and sediment control practices shall be maintained and repaired by the owner during the construction phase as needed to assure continued performance of their intended function. All facilities must be inspected and replaced if necessary, following each precipitation or snowmelt event that results in runoff. (Section 9).

2.3 Planning Process

Erosion control planning should occur early in the site development process. The planning process can be divided into five separate steps:

1. Gather information on topography, soils, drainage, vegetation and other predominant site features.
2. Analyze the information in order to anticipate erosion and sedimentation problems.
3. Devise a plan which schedules construction activities and minimizes the amount of erosion created by development.
4. Develop an *Erosion and Sediment Control Plan* which specifies effective erosion and sediment control measures.
5. Follow the *Erosion and Sediment Control Plan* and revise it when necessary.

2.3.1 Site Assessment. Topography is the primary factor to be considered in developing an *Erosion and Sediment Control Plan*. Soils, vegetation, and hydrologic features must also be considered.

Final grading will determine slope gradient and slope length of the disturbed area. Small areas, or subbasins, will be created that have relatively uniform characteristics of slope and slope length. After grading is completed, areas that remain exposed to precipitation and runoff will require erosion control, and the overall size of subbasin areas will determine what sediment controls are appropriate for each area.

Soil conditions should be assessed as to their potential for erosion and suitability for revegetation. A detailed analysis of soil-erosion potential is not necessary because all soils will be subject to erosion and can be generalized as equivalent for the design of control measures recommended in the *Manual*.

Most vegetation will be removed from a construction site during clearing and grading operations. An assessment of existing vegetation on the site is of limited use when post-development landscaping and irrigation are planned, but can be useful in selecting grasses when non-irrigated revegetation is planned. Analysis of soil is useful to determine fertilizer requirements for vegetation establishment.

Analysis of waterbodies and other hydrologic features of a site is important in the design of sediment controls. The drainage basins upslope and within the site should be assessed. The configuration of hillslope areas and drainageways, in the context of planned roads and buildings, will determine what erosion and sediment controls will be needed. The location of permanent drainage channels and other elements of the drainage system should be defined as a part of the plan.

2.3.2 Selection of Controls. The following guidelines are recommended in developing the erosion and sediment control plan:

1. Determine the limits of clearing and grading. If the entire site will not undergo excavation and grading, the boundaries of cut-and-fill operations should be defined. Buffer strips of natural vegetation may be utilized as a control measure.

2. Define the layout of buildings and roads. This will have been decided previously as a part of the general development plan. If building layout is not final, the road areas stabilized with pavement and the drainage features related to roads should be defined as they relate to the plan.

3. Determine permanent drainage features. The location of permanent channels, storm sewers, roadside swales, and stormwater quality controls such as ponds, wetlands, grassed-lined swales, buffer strips, and areas of porous pavement, if known, should be defined.

4. Determine extent of temporary channel diversions. If permanent channel improvements are a part of the plan, the route, sizing, and lining needed for temporary channel diversions should be determined. Location and type of temporary channel crossings can be assessed.

5. Determine the boundaries of watersheds. The size of drainage basins will determine the types of sediment controls to be used. Areas located off the site that contribute overland flow runoff must be assessed. Measures to limit the size of upland overland flow areas, such as diversion dikes, may be initially considered at this stage.

6. Select sediment controls. Areas greater than one acre will require that sediment basins be installed. Division of large drainage basins into subareas each served by a sediment basin can also be considered.

   Areas smaller than one acre can utilize other sediment controls. Limitations on the size of areas served by individual controls are defined in these criteria. (Section 4.3).

7. Determine staging of construction. The schedule of construction will determine what areas must be disturbed at various stages throughout the development plan. The opportunity for staging cut-and-fill operations to minimize the period of exposure of soils can be assessed. The sequence for installing sediment controls and erosion controls can also be determined at this time.

8. Identify locations of topsoil stockpiles. Areas for storing topsoil should be determined.

9. Identify location of temporary construction roads, vehicle tracking controls, and material storage areas. These three elements can be determined in the context of previously defined aspects of the plan.

10. Select Erosion Controls. All areas of exposed soil will require a control measure be defined dependent on the duration of exposure. These can be selected based on the schedule of construction.

An example erosion and sediment control plan for a small commercial development has been included as Appendix B. Figure C-2 shows an oblique view of an example highway construction project and the sediment controls used. Figure C-3 illustrates how these measures are described on a site plan map.

2.4 Consistency with Other Plans

2.4.1 Drainage Plans. The *Erosion and Sediment Control Plan* should be prepared consistent with the final drainage plan for a development. All of the hydrologic features of the drainage plan must be incorporated into the site at the time of development. Permanent drainage features will be built during the construction phase. Temporary sediment controls can be located and designed to take advantage of the final drainage design features. All temporary controls should be staged and removed at the appropriate time relative to the construction of permanent drainage features.

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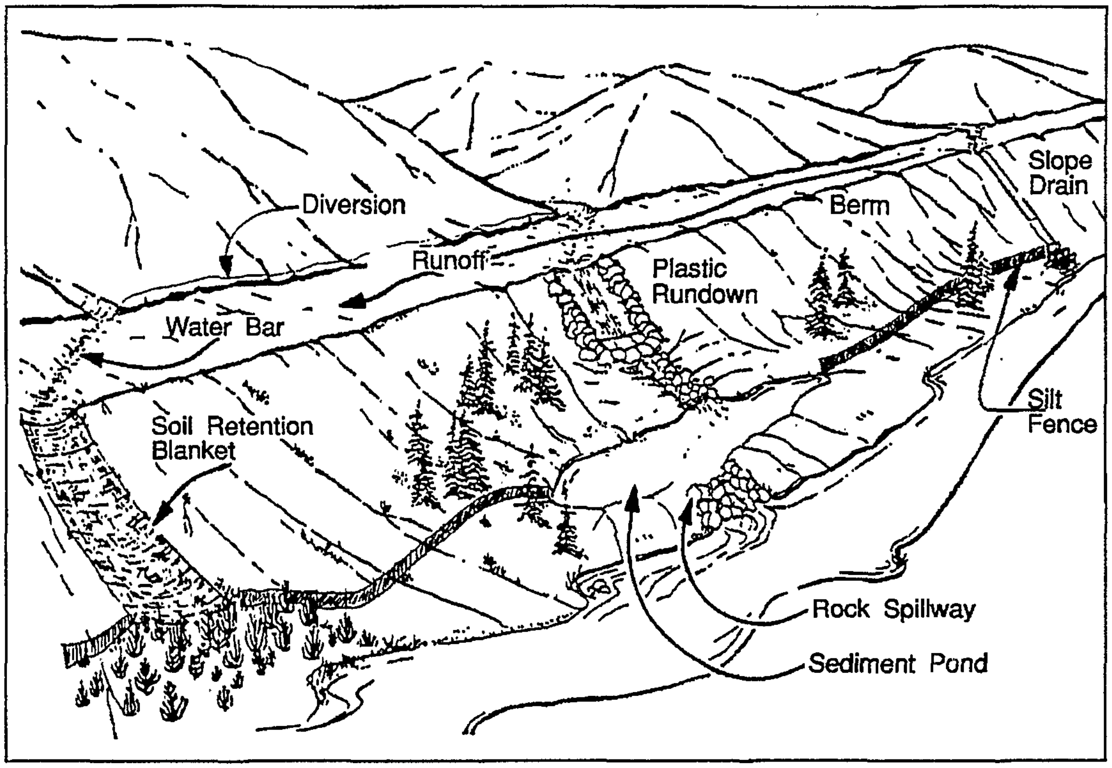
2.4.2 Stormwater Quality Plans. New developments will incorporate elements of stormwater quality control into their design. The erosion and sediment control plan must be prepared consistent with these structural and nonstructural controls. Many of the temporary controls used for sediment control can be modified into permanent structural controls. Where possible, permanent stormwater quality controls can be constructed at the initial stages of construction, or modified at the end of construction.

Where local regulations have not been developed, stormwater quality plans should be developed consistent with the guidelines in the *Stormwater Quality Management* and *BMP Planning for New Development and Redevelopment* chapters of Volume 3 of the *Manual.*

2.4.3 Air Quality Plans. All of the erosion and sediment control measures specified in this section will perform as well to control wind erosion. The surface stabilization measures identified for control of precipitation-induced erosion act also to prevent soils from becoming windborne. Although these guidelines were developed to control erosion by rainfall and snowmelt, they are consistent with design principles for wind erosion and will be effective for this purpose.

The Air Pollution Control Division, Colorado Department of Public Health and Environment, has passed air quality regulations consistent with federal legislation. Regulation No. 3 requires submittal of an Air Pollutant Emission Notice (APEN) for sources of fugitive dust from construction sites, as well as other sources. Regulation No. 1 defines particulate emission control regulations for haul roads and roadways. Additional controls, such as road watering, may be necessary to fully comply with these regulations at a construction site. In certain counties in Colorado, the local health department administers these regulations. This agency, or CDH, should be contacted about APENs and other air quality requirements.



From: Colorado Department of Highways, 1978

FIGURE C-2
Oblique View of Example Construction Site

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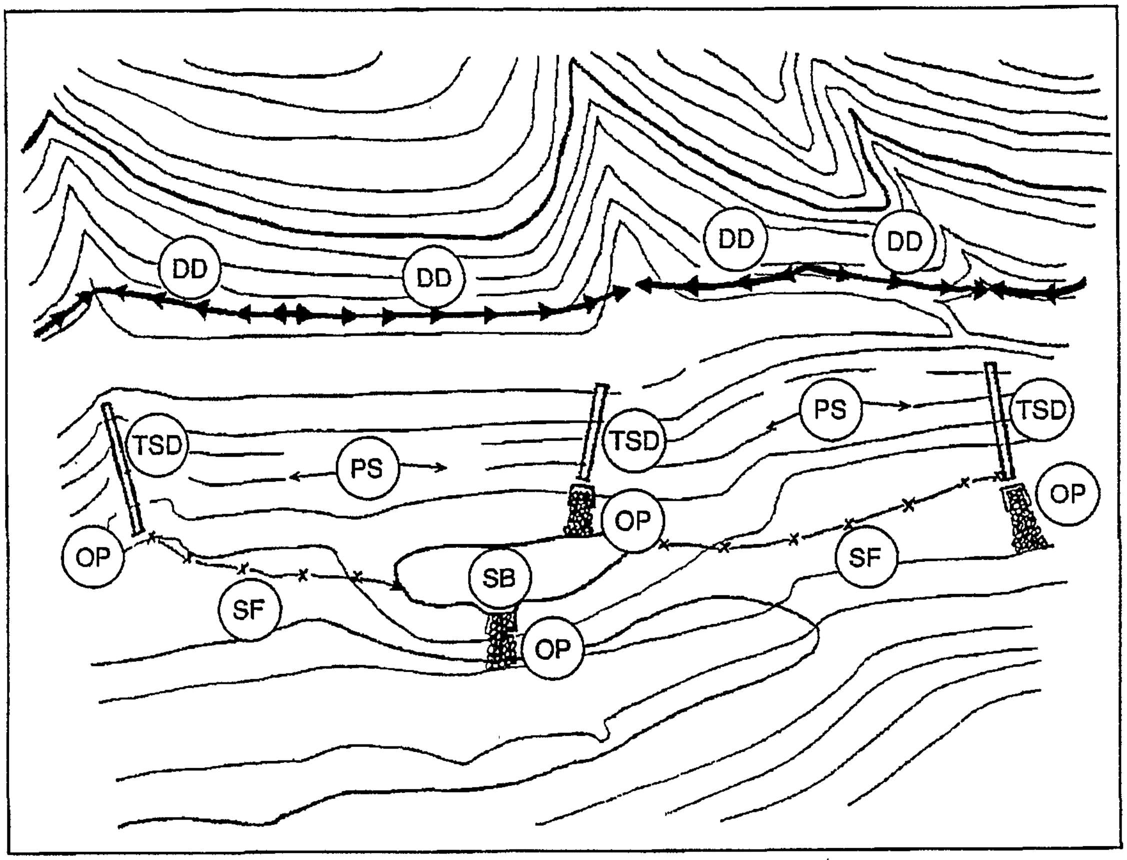

From: Adapted from Colorado Department of Highways, 1978

FIGURE C-3
Site Plan Map for Example Construction Site

3.0 EROSION CONTROL

The planning for the installation of permanent or temporary soil erosion controls needs to begin in advance of all major soil disturbance activities on the construction site. After construction begins, soil surface stabilization shall be applied within 14 days to all disturbed areas that may not be at final grade but will remain dormant (undisturbed) for periods longer than an additional 30 calendar days.

Soil surface stabilization protects soil from the erosive forces of raindrop impact, flowing water, and wind. Erosion control practices include surface roughening, mulching, establishment of vegetative cover, soil treatments, and the early application of gravel base on areas to be paved. Stabilization measures to be used should be appropriate for the time of year, site conditions and estimated duration of use. The maximum time limits of land exposure for selection of erosion controls are summarized in Table C-1.

TABLE C-1
Maximum Time Limits of Land Exposure
for Selection of Erosion Controls

Erosion Control Method	Maximum Allowable Period of Exposure (Months)
Surface Roughening	1
Mulching	12
Temporary Revegetation	12-24
Permanent Revegetation	24 or more
Soil Stockpile Revegetation	2
Early Application of Road Base	1

3.1 Surface Roughening

Surface roughening provides temporary stabilization of disturbed areas from wind and water erosion. It is particularly useful where temporary revegetation cannot be immediately established due to seasonal planting limitations.

The soil surface is considered roughened if depressions are created two to four inches deep and are spaced approximately four to six inches apart. If slopes are sufficiently rough after final grading, no further treatment is required. The surface of exposed soil can be roughened by a number of techniques and equipment. A chisel or ripping implement can be used in most soil conditions. Roughening cannot be performed in very sandy or rocky soil.

Surface roughening, also referred to as scarification, should be performed after final grading. Fill slopes can be constructed with a roughened surface. Cut slopes that have been smooth graded can be roughened as a subsequent operation. Roughening of ridges and depressions should follow along the contours of the slope. On slopes steeper than 2:1, the tracks left by a dozer working perpendicular to the contour can leave acceptable horizontal depressions. A diagram illustrating surface roughening is shown on Figure C-4.

Care should be taken not to drive vehicles or equipment over areas that have been scarified. Tire tracks will smooth the roughened surface and encourage runoff to collect into channels. As surface roughening is only a temporary control, additional treatments may be necessary to maintain the soil surface in a roughened condition.

3.2 Mulching

All disturbed areas must be mulched, or seeded and mulched, within 14 days after final grade is reached on any portion of the site not otherwise permanently stabilized. Areas that will remain in an interim condition for more than one year should also be seeded (See Section 3.3.2). An example of mulching is shown on Figure C-5.

To protect newly seeded areas and to provide temporary cover on other disturbed areas which will not require temporary revegetation, or which cannot be seeded due to seeding date limitations, a mulch should be applied consisting of:

1. Clean, weed- and seed-free, long-stemmed grass hay (preferred) or cereal grain straw. Hay is preferred as it is less susceptible to removal by wind. Mulch should be applied evenly at a rate of two tons per acre. At least 50 percent of the mulch, by weight, should be ten inches or more in length.

   Mulch must be anchored. This can be accomplished mechanically by crimping or with the aid of tackifiers or nets. Anchoring with a crimping implement is preferred, and is the recommended method for all areas equal to or flatter than 3:1. Mechanical crimpers must be capable of tucking the long mulch fibers into the soil four inches deep without cutting them. An agricultural disk, while not an ideal substitute, <u>may</u> work if the disk blades are dull or blunted and set vertically. However, the frame may have to be weighted to afford proper soil penetration.

   On small areas sheltered from the wind and from heavy runoff, spraying a tackifier on the mulch is satisfactory for holding it in place. For steep slopes and other special situations, blankets, anchored with staples, may be required instead of mulch.

2. Hydraulic mulching shall be limited to those situations where it is too difficult to apply and anchor a mulch of long-stemmed grass hay or cereal straw; namely, slopes steeper than 3:1 or where access is limited. Wood cellulose fibers must be mixed with water and a tackifying agent and applied at a rate of 2,000 pounds per acre with a hydraulic mulcher.

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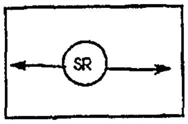


SR

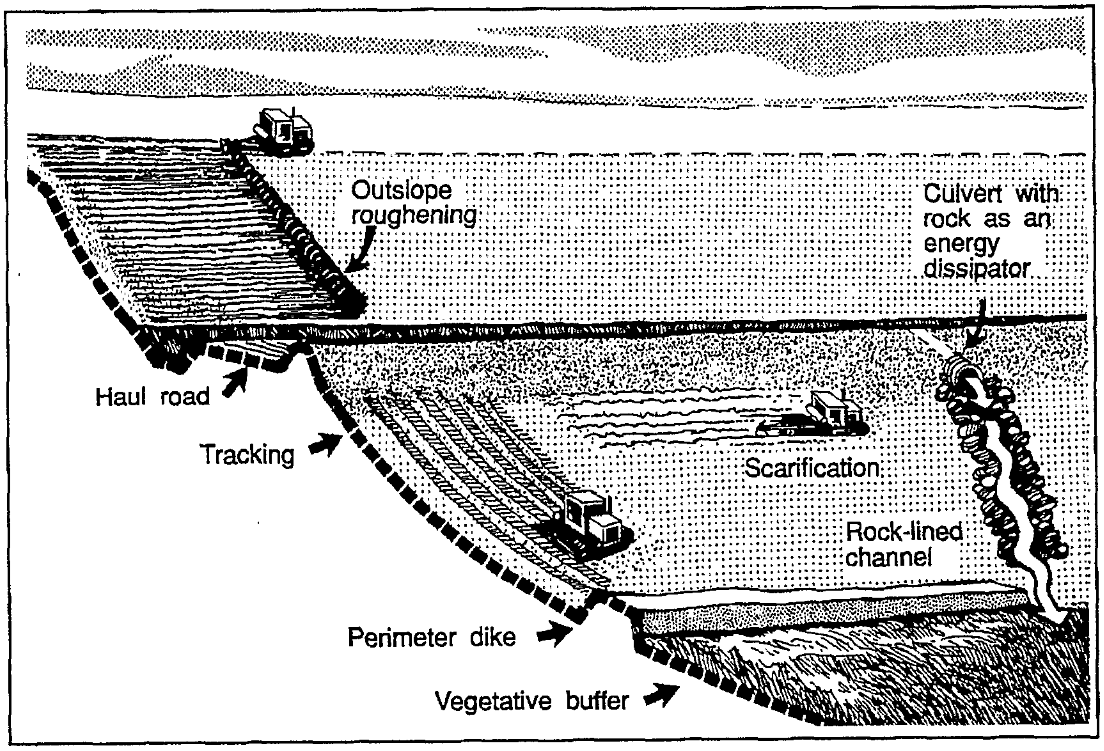
SURFACE ROUGHENING

Definition

Provide a rough soil surface with horizontal depressions created by operating a tillage or other suitable implement on the contour, or by leaving slopes in a roughened condition by no fine-grading them.

Purposes

1. To aid in seed bed preparation and establishment of vegetative cover.
2. To reduce runoff velocity and increase infiltration.
3. To reduce runoff and wind erosion and provide for sediment trapping.



From: Environmental Protection Agency, 1976

FIGURE C-4
Surface Roughening

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MU

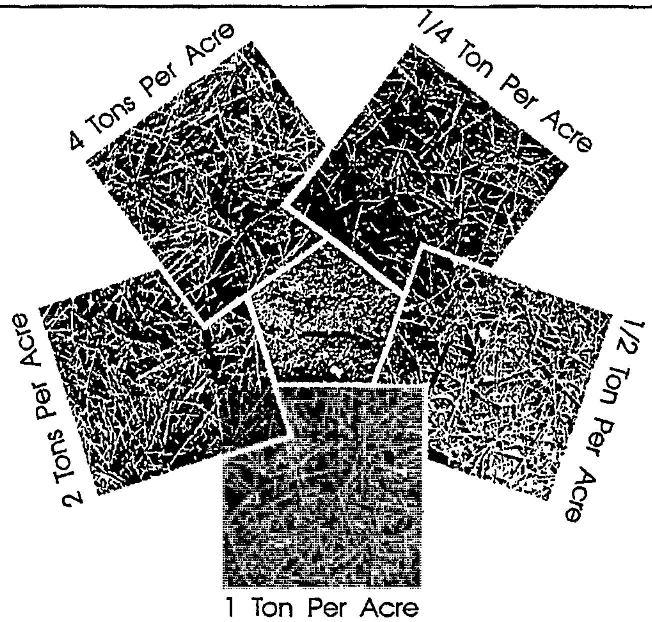
MULCHING

<u>Definition</u>

Application of plant residues or other suitable materials to the soil surface.

<u>Purposes</u>

1. To prevent erosion by protecting the soil surface from raindrop impact and reducing the velocity of overland flow.
2. To foster the growth of vegetation by increasing available moisture and providing insulation against extreme heat and cold.



From: Environmental Protection Agency, 1976

FIGURE C-5
Mulching

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3. Mats, blankets, and nets are available to help stabilize steep slopes and drainage channels. Depending on the product, these may be used alone or in conjunction with grass or straw mulch. Normally, use of these products will be restricted to relatively small areas. Mats made of jute, coconut fiber, or various geosynthetic fibers can be used instead of mulch. Blankets are straw mulch that have been woven and oftentime include a synthetic layer or net. Plastic netting can be used to anchor mulch. Two diagrams showing installation and orientation of these materials are provided as Figures C-6 and C-7.

4. Some synthetic tackifiers or binders may be used to anchor mulch to limit sediment movement and or, if approved by review agency, directly applied to the soil to provide soil stabilization. Caution should be used to prevent the introduction of any potentially harmful material into the environment. Manufacturer's recommendations should be followed at all times.

5. Rock can also be used as a mulch. It provides protection of exposed soils to wind and water erosion and allows infiltration of precipitation. Rock of aggregate base-coarse size can be spread on disturbed areas for temporary or permanent stabilization. Rock must be removed from those areas planned for vegetation establishment.

3.3 Revegetation

A viable vegetative cover should be established within one year on all disturbed areas and soil stockpiles not otherwise permanently stabilized. Vegetation is not considered established until a ground cover is achieved which, in the opinion of the city or county of jurisdiction, is sufficiently mature to control soil erosion and can survive severe weather conditions.

3.3.1 Seedbed Preparation. Areas to be revegetated should have soil conditions capable of supporting vegetation. Overlot grading will oftentimes bring to the surface subsoils that have low nutrient value, little organic matter content, few soil microorganisms, rooting restrictions, and conditions less conducive to infiltration of precipitation. Under certain conditions, soil amendments and treatments may be necessary to provide an adequate growth medium to sustain vegetation.

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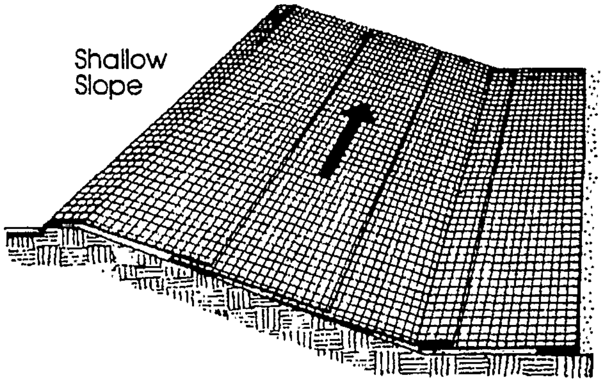
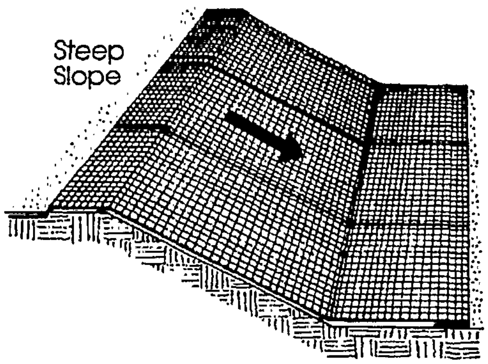


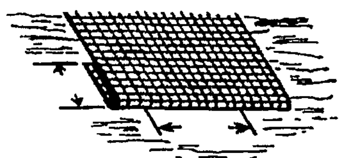
On shallow slopes, strips of netting may be applied across the slope.

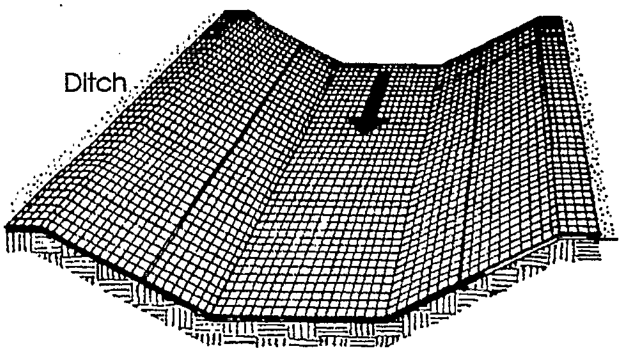
Where there is a berm at the top of the slope, bring the netting over the berm and anchor it behind the berm.



On steep slopes, apply strips of netting parallel to the direction of flow and anchor securely.

Bring netting down to a level area before terminating the installation. Turn the end under 6" and staple at 12" intervals.





In ditches, apply netting parallel to the direction of flow. Use check slots every 15 feet. Do not join strips in the center of the ditch.

From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-6
Orientation of Blankets, Netting and Matting

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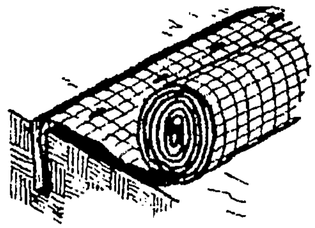
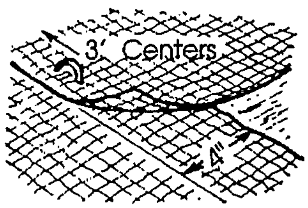
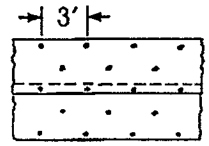
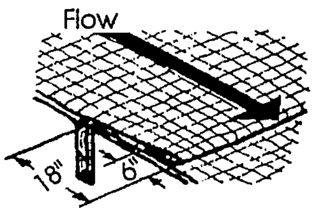


Anchor Slot: Bury the up-channel end of the net in a 6" deep trench. Tamp the soil firmly. Staple at 12" intervals across the net.

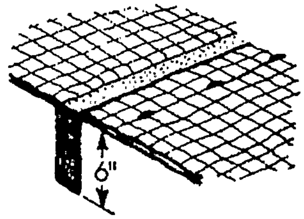


Overlap: Overlap edges of the strips at least 4". Staple every 3 feet down the center of the strip.

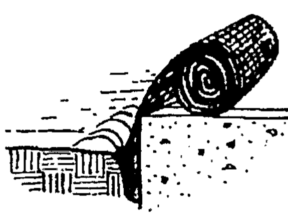




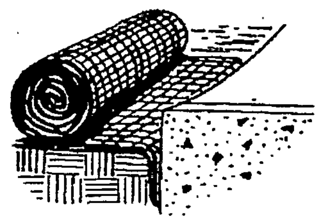
Joining Strips: Insert the new roll of net in a trench, as with the Anchor Slot. Overlap the up-channel end of the previous roll 18" and turn the end under 6". Staple the end of the previous roll just below the anchor slot and at the end at 12" intervals.



Check Slots: On erodible soils or steep slopes, check slots should be made every 15 feet. Insert a fold of the net into a 6" trench and tamp firmly. Staple at 12" intervals across the net. Lay the net smoothly on the surface of the soil - do not stretch the net, and do not allow wrinkles.



Anchoring Ends At Structures: Place the end of the net in a 6" slot on the up-channel side of the structure. Fill the trench and tamp firmly. Roll the net up the channel. Place staples at 12" intervals along the anchor end of the net.



From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-7
Installation of Blankets, Netting and Matting

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Whenever possible, topsoil should be salvaged for respreading on areas to be revegetated. The depth of soil stripping is determined by the depth of available topsoil. Areas near drainageways may have a considerable depth of topsoil, whereas lesser amounts may be available on the crowns of hills and flat slopes. Topsoil should be viewed as an important resource to be utilized for vegetation establishment, primarily due to its water-holding capacity. Native topsoil located on a construction site also have good soil structure, organic matter content, biological activity, and nutrient supply that supports vegetation.

The rooting zone of most semi-arid grasslands evident in the Denver metropolitan area is 6 to 18 inches. At a minimum, the upper six (6) inches of topsoil can be stripped and stockpiled, and respread to a thicker depth on surfaces not planned for buildings or impervious areas. If the surface is compacted, ripping of subsoils prior to topsoiling is recommended. Scarification will assist in placement of a stable topsoil layer on steeper slopes, and allow percolation and root penetration to greater depth.

Where topsoil is not available or utilized, subsoils can be treated to provide a plant-growth medium. Organic matter can be added to improve nutrient levels necessary for plant growth. Other treatments, such as liming, can be used to adjust soil conditions as necessary with amendments. Soil testing is recommended to determine appropriate amendments required.

A suitable seedbed will enhance the success of revegetation efforts. The surface should be rough and the seedbed should be firm, but neither too loose nor compacted. The upper layer of soil should be in a condition suitable for seeding at the proper depth and conducive to plant growth.

3.3.2 Temporary Revegetation. Temporary revegetation is required on all disturbed areas having a period of exposure prior to final stabilization of one year or longer. All temporary seeding shall be protected with mulch.

To provide temporary vegetative cover on disturbed areas which will not be paved, built upon, or fully landscaped within 12 months but will be completed within 24 months, plant an annual grass appropriate for the time of planting and mulch the planted areas. The annual grasses generally suitable for the Denver metropolitan area are listed in Table C-2. These are to be considered only as a general recommendation whenever specific design guidance for a particular site is not available.

3.3.3 Permanent Revegetation. To provide vegetative cover on disturbed areas not paved or built upon for a period of 2 years or longer, or for an indeterminate length of time, a perennial grass or grass mix should be planted. Each site will have different characteristics, and a landscape professional should be contacted to determine the most suitable species or seed mix for a specific site. In lieu of a specific recommendation and for planning purposes, one of the perennial grass mixes appropriate for site conditions listed in Table C-3 can be used. The pure live seed (PLS) rates of application recommended in these tables are considered to be absolute minimum rates for seed applied using proper drill-seeding equipment. All permanent seeding shall be protected with mulch. See Table C-4 for appropriate seeding dates.

TABLE C-2

Minimum Drill Seeding Rates for Annual Grasses[a]

Species (Common name)	Growth Season[b]	Pounds of Pure Live Seed (PLS)/acre[c]	Planting Depth (inches)
1. Oats	Cool	35 - 50	1 - 2
2. Spring wheat	Cool	25 - 35	1 - 2
3. Spring barley	Cool	25 - 35	1 - 2
4. Annual ryegrass	Cool	10 - 15	½
5. Millet	Warm	3 - 15	½ - ¾
6. Sudangrass	Warm	5 – 10	½ - ¾
7. Sorghum	Warm	5 - 10	½ - ¾
8. Winter wheat	Cool	20 - 35	1 - 2
9. Winter barley	Cool	20 - 35	1 - 2
10. Winter rye	Cool	20 - 35	1 - 2
11. Triticale	Cool	25-40	1 - 2

[a] Successful seeding of annual grass resulting in adequate plant growth will usually produce enough dead-plant material residue to provide protection from wind and water erosion for an additional year. This assumes that the cover is not disturbed or mowed closer than 8 inches.

Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1 or where access limitations exist. When hydraulic seeding is used, hydraulic mulching should be done as a separate operation to prevent the seeds from being encapsulated in the mulch.

[b] See Table C-4 for seeding dates. Irrigation, if consistently applied, may extend the use of cool season species during the summer months.

[c] Seeding rates should be doubled if seed is broadcast; or increased by 50 percent if done using a Brillion Drill or by hydraulic seeding.

If desired for wildlife habitat or landscape diversity, shrubs such as rubber rabbitbrush (*Chrysothamnus nauseosus*), fourwing saltbush (*Atriplex canescens*) and skunkbrush sumac (*Rhus trilobata*) could be added to the upland seedmixes at .25, .5 and 1 pounds per acre, respectively. In riparian zones, planting root stock of such species as American plum (*Prunus americana*), woods rose (*Rosa Woodsii*), plains cottonwood (*Populus sargentii*), and willow (*Populus spp.*) may be considered. On non-topsoiled upland sites, a legume such as Ladak alfalfa at 1 lb. PLS per acre can be included as a source of nitrogen for perennial grasses.

TABLE C-3
Minimum Drill Seeding Rates for Perennial Grasses[1]
Alakali Soil Seed Mix

Common Name	Botanical Name	Growth Season[b]	Growth Form	Seeds/ Pound	Pounds of PLS/acre
Alkali sacaton	*Sporobolus airoides*	Cool	Bunch	1,750,000	0.25
Basin wildrye	*Elymus cinereus*	Cool	Bunch	165,000	2.5
Sodar Streambank wheatgrass	*Agropyron riparium 'Sodar'*	Cool	Sod	170,000	2.5
Jose tall wheatgrass	*Agropyron elongatum 'Jose'*	Cool	Bunch	79,000	7.0
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	5.5
Total					**17.75**
Fertile Loamy Soil Seed Mix					
Ephriam crested wheatgrassc	*Agropyron cristatum 'Ephriam'*	Cool	Sod	175,000	2.0
Dural hard fescue	*Festuca ovina 'duriuscula'*	Cool	Bunch	565,000	1.0
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Sodar Streambank wheatgrass	*Agropyron riparium 'Sodar'*	Cool	Sod	170,000	2.5
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	7.0
Total					**15.5**
High Water Table Soil Seed Mix					
Meadow foxtail	*Alopecurus pratensis*	Cool	Sod	900,000	0.5
Redtop	*Agrostis alba*	Warm	Open sod	5,000,000	0.25
Reed canarygrass	*Phalaris arundinacea*	Cool	Sod	68,000	0.5
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Pathfinder switchgrass	*Panicum virgatum 'Pathfinder'*	Warm	Sod	389,000	1.0
Alkar tall wheatgrass	*Agropyron elongatum 'Alkar'*	Cool	Bunch	79,000	5.5
Total					**10.75**
Transition Turf Seed Mix					
Ruebens Canadian bluegrass	*Poa compressa 'Ruebens'*	Cool	Sod	2,500,000	0.5
Dural hard fescue	*Festuca ovina 'duriuscula'*	Cool	Bunch	565,000	1.0
Citation perennial ryegrass	*Lolium perenne 'Citation'*	Cool	Sod	247,000	3.0
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Total					**7.5**

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TABLE C-3
Minimum Drill Seeding Rates for Perennial Grasses[1]
Alakali Soil Seed Mix (continued)

Common Name	Botanical Name	Growth Season[b]	Growth Form	Seeds/ Pound	Pounds of PLS/acre
Sandy Soil Seed Mix					
Blue grama	*Bouteloua gracilis*	Warm	Sod-forming bunchgrass	825,000	0.5
Camper little bluestem	*Schizachyrium scoparium 'Camper'*	Warm	Bunch	240,000	1.0
Prairie sandreed	*Calamovilfa longifolia*	Warm	Open sod	274,000	1.0
Sand dropseed	*Sporobolus cryptandrus*	Cool	Bunch	5,298,000	0.25
Vaughn sideoats grama	*Bouteloua curtipendula 'Vaughn'*	Warm	Sod	191,000	2.0
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	5.5
Total					**10.25**
Heavy Clay, Rocky Foothill Seed Mix					
Ephriam crested wheatgrassc	*Agropyron cristatum 'Ephriam'*	Cool	Sod	175,000	1.5
Oahe Intermediate wheatgrass	*Agropyron intermedium 'Oahe'*	Cool	Sod	115,000	5.5
Vaughn sideoats gramae	*Bouteloua curtipendula 'Vaughn'*	Warm	Sod	191,000	2.0
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	5.5
Total					**17.5**

[a] All of the above seeding mixes and rates are based on drill seeding followed by crimped hay or straw mulch. These rates should be doubled if seed is broadcast and should be increased by 50 percent if the seeding is done using a Brillion Drill or is applied through hydraulic seeding. Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1. If hydraulic seeding is used, hydraulic mulching should be done as a separate operation.
[b] See Table 3-4 for seeding dates.
[c] Crested wheatgrass should not be used on slopes steeper than6H to 1V.
[d] If site is to be irrigated, the transition turf seed rates should be doubled.
[e] Could substitute 0.5 lbs PLS of Blue grama for the 2.0 lbs PLS of Vaughn sideoats grama.

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TABLE C-4
Seeding Dates for Annual and Perennial Grasses

	Annual Grasses		Perennial Grasses	
Seeding Dates	Warm	Cool	Warm	Cool
January 1 - March 15				
March 16 - April 30	4	1,2,3		
May 1 - May 15	4			
May 16 - June 30	4,5,6,7			
July 1 - July 15	5,6,7			
July 16 - August 31				
September 1 - September 30		8,9,10,11		
October 1 - December 31				

Notes:

See Table C-2 and C-3 for growth season of annual and perennial grasses, respectively. Number codes for annual species refer to specific seeding periods for: (1) oats; (2) spring wheat; (3) spring barley; (4) annual ryegrass; (5) millet; (6) sudangrass; (7) sorghum; (8) winter wheat; (9) winter barley; (10) winter rye; and, (11) triticale.

To provide temporary erosion control between the seeding dates specified, utilize surface roughening (on the contour or perpendicular to prevailing winds) and/or apply a mulch.

The seeding dates for perennial species are generally in the spring from March through early May, and in the fall after mid-October until snow cover precludes planting. Fall seeding is referred to as "dormant seeding" because the seeds will lie dormant through the winter and germinate in the spring.

Perennial grasses can be seeded using a drill seeder in areas previously planted with a temporary grass cover. In this case, the annual grass may need to be mowed for the drill to operate. Broadcast seeding or hydroseeding of permanent grasses should not be done with a live crop of annual grasses without first reworking and preparing the topsoil.

3.4 Roads and Soil Stockpiles

Road cuts, road fills, and parking lot areas should be covered with the appropriate aggregate base course on the surfaces to be paved in lieu of mulching. Early application of road base is suitable where a layer of course aggregate is specified for final road or parking lot construction. This practice may not be desirable in all instances, and is not needed when final pavement construction will take place within 30 days of grading to final contours. All non-paved portions of road cut, fill, and parking lot areas should be seeded and mulched as soon as possible after final grading has occurred, but in no case later than 14 days after grading has been completed.

Soils stockpiled for more than 60 days should be seeded with a temporary or permanent grass cover within 14 days after completion of stockpile construction. Mulching is recommended to ensure vegetation establishment. If stockpiles are located within close proximity to a drainageway (i.e., 100 feet), additional sediment control measures, such as a temporary diversion dike or silt fence, should be provided (see Section 4).

4.0 SEDIMENT CONTROL

The installation of sediment entrapment and control facilities has to begin before major land disturbance activities begin on a construction site.

Sediment control will be site specific and can include vehicle tracking controls; sod buffer strips around the lower perimeter of the land disturbance; sediment barriers, filters, dikes, sediment basins; or a combination of any or all of these measures.

Sediment controls must be constructed before land disturbance takes place. Earthen structures such as dams, dikes, and diversions should be mulched within 14 days of installation. Earthen structures that are expected to remain in place for more than one year must be seeded and mulched.

Dams must address stable embankment design and water rights considerations. Consult with the State Engineer's Office on these requirements prior to constructing any dam.

4.1 Vehicle Tracking

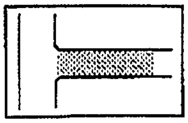
Wherever construction vehicles enter onto paved public roads, provisions must be made to prevent the transport of sediment (mud and dirt) by runoff or by vehicles tracking onto the paved surface. It is recommended that coarse-aggregate rock surfacing be provided to keep most construction traffic from coming into contact with mud and dirt. In other words, stabilized access, parking, staging, and loading/unloading areas will reduce the likelihood that vehicles will come in contact with mud.

For sites greater than two (2) acres, a stabilized vehicle tracking control must be constructed (see Figure C-8). Whenever deemed necessary by the city or county of jurisdiction, wash racks shall be installed to remove mud and dirt from the vehicle and its tires before it enters onto public roads (see Figure C-8A).

Whenever sediment is transported onto a public road, regardless of the size of the site, the road shall be cleaned at the end of each day. Sediment shall be removed from roads by shoveling or sweeping and be transported to a controlled sediment disposal area. Street washing shall not be allowed until after sediment is removed in this manner. Storm sewer inlet protective measures should be in place at the time of street washing.

4.2 Slope-Length and Runoff Considerations

Cut-and-fill slopes must be designed and constructed to minimize erosion. This requires consideration of the length and steepness of the slope, the soil type, upslope drainage area, groundwater conditions and other applicable factors. Slopes which are found to be eroding excessively will require additional slope



VTC

VEHICLE TRACKING CONTROL

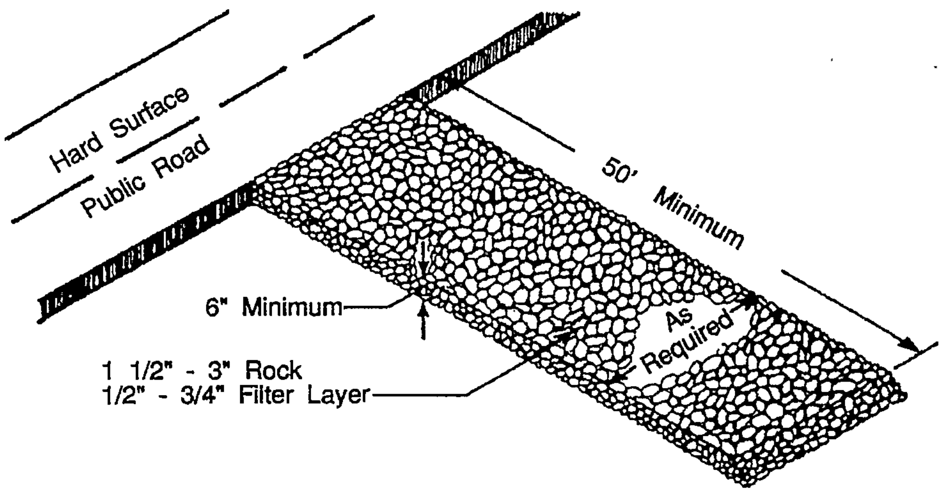
Definition

A stone stabilized pad located at points of vehicular ingress and egress on a construction site.

Purposes

To reduce the amount of mud transported onto public roads by motor vehicles or runoff.

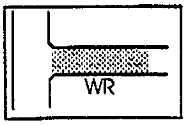
Note: Only applicable for sites greater than 2 acres in size



VEHICLE TRACKING CONTROL

From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-8
Temporary Vehicle Tracking Control



VEHICLE TRACKING CONTROL

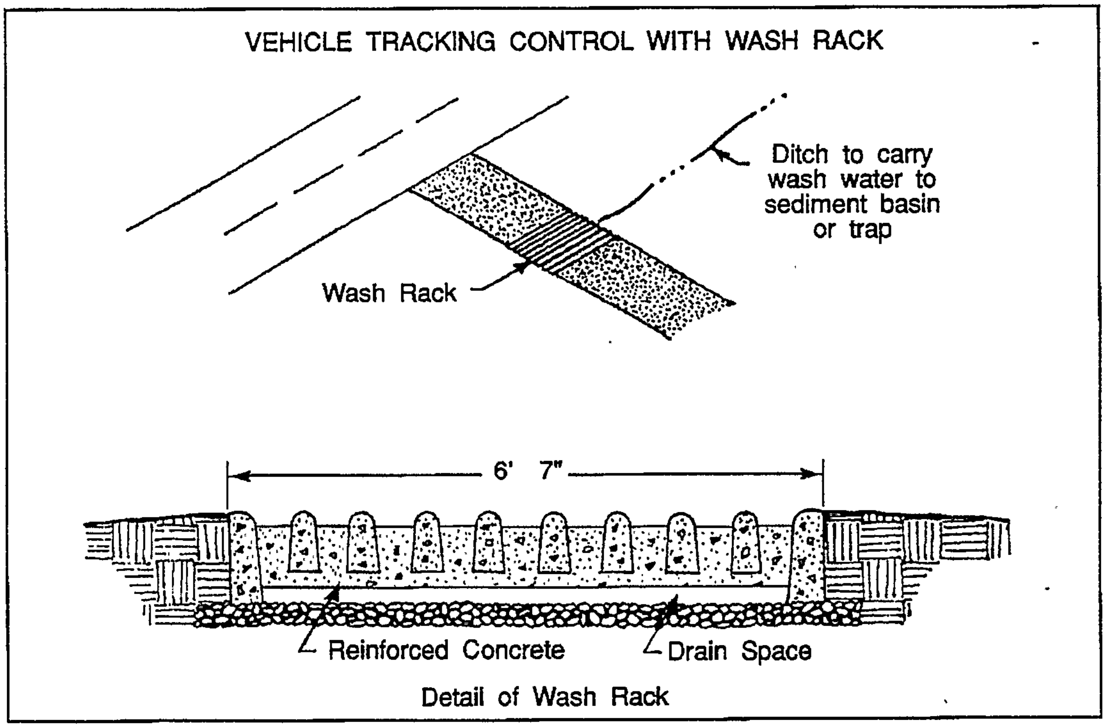
Definition

A stone stabilized pad located at points of vehicular ingress and egress on a construction site equipped with a concrete wash rack.

Purposes

To reduce the amount of mud transported onto public roads by motor vehicles or runoff.

Note: Only needed when required by local City or County of jurisdiction. May be precluded from use if no water supply is available.



From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-8A
Temporary Vehicle Tracking Control With Wash Rack

R0017896

stabilization until the problem is corrected. The following guidelines should assist site planners and plan reviewers in developing an adequate design:

1. Rough soil surfaces are preferred over smooth surfaces on slopes (Section 3.1).

2. Temporary diversion dikes (Section 4.2.1) can be constructed at the top of long or steep slopes, or hillslopes that have an upslope tributary drainage area over five acres. Diversion dikes or terraces (Section 4.2.3) may also be used to reduce slope length within the disturbed area.

   Temporary diversion dikes shall be provided whenever:

$$S^2L > 2.5$$

   where: S = slope of the upstream tributary area (in feet/foot); and,
   L = length of the upstream slope (in feet).

3. Concentrated stormwater should not be allowed to flow down cut or fill slopes unless contained within an adequately-sized temporary channel diversion, a permanent channel, or temporary slope drain (Section 4.2.4).

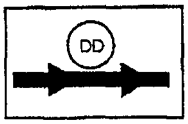
4. Wherever a slope face crosses a water seepage plane which endangers the stability of the slope, adequate drainage should be provided.

5. Provide sediment basins or barriers (silt fences or straw bale dikes) below slopes to reduce offsite sediment transport or to reduce slope lengths (Section 4.3).

4.2.1 Slope Diversion Dikes. A temporary diversion dike is a horizontal ridge of soil placed perpendicular to the slope and angled slightly to provide drainage along the contour. Temporary diversion dikes can be constructed by excavation of a V-shaped trench or ditch and placement of the fill on the downslope side of the cut. A design of a temporary diversion dike is shown on Figure C-9.

There are two types of temporary slope diversion dike:

1. A diversion dike located at the top of a slope to divert upland runoff away from the disturbed area. The discharge from undisturbed or previously-developed upland areas collected by these diversion dikes may be directed to a permanent channel or temporary channel diversion (Section 5.2).



DD

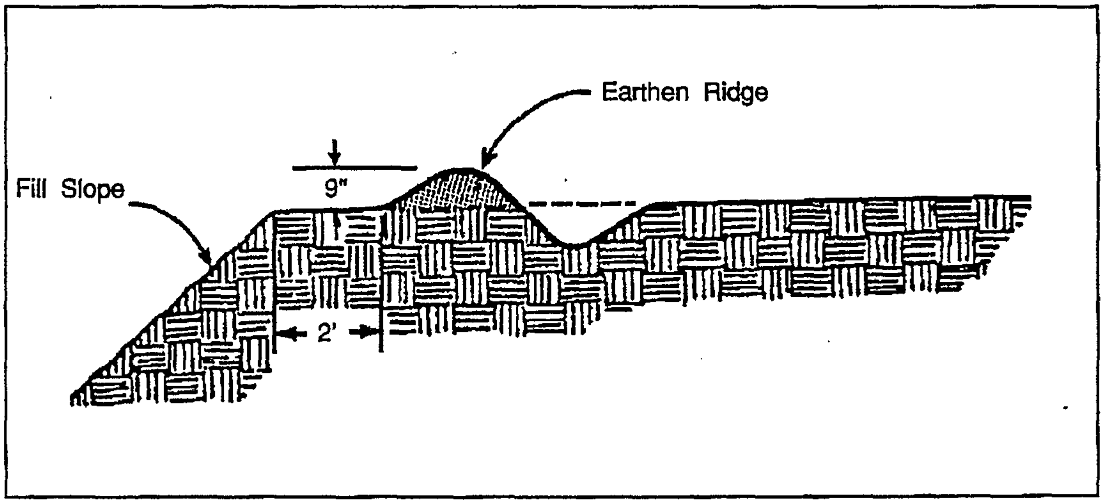
TEMPORARY DIVERSION DIKE

Definition

A temporary ridge of compacted soil located at the top, midslope, or base of a disturbed area.

Purposes

1. To divert storm runoff from higher drainage areas away from unprotected slopes to a permanent channel or temporary channel diversion.
2. To divert sediment-laden runoff from the midslope of a disturbed area to a temporary slope drain.
3. To divert sediment-laden runoff from the base of a disturbed area to a sediment trapping facility.



From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-9
Temporary Diversion Dike

R0017898

2. A diversion dike located at the base or midslope of a disturbed area to divert sediment-laden water to a sediment basin. These diversions are also very useful at road intersections during the construction phase. The discharge from these diversion dikes may be directed to a temporary slope drain or sediment basin.

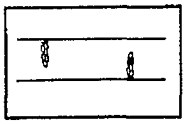
4.2.2 Roads and Roadside Swales. The drainage system provided for roads will define to some extent the length and area of individual slope segments within the disturbed area. A number of smaller hillslope segments will be created by construction of roads. These areas will require erosion control as described in Section 3.4, and sediment controls dependent on the size of upslope tributary area (Section 4.3).

For road areas that are not paved within 30 days of final grading, and have not received early application of roadbase (Section 3.4), rough-cut street controls should be used. These are runoff barriers that are constructed at intervals down the road. The barrier projects perpendicular to the longitudinal slope from the outer edge of the roadside swale to the crown of the road. The barriers are positioned alternately from the right and left side of the road to allow construction traffic to pass in the lane not barred. If construction traffic is expected to be congested and a vehicle tracking control has been constructed, rough-cut street controls may be omitted for 400 feet from the entrance. The design and spacing of temporary rough-cut road controls are shown on Figure C-10.

4.2.3 Terracing. Sediment can be controlled on slopes that are particularly steep by the use of terracing. During grading, relatively flat sections, or terraces, are created and separated at intervals by steep slope segments. The steep slope segments are prone to erosion, however, and must be stabilized in some manner. Retaining walls, gabions, cribbing, deadman anchors, rock-filled slope mattresses and other types of soil retention systems are available for use. These should be specified in the plan and installed according to manufacturer's instructions.

4.2.4 Slope Drains. There are certain instances when runoff must be directed down a slope within the disturbed area. A temporary slope drain can be used to protect these hillslope areas from scour and additional erosion. A number of alternative designs and materials can be used for a slope drain. These are illustrated in Figures C-11 and C-11A.

The sizing of temporary slope drains must be defined but do not need rigorous hydraulic analysis. Criteria for sizing are given in the design criteria. The discharge from all slope drains must be directed to a stabilized outlet (Section 5.3).



RCS

ROUGH-CUT STREET CONTROL

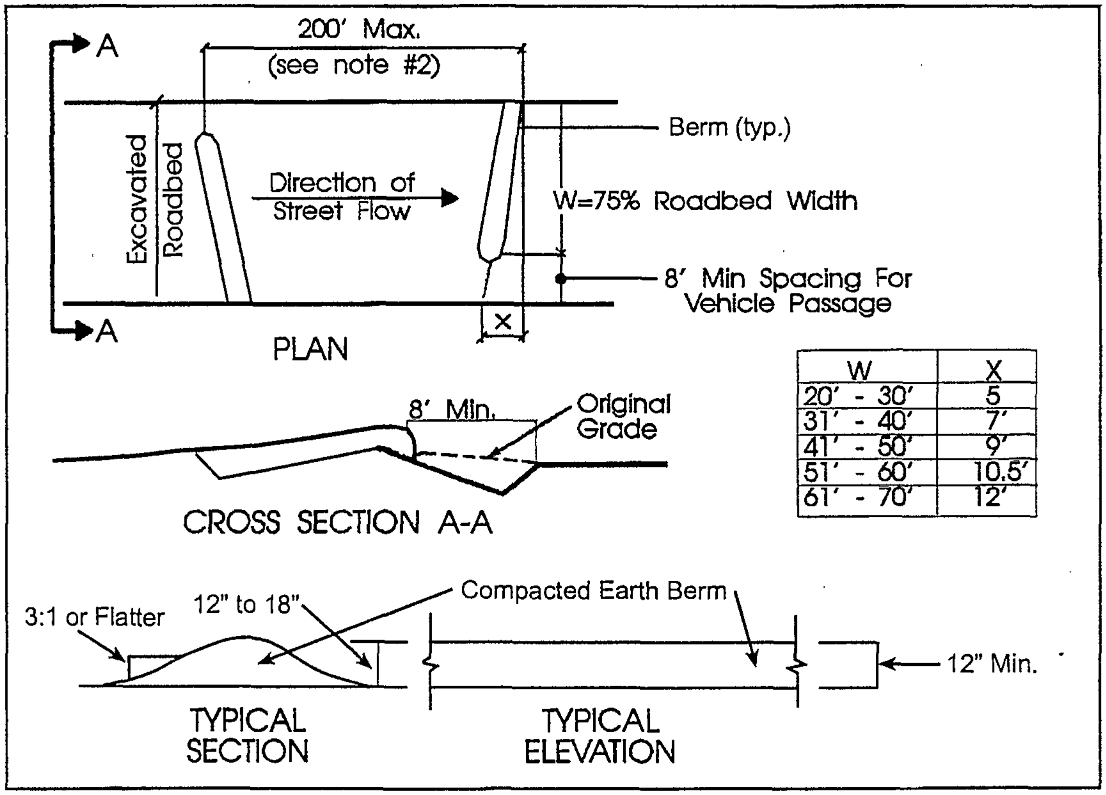
Definition

A temporary sediment barrier placed on alternate sides of a rough cut street.

Purposes

To divert sediment-laden runoff from rough-cut streets and slow the velocity of storm runoff.

Note:
1. Alternate materials such as curb socks or silt fences may be used where large flows are not expected.
2. Requirements for and spacing of velocity reducers for streets with grades of less than 4% shall be as shown on the erosion control plan.

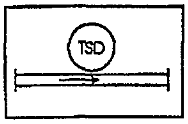


W	X
20' - 30'	5
31' - 40'	7'
41' - 50'	9'
51' - 60'	10.5'
61' - 70'	12'

Adopted From: Orange County, California Department of Environmental Quality, 1981

FIGURE C-10
Rough-Cut Street Control

R0017900



TSD

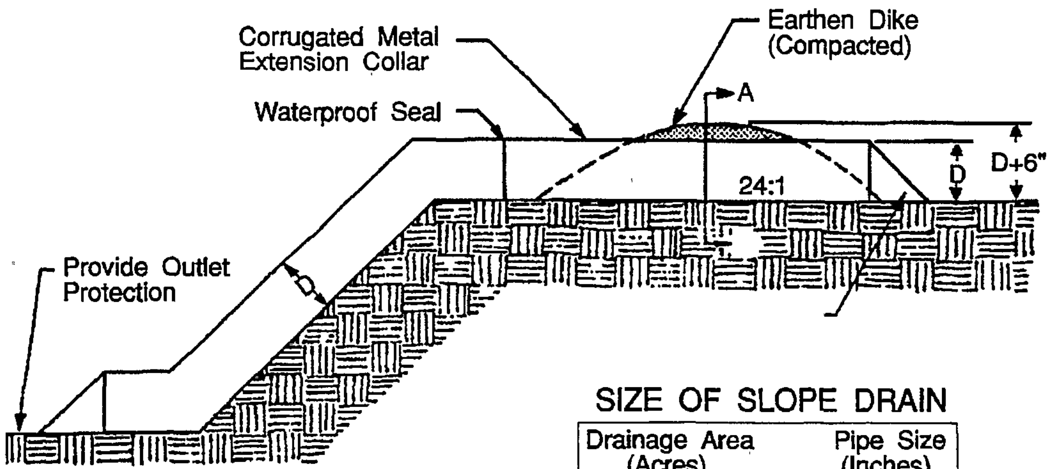
TEMPORARY SLOPE DRAIN

Definition

A flexible tube or conduit extending from the top to the bottom of a cut or fill slope.

Purposes

To temporarily conduct concentrated stormwater runoff safely down the face of a cut or fill slope without causing erosion problems on or below the slope.



SIZE OF SLOPE DRAIN

Drainage Area (Acres)	Pipe Size (Inches)
<1.5	12"
<5.0	18"
<10.0	24"

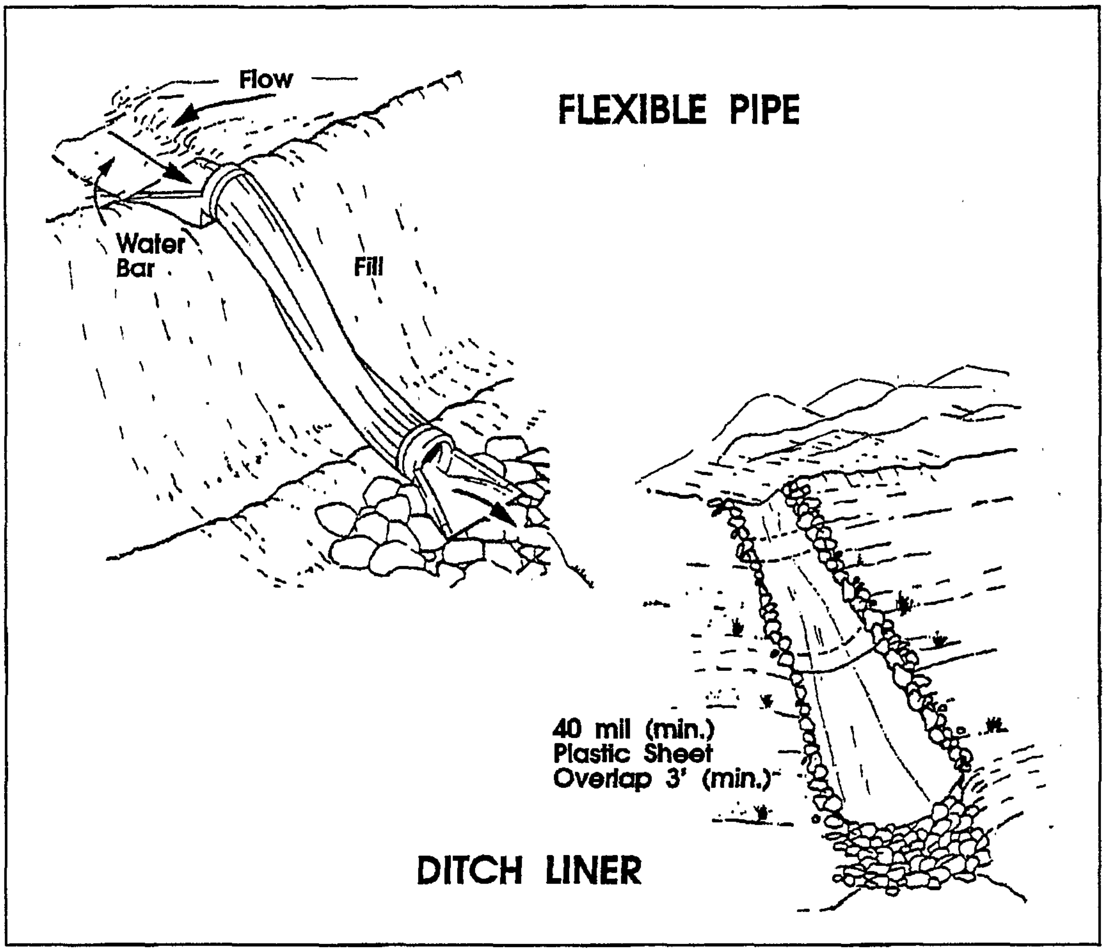
From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-11
Temporary Slope Drain

R0017901

TSD

TEMPORARY SLOPE DRAINS



From: Colorado Department of Highways, 1978

FIGURE C-11A
Temporary Slope Drain Applications

R0017902

4.3 Sediment Entrapment Facilities

Sediment entrapment facilities are necessary to reduce sediment discharges to downstream properties and receiving waters. Sediment entrapment facilities include straw bale barriers, silt fences, and sediment basins. The type of sediment entrapment facility to be used depends on the tributary area, basin slope and slope length of the upstream area. Table C-5 summarizes the recommended maximum tributary areas, slope lengths and slopes for three (3) types of sediment entrapment facilities.

All runoff leaving a disturbed area shall pass through a sediment entrapment facility before it exits the site and flows downstream.

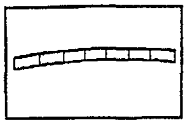
TABLE C-5
Sediment Entrapment Facility Limitations

Sediment Control Facility	Allowable Maximum Limit: Tributary Drainage Area (ac)	Tributary Slope Length (ft)	Tributary Slope Gradient
Straw Bale Barrier or Silt Fence	0.5-1.0 per 100 lineal ft	150	2:1 (50%)
Sediment Basin	n/a	n/a	n/a

Straw bale barriers or silt fences may be used for small sites. When the tributary area is greater than that allowed for straw bale barriers or silt fences, runoff shall be collected in diversion dikes and routed through temporary sediment basins.

4.3.1 Straw Bale Barriers. Straw bales can be placed at the base of a hillslope to act as a sediment barrier. These are not recommended for use within a swale or channel. Straw bales are temporary in nature and may only perform for a period of weeks or months. Proper installation and maintenance is necessary to ensure their performance. These limitations should be considered when selecting straw bales for use. Guidance on design and installation of straw bales is given on Figures C-12 and C-12A.

4.3.2 Silt Fence. A silt fence is made of a woven synthetic material and acts to filter runoff. Silt fence can be placed as a temporary barrier along the contour at the base of a disturbed area but is not recommended for use in a channel or swale. The material is durable and will last for more than one season if properly installed and maintained. Silt fence is not intended to be used as a perimeter fence, particularly on ridges or transverse to the contours, or in areas of concentrated flow. If concentrated flow conditions exist, the use of a rack overtopping berm is recommended. Silt fence design criteria and construction techniques are shown on Figure C-13 and C-14.



STB

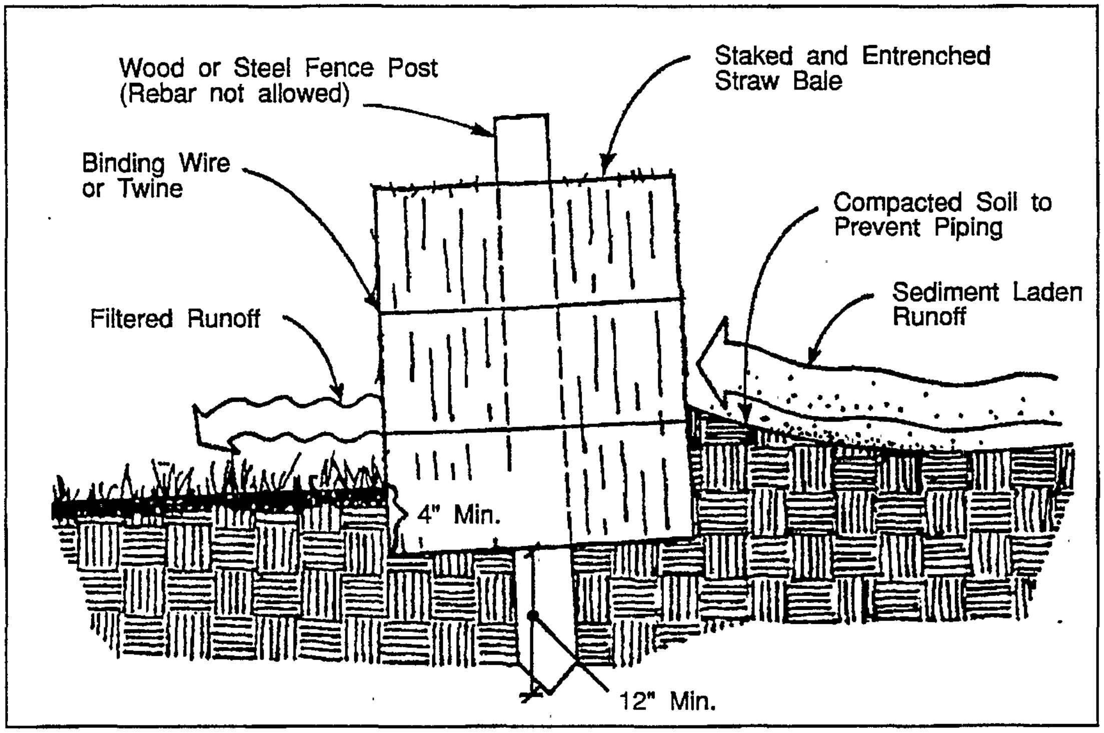
STRAW BALE BARRIER

Definition

A temporary sediment barrier consisting of a row of entrenched and anchored straw bales.

Purposes

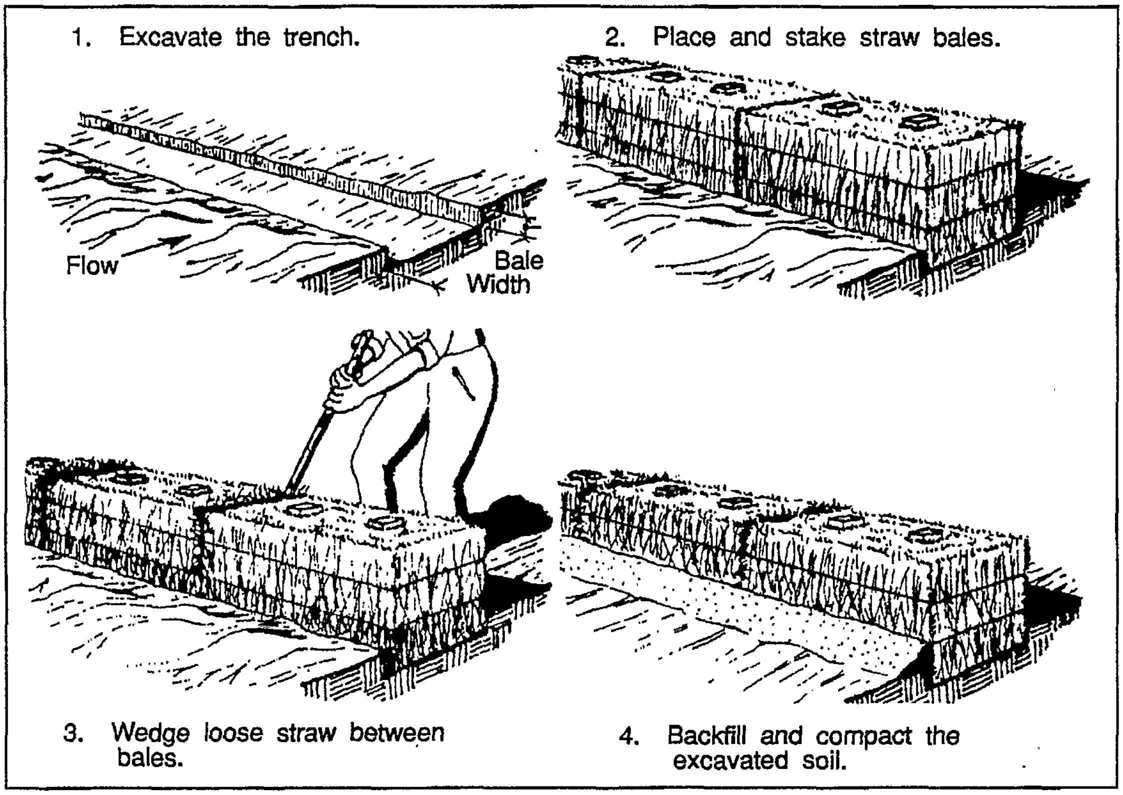
1. To intercept and detain small amounts of sediment from disturbed areas of limited extent in order to reduce sediment in runoff from leaving the site.
2. To decrease the velocity of sheet flows from hillslope areas



From: Virginia Soil and Water Conservation Commission, 1985

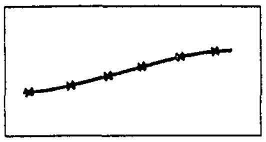
FIGURE C-12
Straw Bale Barriers

STRAW BALE BARRIER INSTALLATION

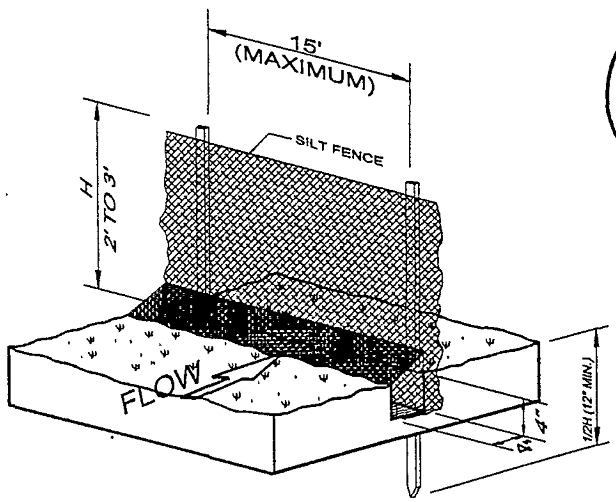


From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-12A
Straw Bale Barrier Installation

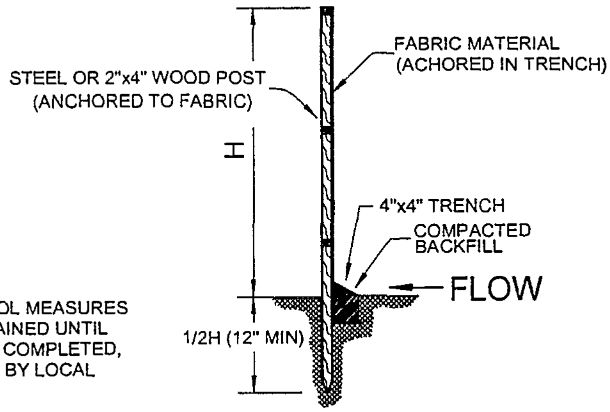


SF



SILT FENCE INSTALLATION

-NTS-



NOTE: EROSION CONTROL MEASURES SHALL BE MAINTAINED UNTIL LANDSCAPING IS COMPLETED, OR AS DIRECTED BY LOCAL JURISDICTION

SECTION

-NTS-

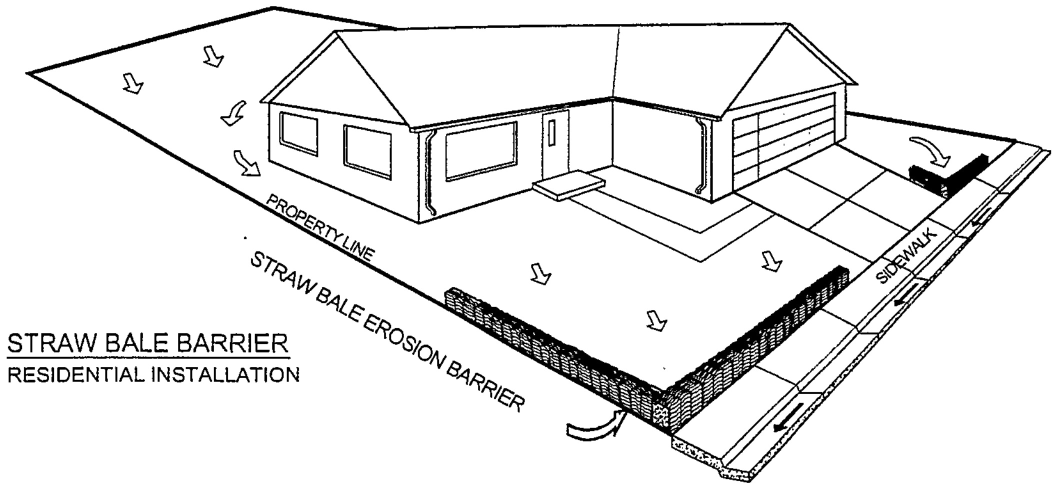
DETAIL

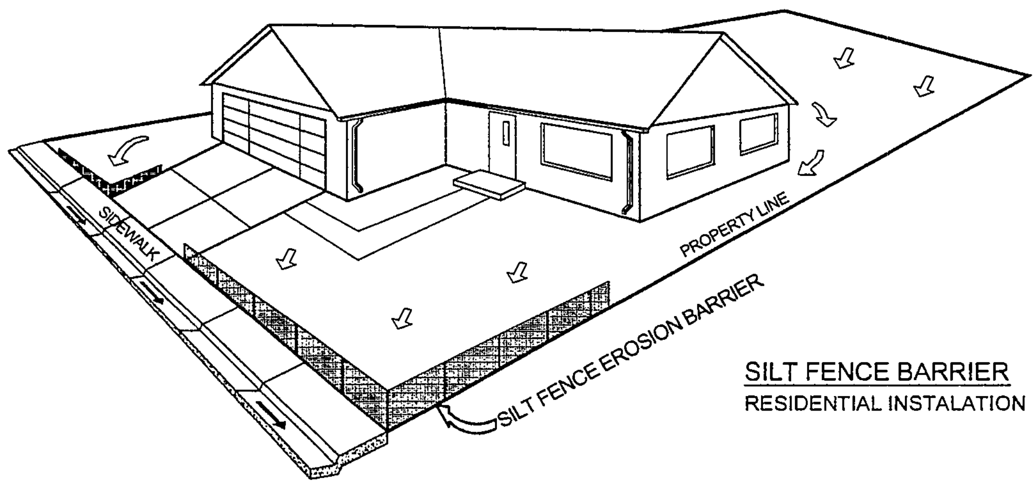
SILT FENCE EROSION BARRIER

Details provided to District by the City of Broomfield, Colorado

FIGURE C-13

Silt Fence Erosion Barrier





Note: Extend barriers so as to intercept all runoff from the residential lot.

Details provided to District by the City of Broomfield, Colorado

FIGURE C-14

Residential Erosion Control Barriers

R0017907

4.3.3 Sediment Basins. Areas draining more than 1 acre must be routed through a sediment basin similar to one shown in Figures C-15, C-15A, and C-16. Sediment basins in the Denver region shall be designed to a minimum 1,800 cubic feet of volume per tributary acre and shall be cleaned out prior to becoming half full.

If the site is to include a stormwater quality or flood detention basin, the permanent detention facility may be used as the temporary sediment basin, provided the outlets are modified upon completion for this purpose. Such permanent detention facilities shall be restored to design grades, volumes, and configurations after site development is completed and the project is finalized.

The outlet from a sediment basin should be designed to empty its volume in 40 hours. The basin's length shall be no less than twice the basin's width. The inflow structures at the entrance of the basin should be designed to dissipate inflow energy and to spread the flow so as to achieve uniform flow throughout the basin's width.

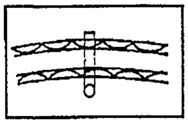
A recommended design procedure is shown below:

4.3.4 Design Procedure: Sediment Basin

The following steps outline the temporary sediment basin design procedure and criteria:

- Basin Storage Volume: Provide a design storage volume that is greater than or equal to 1800 cubic feet per acre of drainage area.
- Dam Embankment: Embankment slopes should be no steeper than 3:1, preferably 4:1 or flatter.
- Emergency Spillway: Design an emergency spillway to convey flows over the embankment when the design storage volume of the basin is exceeded (100 year events or larger). Set the crest at or slightly above the water surface elevation resulting from the design storage volume. The entire emergency spillway should be protected with riprap. Do not construct the spillway over fill material.
- Outlet Works: Design the outlet works in accordance with Figure C-15A. A perforated riser pipe (8-inch or larger PVC) shall be installed to release the design storage volume over a 40-hour period. The perforations in the riser pipe should be sized as follows:
  - Refer to Figure EDB-3 in the *Structural BMP* section to calculate the required perforation area per row of the riser pipe (for purposes of this application, the design storage volume is the same as the water quality capture volume).

R0017908



SB

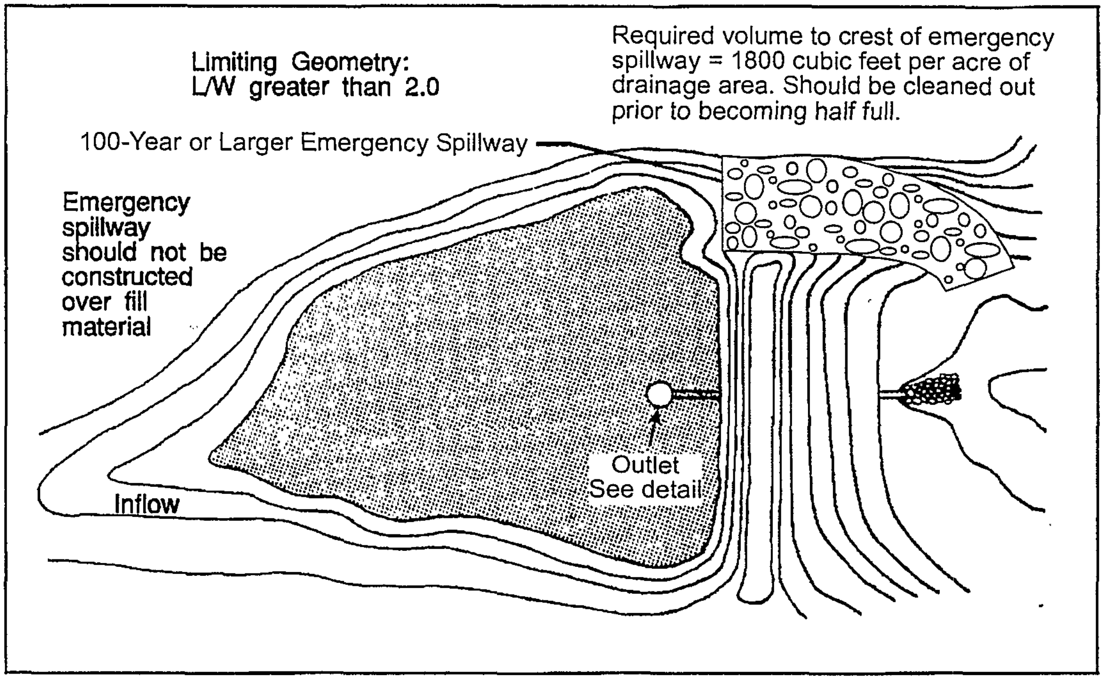
TEMPORARY SEDIMENT BASIN

Definitions

A temporary basin with a controlled stormwater release structure, formed by excavation or construction of an embankment of compacted soil. Required for all drainage areas greater than 1 area.

Purposes

To detain sediment-laden runoff from distributed areas to allow the majority of the sediment to settle out.



From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-15
Temporary Sediment Basin

R0017909

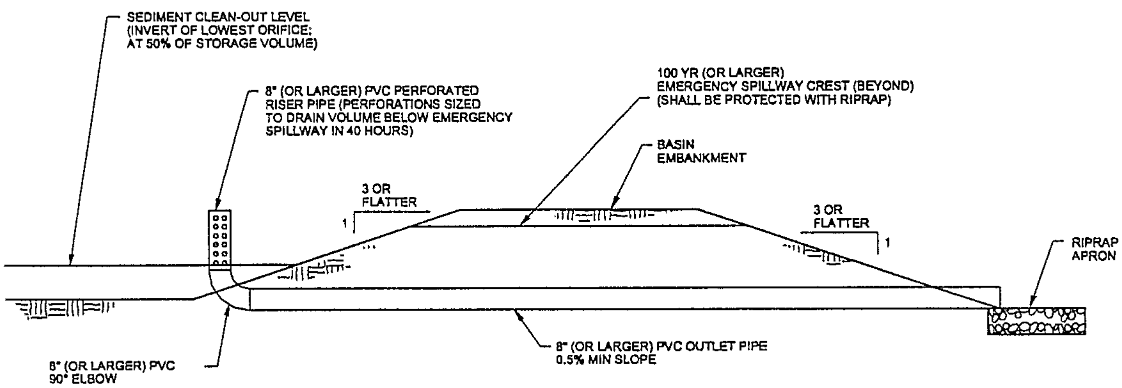
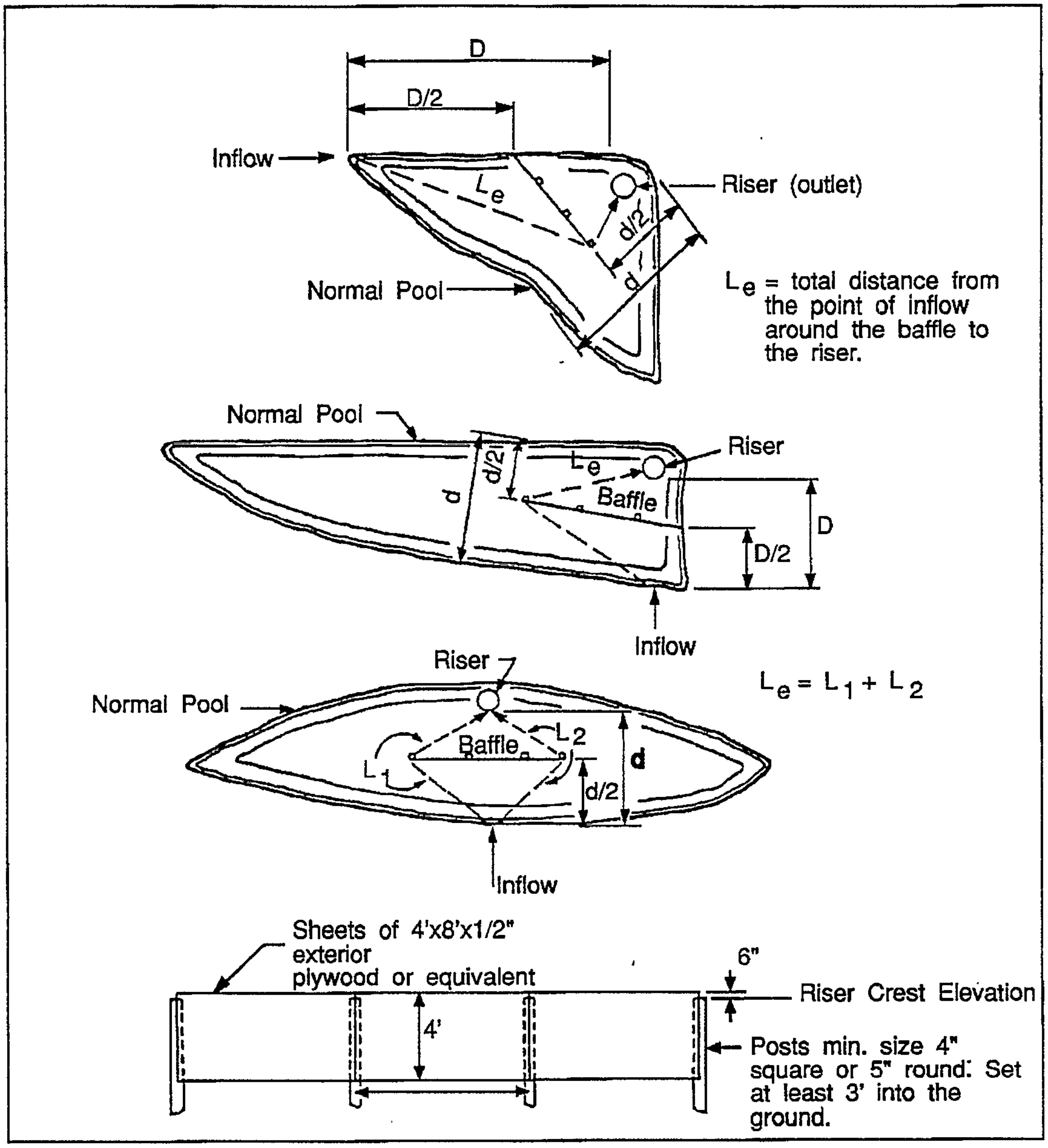


FIGURE C-15A

Temporary Sediment Basin Outlet Detail

R0017910

BAFFLE LOCATIONS IN SEDIMENT BASINS



From: Environmental Protection Agency, 1976

FIGURE C-16
Baffle Locations in Sediment Basins

- See Figures 4 and 5 in the *Typical Det*ails section to determine the appropriate perforation geometry (Note: Although Figures 4 and 5 are based on a flat orifice plate, the resulting hole sizes and patterns may be applied to the cylindrical riser pipe.).

The outlet pipe (8-inch or larger PVC) shall extend through the embankment at a minimum slope of 0.5%. A riprap apron shall be provided at the outfall. A baffle should be constructed to protect the outlet and improve sedimentation in the basin if the length-to-width ratio is less than 2 to 1 (D to D/2) for various geometrys to provide Le greater than or equal to D as shown in Figure C-16.

- Maintenance: The basin shall be dredged out prior to the design storage volume becoming half filled with sediment.

R0017912

5.0 DRAINAGEWAY PROTECTION

At times construction activities must occur adjacent to or within a drainageway. Whenever this occurs, bottom sediments will be disturbed and transported downstream. The goal of these criteria is to minimize the movement of sediments resulting from construction activities that take place within any drainageway. Temporary facilities can be installed to divert flowing water around such sediment-generating construction activities within drainageways.

Some construction activities within a waterway are short lived, namely a few hours in duration, and are minor in nature. These are typically associated with maintenance of utilities and stream crossings and minor repairs to outfalls and eroded banks. In these cases, construction of temporary diversion facilities may cause more soil disturbance than the maintenance activity itself. If it can be reasonably determined that any channel work is maintenance related, is of very short duration, and will result in only a small disturbance of bottom sediment, it is reasonable to exempt these from the requirement to construct temporary diversion facilities.

5.1 Working Within or Crossing a Waterway

Whenever work occurs within a waterway, the following should be considered as appropriate:

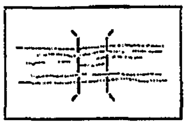
1. Construction vehicles should be kept out of a waterway to the maximum extent practicable. Where in-channel work is necessary, steps, such as temporary channel diversions, must be taken to stabilize the work area during construction to control erosion. The channel (including bed and banks) must be restabilized immediately after in-channel work is completed.

2. Where an actively-flowing watercourse must be crossed regularly by construction vehicles, a temporary crossing should be provided. Two primary methods are available: (1) a culverted crossing; and, (2) a stream ford.

   A culverted crossing should be designed to pass the 2-year design flow. A typical temporary stream crossing is shown on Figure C-17. For additional discussion on design of box culverts and pipes, see Sections 3 and 4, *Major Drainage*, of the *USDCM*.

   A ford should be lined with a minimum 6-inch thick layer of 1-1/2 inch diameter rock. A typical stream ford is shown on Figure C-18.

   A permit is required for placement of fill in a waterway under Section 404 of the Clean Water Act. The U.S. Army Corps of Engineers has issued nationwide general permit Number 14 for Minor Road Crossing Fills. This is defined as placement of less than 200 cubic yards of fill



SC

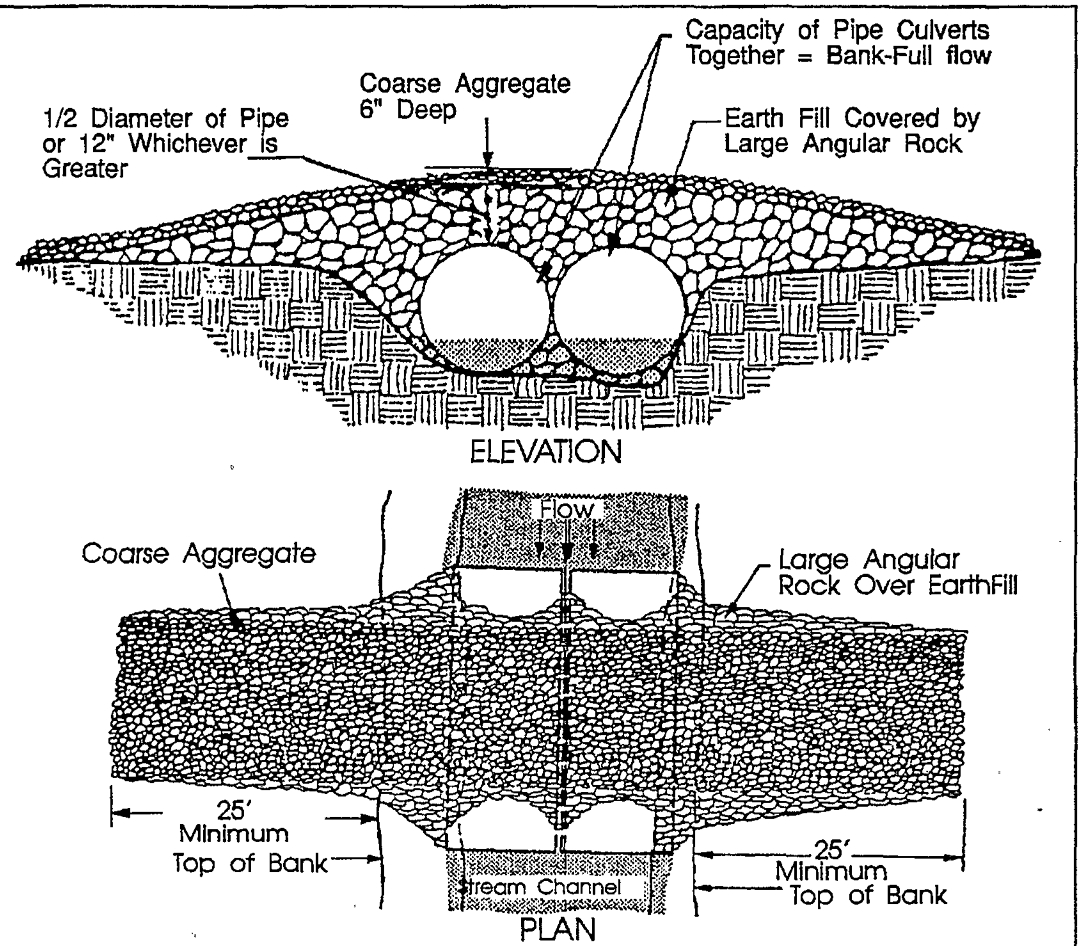
TEMPORARY STREAM CROSSING

Definition

A temporary structural span installed across a flowing watercourse for use by construction traffic. Structures may include bridges, round pipes or pipe arches.

Purposes

To stabilize stream crossings and reduce erosion created by construction traffic.



From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-17
Temporary Culvert Stream Crossing

R0017914

SC

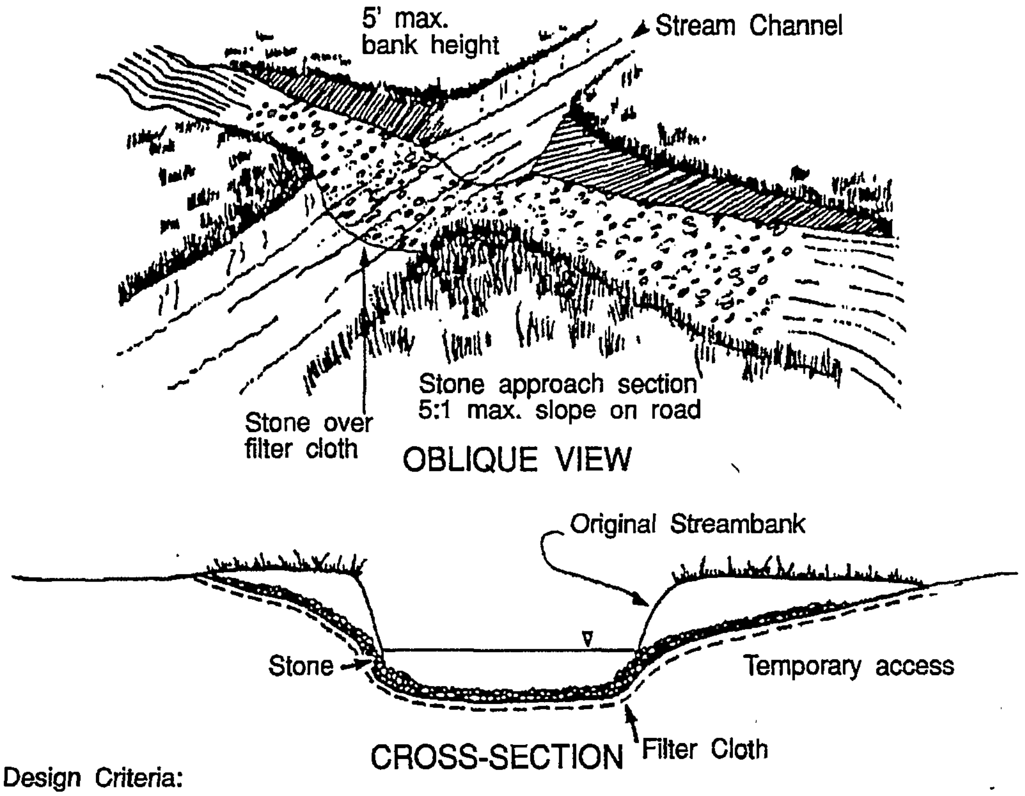
TEMPORARY STREAM CROSSING

Definition

A temporary at-grade stream crossing installed across a normally dry watercourse for use by construction traffic.

Purposes

To stabilize stream crossings and reduce erosion created by construction traffic.



Design Criteria:

- As a minimum, design the structure to pass bankfull flow or peak flow, whichever is less, from a 2-year peak storm, without overtopping.
- Ensure that design flow velocity at the outlet of the crossing structure is nonerosive for the receiving stream channel. See Vol. II, Major Drainage, Section 5.3

From: North Carolina Sediment Control Commission, 1988

FIGURE C-18
Typical Ford Stream Crossing

R0017915

material below the plane of ordinary high water. The local office of the Corps should be contacted about the requirements for obtaining a 404 permit. The city or county of jurisdiction should also be consulted and can provide assistance. A further discussion on the need for 404 permits is included in Section 2.1, *Major Drainage*, of the *USDCM*.

3. Whenever feasible, use a temporary water diversion (Section 5.2) to bypass the work areas when work takes place within a channel itself.
4. Whenever possible, construction in a waterway should be sequenced to begin at the most downstream point and work progressively upstream installing required channel and grade control facilities.
5. Complete work in small segments, exposing as little of the channel at a time as possible.
6. Where possible, perform all in-channel work between September 15 and April 15.

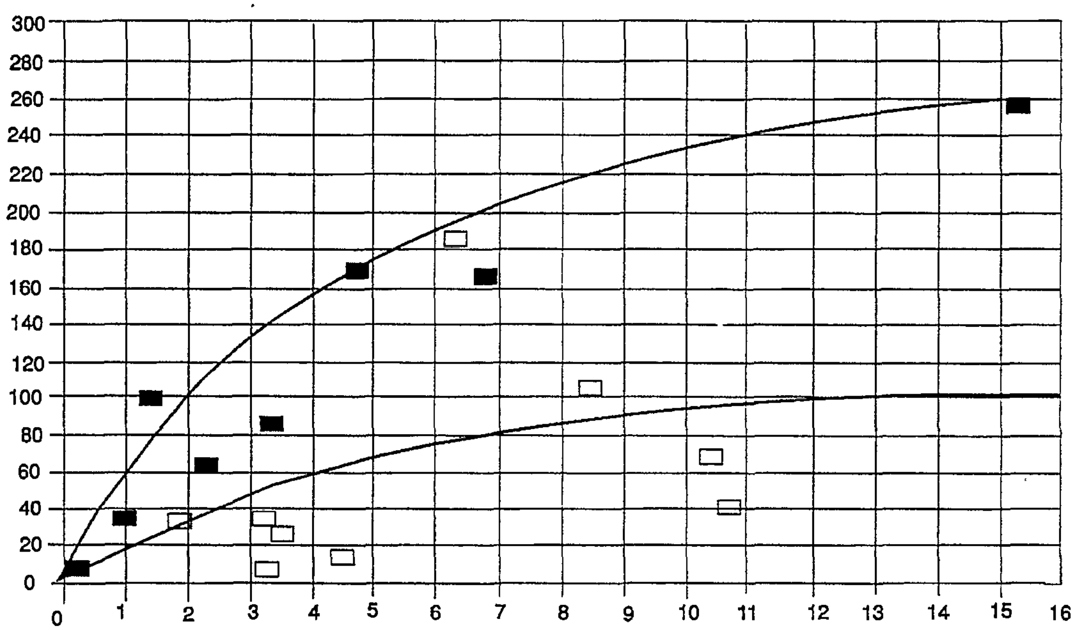
5.2 Temporary Channel Diversions

Limiting construction activities within actively-flowing water will significantly reduce sediment movement downstream from these activities. This can be done by using a temporary diversion facility that carries water around construction activities taking place within a waterway.

Permanent drainage channels should be constructed at the earliest possible stage of development. Temporary channel diversions should not remain in place for more than two years prior to removal or replacement by permanent facilities.

5.2.1 Temporary Diversion Sizing. Figure C-19 must be used to determine the minimum design discharge to size temporary diversions. The two curves in Figure C-19 were developed using monthly peak flow data for the months of April through September collected at 17 watersheds within the Urban Drainage and Flood Control District. Data for these watersheds were collected over periods that ranged from six years to eleven years and, as a result, provide reasonable statistical foundation for Figure C-19. The designer of a temporary diversion facility and the construction contractor must recognize that the design flows taken from Figure C-19 are for sediment control and not job-site protection from large runoff events, since these flow values are not representative of major or minor floods. However, all temporary channel diversions shall be sized to convey no less than the flows provided by Figure C-19. Since each construction project is unique, it is recommended that the contractor consider the use of larger temporary water diversion facilities to protect the job site from higher runoff.

ADJUSTED TRIBUTARY AREA VS. 50 PERCENTILE COMPUTED OUTFLOW



This figure covers the April through September period. When construction is expected to be totally completed within October through March period without a possibility of extending into the April through September period, temporary diversion design can be based on 50% of these flows.

FIGURE C-19
Temporary Diversion Facility Sizing Nomograph for Denver Region

R0017917

While Figure C-19 suggests minimum design flows for April through September, the chances of high runoff decrease substantially during the months of October through March. During these months, much of the precipitation is snow that produces snowmelt runoff rates that are low when compared to runoff from rainstorms. As a result, it is suggested that temporary channel diversion structures for projects scheduled to be performed and completed during October through March be designed to carry no less than one-half of the flow values taken from Figure C-19.

5.2.2 Stability Considerations. Temporary channels are not likely to be in service long enough to establish adequate vegetative lining. Temporary channel diversions must be designed to be stable for the design flow with the channel shear stress less than the critical tractive shear stress for the channel lining material. Unlined channels should not be used unless it can be demonstrated that an unlined channel will not erode during the design flow. Table C-6 gives allowable channel lining materials for a range of slope and flow depth. Table C-7 gives Mannings 'n' values for lining materials. Design procedures for temporary channels are described in detail in the Hydraulic Engineering Circular No. 15 published by the Federal Highway Administration. The methods presented in this section are greatly simplified and are based on information developed using only the most commonly used erosion control materials.

TABLE C-6
Lining Materials for Temporary Channels[a]

	Maximum Flow Depth	
Slope Range	**1 ft.**	**3 ft.**
0% - 0.005%	Jute Netting	Straw or Wood Fiber Erosion Control Netting or Plastic Membrane
0.005% - 1.0%	Straw or Wood Fiber Erosion Control Netting or Plastic Membrane	Straw or Wood Fiber Erosion Control Netting
1.0% - 2.0%	Straw or wood Fiber Erosion Control Netting	Type VL Riprap
2.0% - 3.0%	Type VL Riprap	Type L Riprap
3.0% - 4.0%	Type VL Riprap	Type M Riprap

[a]See Table C-7 for channel design parameters.

5.2.3 Example: Temporary Diversion Design. A simplified method for designing a non-erosive channel is given as follows:

Step One: Using the tributary area A (in acres) determine peak flow according to Figure C-19.

R0017918

Step Two: Determine depth of flow, one foot maximum for flows less than 20 cfs and three feet maximum for flows less than 100 cfs. (Flows in excess of 100 cfs should be designed in accordance with the *Major Drainage* Section of the *USDCM*.)

Step Three: Determine channel slope based on existing and proposed site conditions.

Step Four: Select lining material from Table C-6.

Step Five: Determine the channel geometry and check the capacity using Manning's Equation and the "n" value given in Table C-7. The steepest side slope allowable for a temporary channel is two horizontal to one vertical (i.e., 2:1). It is suggested that the design for temporary bypass channels include an additional 0.5 feet of freeboard.

TABLE C-7
Temporary Channel Design Criteria

Lining Material	Flow Depth 0 ft to 1.0 ft	Flow Depth 1.0 ft to 3.0 ft
Plastic Membrane	0.011	0.010
Jute Netting	0.028	n/a
Straw or Curled Wood Mats	0.035	0.025
Riprap, Type VL	0.070	0.035
Riprap, Type L	0.073	0.037
Riprap, Type M	0.075	0.040

Notes: Maximum depth is 1 foot for flows less than 20 cfs.

Maximum depth is 3 feet for flows equal to or greater than 20 cfs but less than 100 cfs (flows than 100 cfs should be designed in accordance with the Major Drainage Section of the *USDCM*).

Determine the channel bottom width by using Manning's Equation and the "n" value given above.

See Table 5-1 in the Major Drainage Section of the *USDCM* for riprap gradation.

Unless structurally reinforced, side slopes shall be two horizontal to one vertical (2:1) or flatter.

Erosion protection should extend to 0.5 feet above the design depth.

5.3 Outlet Protection

To protect adjacent downstream properties from erosion due to concentrated flows, a stable outlet or channel is necessary. If there is no stable outlet, one may have to be constructed. In lieu of constructing a temporary or permanent outlet to the storm drainageway system, temporary total retention of the runoff from a 24-hour, 100-year storm may be provided. Written approval by the local city or county must be obtained for total retention of stormwater.

The outlets of slope drains, culverts, sediment traps, and sediment basins must be protected from erosion and scour. Outlet protection should be provided where the velocity of flow will exceed the maximum permissible velocity of the material where discharge occurs. This may require the use of a riprap apron at the outlet location. Design guidance on outlet protection is provided on Figure C-20.

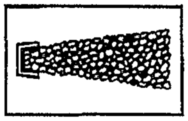
Check dams can be used in ditches or swales and downstream of the outlets of temporary slope drains, culverts, sediment traps, and sediment basins. Check dams reduce the velocity of concentrated flows and trap sediment eroded from the upstream ditch or swale. They are not a primary sediment trapping facility and are a temporary flow-control structure.

Check dams may be used under the following conditions:

- In temporary or permanent swales that need protection during the establishment of grasses
- In permanent swales that need protection prior to installation of a non-erodible lining
- In temporary ditches or swales that need protection where construction of a non-erodible lining is not practicable.

Check dams should be constructed of four- to six-inch angular rock to a maximum height of two-feet. The center of the top of the dam should be six-inches lower than the sides to concentrate the flow to the channel center. Where multiple check dams are used, the top of the lower dam should be at the same topographical elevation as the toe of the upper dam. Cross-sections of a loose-rock check dam and the spacing between a series of check dams are illustrated on Figure C-21.

Sediment that collects behind a check dam shall be removed when the sediment reaches the spillway level. Check dams constructed in permanent swales should be removed when perennial grasses have become established, or immediately prior to installation of a non-erodible lining. All of the rock and accumulated sediment should be removed, and the area seeded and mulched, or otherwise stabilized.



OP

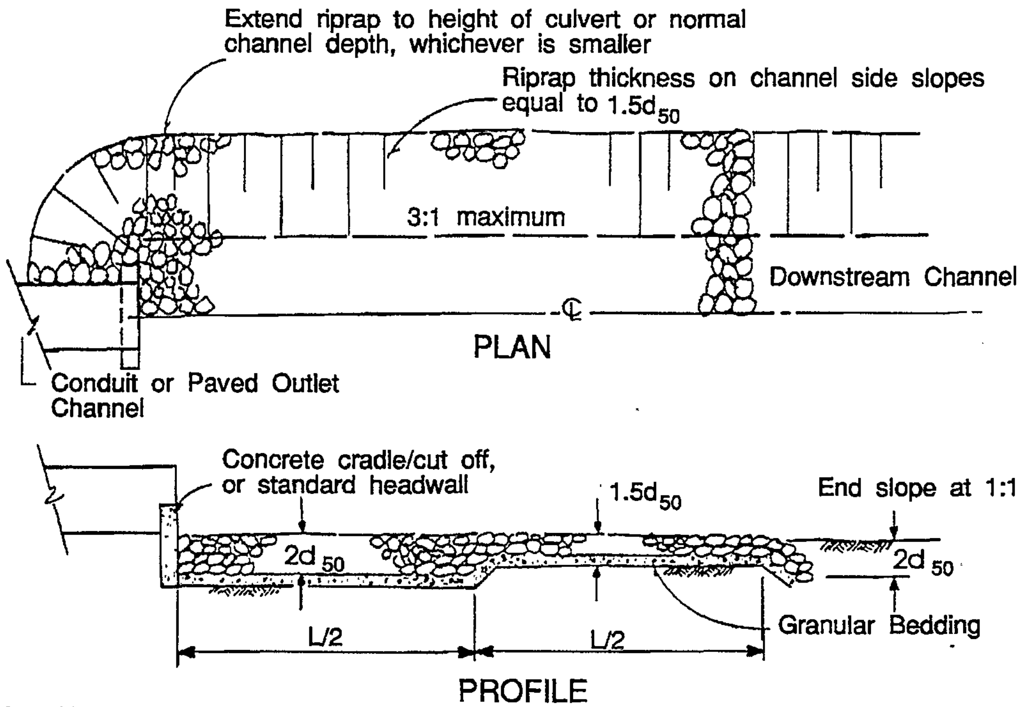
OUTLET PROTECTION

Definition

Structurally lined aprons or other acceptable energy dissipating devices placed at the outlets of pipes or paved channel sections.

Purposes

To prevent scour at stormwater outlets and to minimize the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

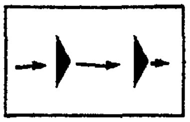


See Urban Storm Drainage Criteria Manual, Vol. 2, "Major Drainage", Section 5.6 for design criteria.

From: Urban Drainage and Flood Control District, 1969

FIGURE C-20
Outlet Protection

R0017921



CD

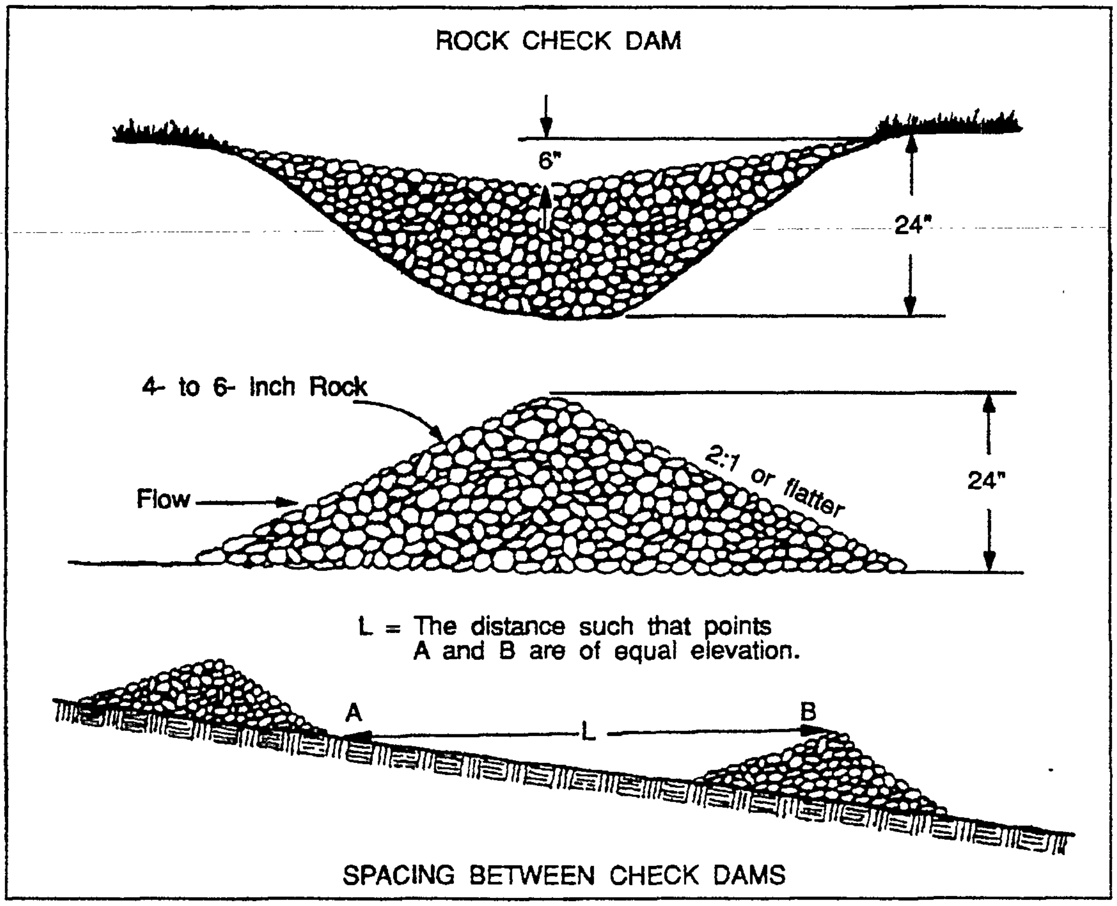
CHECK DAM

Definition

Small temporary dam constructed across a swale or drainage ditch.

Purposes

To reduce the velocity of stormwater flows and erosion of the swale or ditch.



From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-21
Check Dam

R0017922

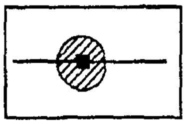
5.4 Inlet Protection

All storm sewer inlets which are made operable during construction must be protected to prevent sediment-laden runoff from entering the conveyance system without first being filtered or otherwise treated to remove sediment. A number of alternate inlet protection designs are available for use as shown on Figures C-22 through C-27.

An important consideration in construction of curb-opening inlets is that their maximum height should be less than the top of the curb opening. This is to allow overflows to occur during large rainfall events even though sediment-laden runoff will enter the storm drainage system. If the inlet protection height is greater than the curb elevation, particularly if the filter is clogged from previous sediment deposits, runoff will not be allowed to enter the inlet and will bypass the inlet. If downstream inlets are constructed similarly, runoff amounts that are bypassed accumulate rapidly. Significant erosion will occur at the downstream location where curb flows eventually level the gutter and travel across unprotected soil on a hillslope.

Inlet protection devices that are easy to construct, portable, and reusable, such as the "gravel sock" shown in Figure C-27, offer many advantages. These can also be placed upstream of an inlet at intervals in the gutter flow line and also at the entrance to the inlet. Sediment removal and re-construction is facilitated with this portable device. Inlet protection measures may be removed after upstream disturbed areas are stabilized.

R0017923



IP

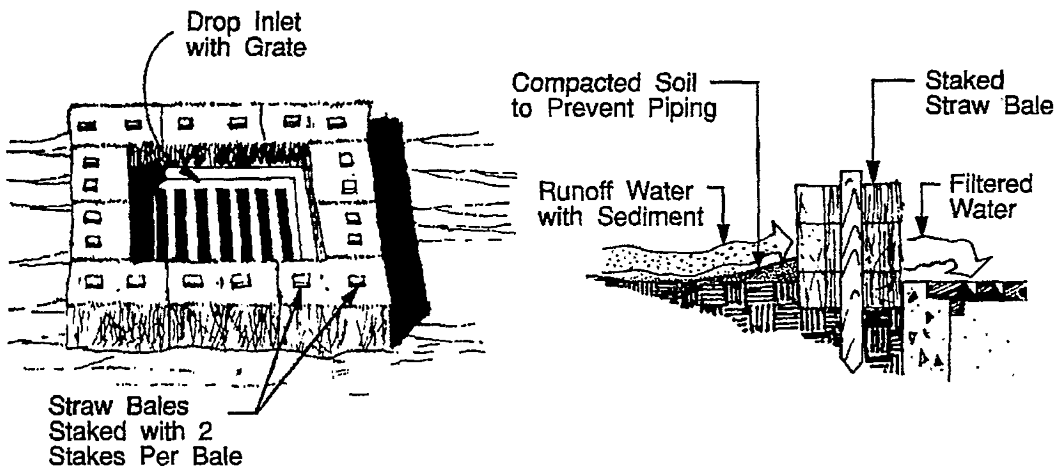
INLET PROTECTION

Definition

A sediment filter or an excavated impounding area around a storm drain drop inlet or curb inlet.

Purposes

To reduce sediment from entering storm drainage systems prior to permanent stabilization of disturbed areas.



Specific Application

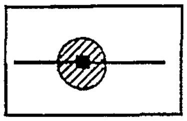
This method of inlet protection is applicable where the inlet drains a relatively flat area (slopes no greater than 5 percent) where sheet or overland flows (not exceeding 0.5 cfs) are typical. The method shall not apply to inlets receiving concentrated flows, such as in street or highway medians.

STRAW BALE DROP INLET SEDIMENT FILTER

From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-22
Inlet Protection - Straw Bales

R0017924



IP

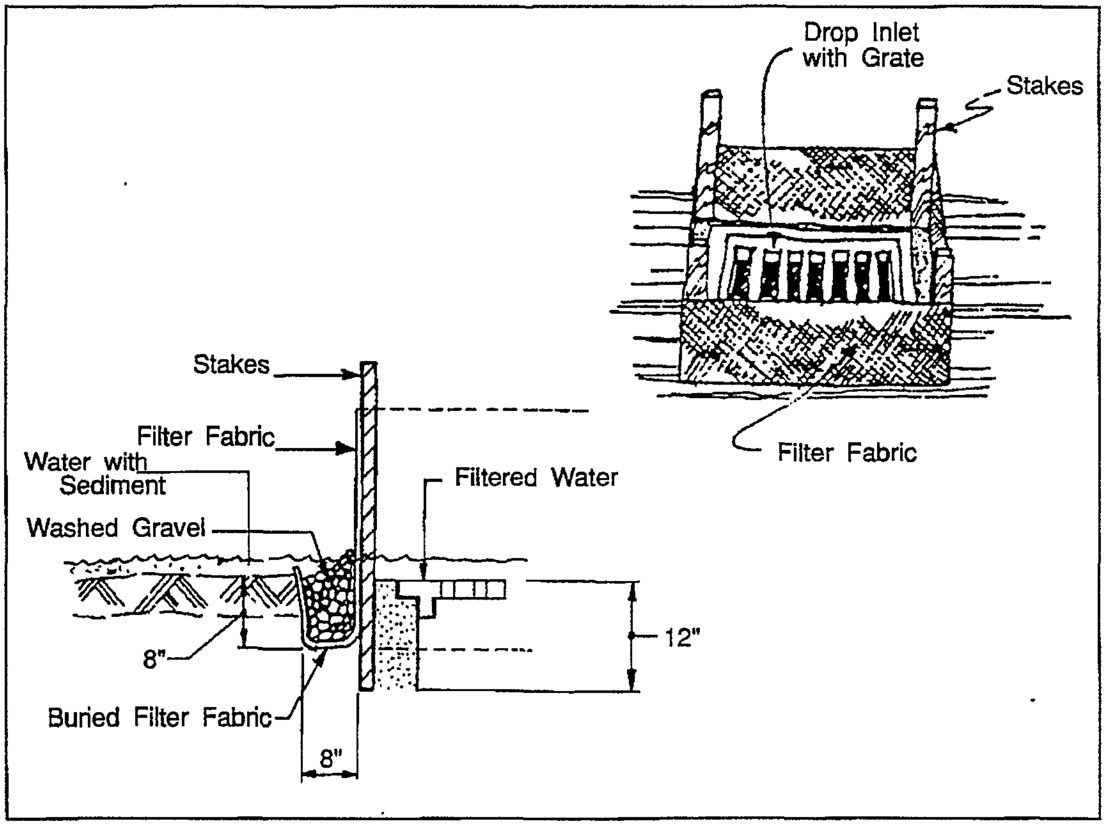
INLET PROTECTION

Definition

A sediment filter or an excavated impounding area around a storm drain drop inlet or curb inlet.

Purposes

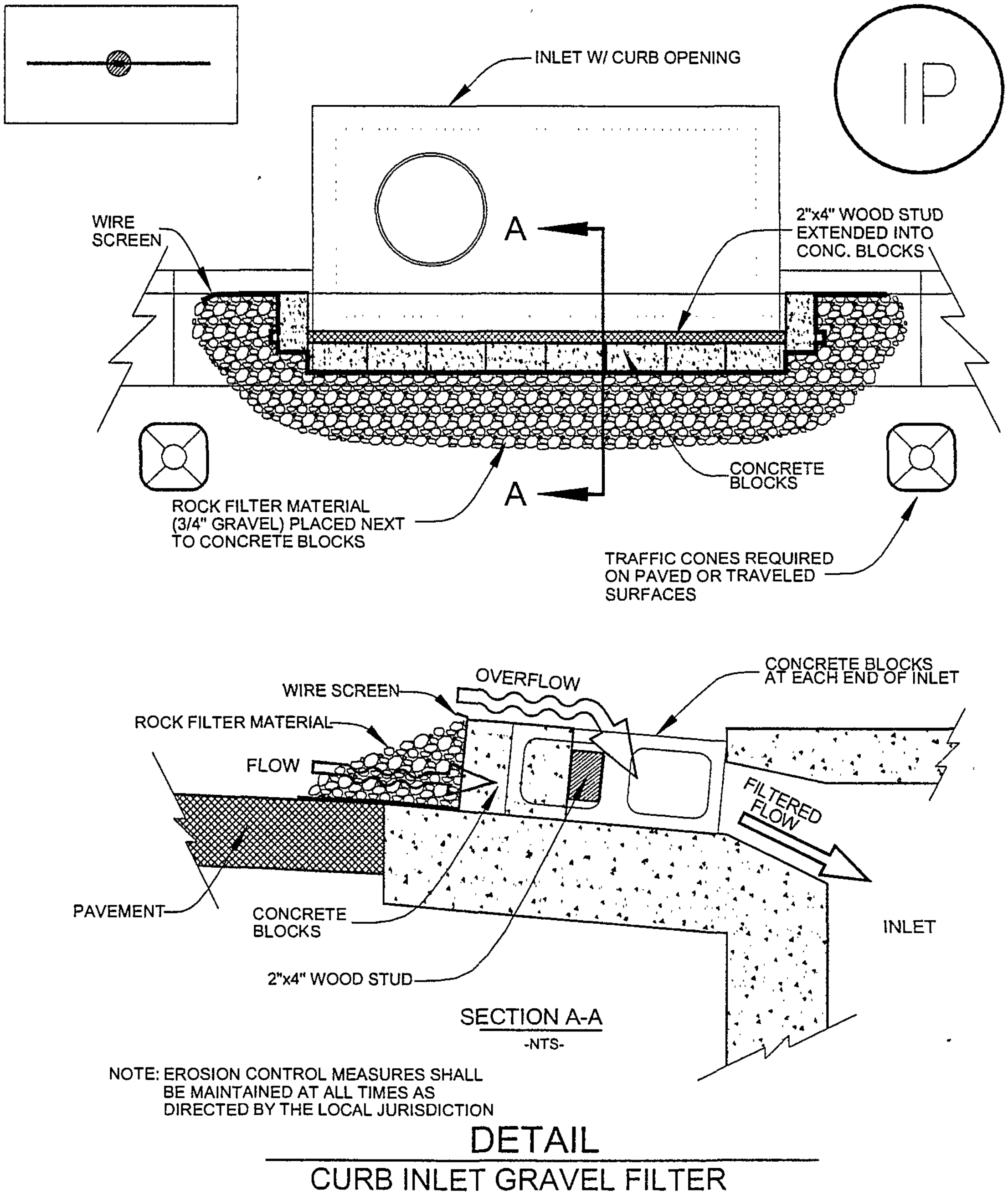
To reduce sediment from entering storm drainage systems prior to permanent stabilization of disturbed areas.



From: Washington State Department of Ecology, 1991

FIGURE C-23
Inlet Protection - Filter Fabric

R0017925

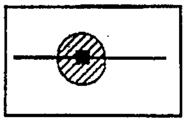


Details provided to District by the City of Broomfield, Colorado

FIGURE C-24

Curb Inlet Gravel Filter

R0017926



IP

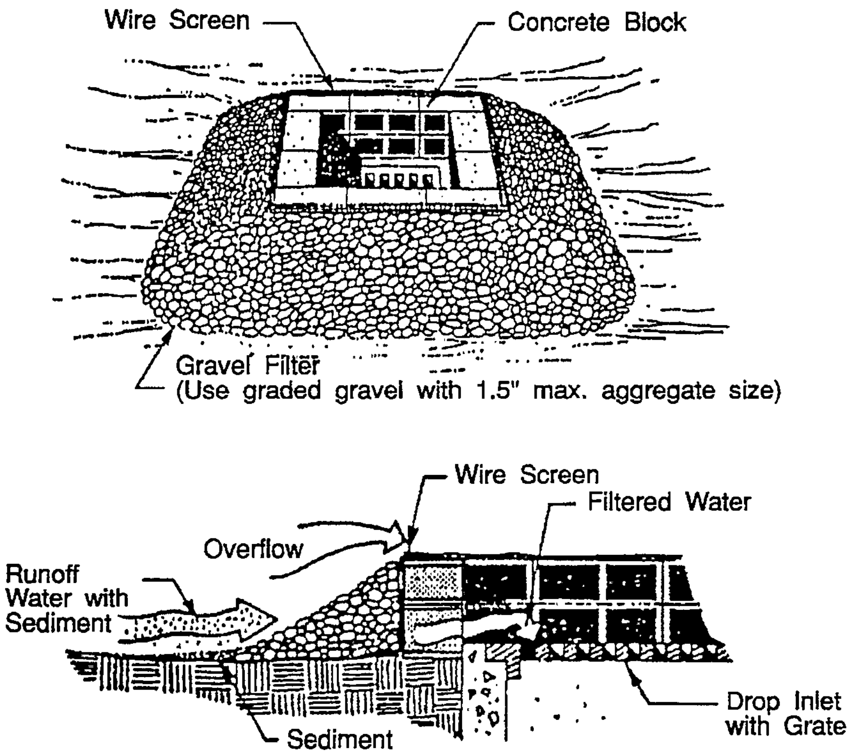
INLET PROTECTION

Definition

A sediment filter or an excavated impounding area around a storm drain drop inlet or curb inlet.

Purposes

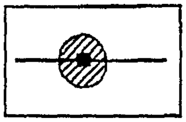
To reduce sediment from entering storm drainage systems prior to permanent stabilization of disturbed areas.



From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-25
Drop Inlet Protection - Block and Gravel Filter

R0017927



IP

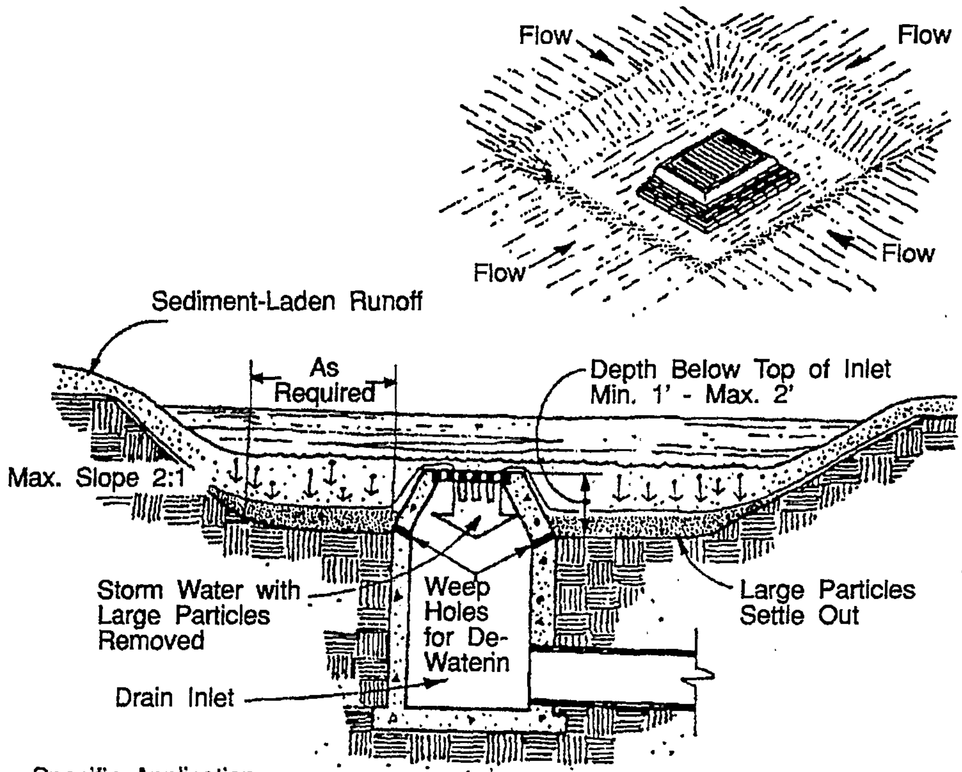
INLET PROTECTION

Definition

A sediment filter or an excavated impounding area around a storm drain drop inlet or curb inlet.

Purposes

To reduce sediment from entering storm drainage system prior to permanent stabilization of disturbed areas.



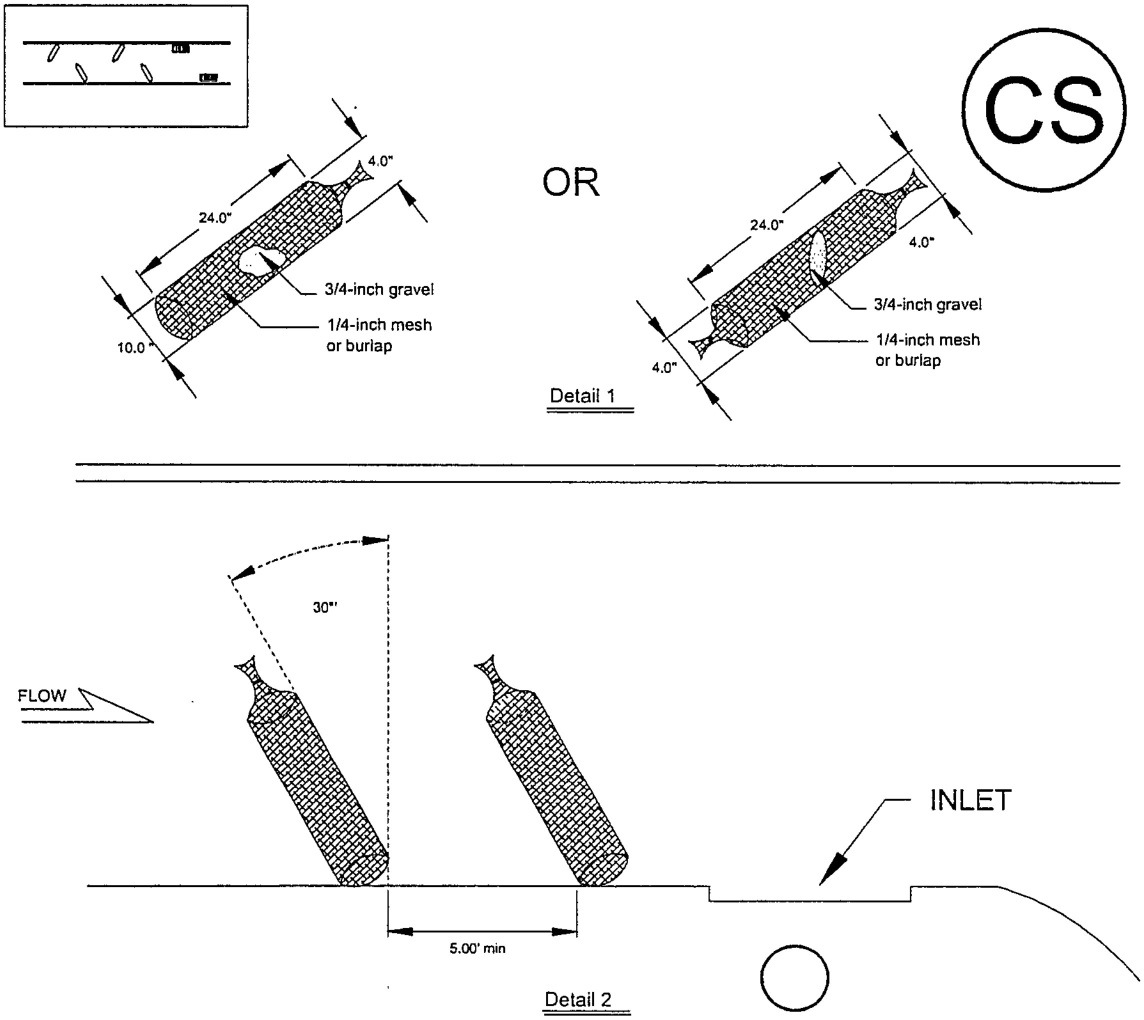
Specific Application

This method of inlet protection is applicable where heavy flows are expected and where an overflow capability and ease of maintenance are desirable.

From: Virginia Soil and Water Conservation Commission, 1985

FIGURE C-26
Inlet Protection - Excavated Drop Inlet Sediment Trap

R0017928



NOTES:

1) Socks will be used upgradient of inlet perpendicular to and flush with curb.
2) No less than two 10-inch diameter socks must be used in sequence, spaced no more than five feet apart, upgradient of inlet. No less than six socks shall be used if the 4-inch sock size is chosen.
3) Incline at 30 degrees from perpendicular, opposite the direction of flow (see Detail 2).
4) Erosion control measures shall be maintained at all times as directed by the local jurisdiction.

Details based on those provided to District by City of Lakewood, Colorado

FIGURE C-27

Inlet Protection – Curb Sock

6.0 MATERIAL STORAGE

Materials are sometimes used at a construction site that present a potential for contamination of stormwater runoff. These include fuel, oil, lubricants, paints, solvents, concrete-curing compounds and other liquid chemicals such as fertilizers, herbicides and pesticides. Practices that can be used to prevent or minimize toxic materials in runoff from a construction site are described in this section.

6.1 Chemical and Petroleum Products Storage

Areas at the construction site that are used for storage of toxic materials and petroleum products should be designed with an enclosure, container, or dike located around the perimeter of the storage area to prevent discharge of these materials in runoff from the construction site. These barriers will also function to contain spilled materials from contact with surface runoff.

Measures to prevent spills or leaks of fuel, gear oil, lubricants, antifreeze, and other fluids from construction vehicles and heavy equipment should be considered to protect groundwater and runoff quality. All equipment maintenance should be performed in a designated area and measures, such as drip pans, used to contain petroleum products. Spills of construction-related materials, such as paints, solvents, or other fluids and chemicals, should be cleaned up immediately and disposed of properly. For additional guidance on spill prevention and response, and material storage practices, see the appropriate sections in the *Nonstructural BMPs* chapter of the *Manual.*

6.2 Waste Storage

Areas used for collection and temporary storage of solid or liquid waste should be designed to prevent discharge of these materials in runoff from the construction site. Collection sites should be located away from the storm drainage system. Consideration should be given to covering waste storage areas, fencing these areas, if necessary, to contain windblown materials, and construction of a perimeter dike to exclude runoff. These measures may not be necessary if all waste is placed immediately in covered waste containers at the site and is otherwise controlled in an effective manner. All waste should be disposed at an approved landfill. For additional guidance on waste storage and disposal practices, see the appropriate sections in the *Nonstructural BMPs* chapter of the *Manual.*

7.0 UNDERGROUND UTILITY CONSTRUCTION

The construction of underground utility lines that are not exempted (see Section 1.3.4) shall be subject to the following criteria:

1. No more than 200 feet of trench are to be opened at one time (local criteria may be more restrictive).
2. Where consistent with safety and space considerations, excavated material is to be placed on the uphill side of trenches.
3. Trench dewatering devices must discharge in a manner that will not adversely affect flowing streams, wetlands, drainage systems, or off-site property. Site dewatering permit requirements should be discussed with the Colorado Department of Public Health and Environment.
4. Provide storm sewer inlet protection (Section 5.4) whenever soil erosion from the excavated material has the potential for entering the storm drainage system.

8.0 DISPOSITION OF TEMPORARY MEASURES

All temporary erosion and sediment control measures shall be removed and disposed within 30 days after final site stabilization is achieved, or after the temporary measures are no longer needed, whichever occurs earliest, or as authorized by the city or county of local jurisdiction. For example, a site containing only one building will have temporary erosion control measures removed after building construction is complete and final landscaping is in place. Temporary erosion control measures may be removed from a commercial construction site or residential subdivision only after streets are paved and all areas have achieved final stabilization. Trapped sediment and disturbed soil areas resulting from the disposal of temporary measures must be returned to final plan grades and permanently stabilized to prevent further soil erosion.

The Professional Engineer preparing the erosion and sediment control plan shall submit, as part of the narrative report, a schedule of removal dates for temporary control measures. The schedule should be consistent with key construction phases such as street paving, final stabilization of disturbed areas, or installation of structural stormwater controls.

9.0 MAINTENANCE

All temporary and permanent erosion and sediment control practices shall be maintained and repaired by the owner during the construction phase as needed to assure continued performance of their intended function. Straw bale barriers, silt fences, and inlet protection devices may require periodic replacement and all sediment accumulated behind them must be removed and disposed of properly. Sediment basins will require periodic sediment removal when the design storage level is one-half full. All facilities must be inspected by the owner or owner's representative following each heavy precipitation or snowmelt event that results in runoff.

The Professional Engineer preparing the erosion and sediment control plan shall submit, as part of the narrative report, a schedule of planned maintenance activities for temporary and permanent erosion and sediment control measures. The schedule should be consistent with the level of maintenance required for the control measures proposed in the plan.

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DESIGN FORMS

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Constructied Wetlands Channel (CWC) – Sedimentation Facility

Design Procedure Form: Grass Swale (GS) Sedimentation Facility

Designer: ______________________
Company: ______________________
Date: ______________________
Project: ______________________
Location: ______________________

1. 2-Year Design Discharge (Total)	Q_2 = ________ cfs
2-Year Design Flow Velocity (V_2, 1.5 fps Maximum)	V_2 = ________ fps
2. Swale Geometry	
A) Channel Side Slopes (Z, horizontal distance per unit vertical)	Z = ________ (horizontal/vertical)
B) 2-Year Design Flow Depth (D_2, 2 feet maximum)	D_2 = ________ feet
C) Bottom Width of Channel (B)	B = ________ feet
3. Longitudinal Slope	
A) Froude Number (F, 0.50 maximum, reduce V_2 until $F \leq 0.50$)	F = ________
A) Design Slope (S, Based on Manning's n = 0.05, 0.01 Maximum)	S = ________ feet/feet
B) Number of grade control structures required	________ (number)
4. Vegetation (Check the type used or describe "Other") (Must use irrigated turf grass if S >0.005 in semi-arid areas of Colorado)	______ Dryland Grass ______ Irrigated Turf Grass ______ Other: ______________
5. Outlet (Check the type used or describe "Other")	______ Infiltration Trench w/ Underdrain ______ Grouted Inlet ______ Other: ______________

Notes: ______________________

R0017945

Design Procedure Form: Grass Buffer (GB)

Designer: ____________
Company: ____________
Date: ____________
Project: ____________
Location: ____________

1. 2-Year Design Discharge (Total)	Q_2 = ______ cfs
2. Tributary Catchment Flow A) Design Length (Normal to runoff flow path): $L_G = Q_2 / 0.05$ B) Tributary Area in Square Feet (A_t)	 L_G = ______ feet A_t= ______ square feet
3. Design Width Along Direction of Flow (Use A **or** B) A) Sheet Flow Control Upstream i) Length of Flow Path Over Upstream Impervious Surface ii) Design Width of Buffer: $W_G = 0.2 * L_I$ (8' minimum) B) Concentrated (Non-Sheet) Flow Control Upstream (requires a level spreader in step 5 below) i) Length of Upstream Flow Level Spreader ii) Design Width of Buffer: $W_G = 0.15 * A_t / L_t$ (8' minimum)	 L_I = ______ feet W_G = ______ feet L_t = ______ feet W_G = ______ feet
4. Design Slope (not to exceed 4%)	S = ______ %
5. Flow Distribution (Check the type used or describe "Other") Note: If Method B was Used In Step 3, Level Spreader Must Be Checked Here	______ Slotted Curbing ______ Modular Block Porous Pavement ______ Level Spreader ______ Other: ______
6. Vegetation (Check the type used or describe "Other") Note: Irrigated Turf Grass Is Required in Semi-Arid Climates	______ Irrigated Turf Grass ______ Non-Irrigated Turf Grass ______ Other: ______
7. Outflow Collection (Check the type used or describe "Other")	______ Grass Lined Swale ______ Street Gutter ______ Storm Sewer Inlet ______ Underdrain Used ______ Other: ______

Notes: ____________

Design Procedure Form: Modular Block Porous Pavement (MBP)

Designer: ____________
Company: ____________
Date: ____________
Project: ____________
Location: ____________

1. Modular Block Properties May substitute MBP with reinforced turf pavement such as provided by Invisible Structures (or equal). Note: Blocks shall have no less than 40% open area and shall be no less than 4" thick	Block Name: ____________ Manufacturer: ____________ Open Surface Area = ______ % Thickness = ______ inches
2. Porous Pavement Infill (Check the type or describe "Other")	______ ASTM C-33 Sand ______ Sandy Loam Sod ______ Other: ____________
3. Base Course A) Sand (ASTM C-33) B) Gravel (AASHTO #8 Coarse Aggregate-CDOT Section 703)	______ 1" Layer ASTM C-33 Sand ______ Other: ____________ ______ 9" Layer AASHTO #8 Course Agg. ______ Other: ____________
4. Design Impervious Area to Porous Pavement Area Ratio (Not to Exceed 2.0)	Ratio = ______ (A_{IMP} / A_{POROUS})
5. Perimeter Wall (6" deeper than base coarse)	______ Concrete ______ inches thick ______ Other ____________
6. Contained Cells A) Type B) Slope of the base course C) Minimum distance between cutoffs (normal to flow, L_{MAX}) $L_{MAX} = 0.8 / S_O$	______ 15 mil (min) P.E. Liner ______ Concrete Wall S_O = ______ ft/ft L_{MAX} = ______ feet
7. Draining of modular block pavement (Check a, **or** b, **or** c, **answer** d) Based on answers to 7a through 7d, check the appropriate method a) Check box if subgrade is heavy or expansive clay ☐ b) Check box if subgrade is silty or clayey sands ☐ c) Check box if subgrade is well-draining soils ☐ d) Does tributary catchment contain land uses that may have petroleum products, greases, or other chemicals present, such as gas station, hardware store, restaurant, etc.? yes ☐ no ☐	______ Infiltration to Subgrade with Permeable Membrane: 7(c) checked **and** 7(d) = no ______ Underdrain with Impermeable Membrane: 7(a) checked **or** 7(d) = yes ______ Underdrain with Permeable Membrane: 7(b) checked **and** 7(d) = no ______ Other: ____________

Notes: ____________

R0017947

Design Procedure Form: Porous Pavement Detention (PPD)

Designer: ______________________
Company: ______________________
Date: ______________________
Project: ______________________
Location: ______________________

1. Basin Storage Volume A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) (I_a = 100% if all paved and roofed areas) B) Contributing Watershed Area, Including PPD Area C) Water Quality Capture Volume (WQCV) (WQCV = 0.8 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)) D) Design Volume: Vol = (WQCV / 12) * Area E) Porous Pavement Suface Elevation	I_a = ________ % i = ________ Area = ________ square feet WQCV = ________ watershed inches Vol = ________ cubic feet Elev. = ________ feet
2. Required Minimum MBP Surface Area: A = Vol / 0.17 *Overflow Inlet Elevation: Porous Pavement Elev. + 0.17 feet*	A = ________ square feet *Elev. = ________ feet*
3. Modular Block Properties Note: Blocks shall have no less than 40% open area and shall be no less than 4" thick	Block Name: ________ Manufacturer: ________ Open Surface Area = ________ % Thickness (4" min.) ________ inches
4. Porous Pavement Infill (Check the type used or describe "Other")	________ ASTM C-33 Sand ________ Other: ________
5. Base Course A) Sand B) Gravel	________ 1" Layer ASTM C-33 Sand ________ Other: ________ ________ 9" Layer AASHTO #8 Course Agg. ________ Other: ________
6. Perimeter Wall (required)	________ Concrete ________ inches thick ________ Other: ________
7. Draining of porous pavement (Check a, **or** b, **or** c, **answer** d) Based on answers to 7a through 7d, check the appropriate method a) Check box if subgrade is heavy or expansive clay ☐ b) Check box if subgrade is silty or clayey sands ☐ c) Check box if subgrade is well-draining soils ☐ d) Does tributary catchment contain land uses that may have petroleum products, greases, or other chemicals present, such as gas station, hardware store, restaurant, etc.? yes ☐ no ☐	________ Infiltration to Subgrade with Permeable Membrane: 7(c) checked **and** 7(d) = no ________ Underdrain with Impermeable. Membrane: 7(a) checked **or** 7(d) = yes ________ Underdrain with Permeable Membrane: 7(b) checked **and** 7(d) = no ________ Other: ________
8. Overflow For Larger Storms	________ Yes / No

Notes: ____

R0017948

Design Procedure Form: Porous Landscape Detention (PLD)

Designer: ______________________
Company: ______________________
Date: ______________________
Project: ______________________
Location: ______________________

1. Basin Storage Volume (I_a = 100% if all paved and roofed areas u/s of PLD) A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) B) Contributing Watershed Area Including the PLD (Area) C) Water Quality Capture Volume (WQCV) ($WQCV = 0.8 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)$) D) Design Volume: Vol_{PLD} = (WQCV / 12) * Area	I_a = ________ % i = ________ Area = ________ square feet WQCV = ________ watershed inches Vol = ________ cubic feet
2. PLD Surface Area (A_{PLD}) and Average Depth (d_{av}) (d_{av}: = (Vol / A_{PLD}), Min=0.5', Max=1.0')	A_{PLD} = ________ square feet d_{av} = ________ feet
3. Base Course (See Figure PLD-1)	______ 6" (Min.) Sandy Loam Turf Layer, Plus 18" (Min.) Layer of 25% Peat and 75% Sand Mix, Plus 9" (Min.) Layer of ASSHTO #8 Coarse Aggregate (CDOT Section 703 Specification). ______ Other: ______________
5. Draining of porous pavement (Check a, **or** b, **or** c, **answer** d) Based on answers to 5a through 5d, check the appropriate method a) Check box if subgrade is heavy or expansive clay ☐ b) Check box if subgrade is silty or clayey sands ☐ c) Check box if subgrade is well-draining soils ☐ d) Does tributary catchment contain land uses that may have petroleum products, greases, or other chemicals present, such as gas station, hardware store, restaurant, etc.? yes ☐ no ☐	______ Infiltration to Subgrade with Permeable Membrane: 5(c) checked **and** 5(d) = no ______ Underdrain with Impermeable Membrane: 5(a) checked **or** 5(d) = yes ______ Underdrain with Permeable Membrane: 5(b) checked **and** 5(d) = no ______ Other: ______________

Notes: ______________________

R0017949

Design Procedure Form: Sand Filter Basin (SFB)

Designer: ____________________
Company: ____________________
Date: ____________________
Project: ____________________
Location: ____________________

1. Basin Storage Volume A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) B) Contributing Watershed Area (Area) C) Water Quality Capture Volume (WQCV) ($WQCV = 1.0 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)$) D) Design Volume: Vol = (WQCV / 12) * Area	I_a = ______ % i = ______ Area = ______ acres WQCV = ______ watershed inches Vol = ______ acre-feet
2. Minimum Filter Surface Area: A_s = (Vol / 3) * 43,560 Filter Surface Elevation Average Side Slope of the Filter Basin (4:1 or flatter)	A_s = ______ square feet ______ feet Z = ______
3. Estimate of Basin Depth (D), based on filter area A_s	D = ______ feet
4. Outlet Works A) Sand (ASTM C-33) Layer Thickness (18" min.) Gravel (AASHTO No. 8; CDOT Section 703) Layer Thickness (9" min.) B) Overflow Elevation At Top of Design Volume (Filter Surface Elev. + 0.70')	 ______ inches ______ inches ______ feet
5. Draining of porous pavement (Check a, **or** b, **or** c, **answer** d) Based on answers to 5a through 5d, check the appropriate method a) Check box if subgrade is heavy or expansive clay ☐ b) Check box if subgrade is silty or clayey sands ☐ c) Check box if subgrade is well-draining soils ☐ d) Does tributary catchment contain land uses that may have petroleum products, greases, or other chemicals present, such as gas station, hardware store, restaurant, etc.? yes ☐ no ☐	______ Infiltration to Subgrade with Permeable Membrane: 5(c) checked **and** 5(d) = no ______ Underdrain with Impermeable Membrane: 5(a) checked **or** 5(d) = yes ______ Underdrain with Permeable Membrane: 5(b) checked **and** 5(d) = no ______ Other: ______
6 Describe Provisions for Maintenance ______	

Notes: ____________________

R0017950

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer: ______________________
Company: ______________________
Date: ______________________
Project: ______________________
Location: ______________________

1. Basin Storage Volume	
A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	I_a = ______ % i = ______
B) Contributing Watershed Area (Area)	Area = ______ acres
C) Water Quality Capture Volume (WQCV) ($WQCV = 1.0 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)$)	WQCV = ______ watershed inches
D) Design Volume: Vol = (WQCV / 12) * Area * 1.2	Vol = ______ acre-feet
2. Outlet Works	
A) Outlet Type (Check One)	______ Orifice Plate ______ Perforated Riser Pipe ______ Other: ______
B) Depth at Outlet Above Lowest Perforation (H)	H = ______ feet
C) Required Maximum Outlet Area per Row, (A_o)	A_o = ______ square inches
D) Perforation Dimensions (**enter one only**): i) Circular Perforation Diameter **OR** ii) 2" Height Rectangular Perforation Width	D = ______ inches, **OR** W = ______ inches
E) Number of Columns (nc, See Table 6a-1 For Maximum)	nc = ______ number
F) Actual Design Outlet Area per Row (A_o)	A_o = ______ square inches
G) Number of Rows (nr)	nr = ______ number
H) Total Outlet Area (A_{ot})	A_{ot} = ______ square inches
3. Trash Rack	
A) Needed Open Area: $A_t = 0.5 * (\text{Figure 7 Value}) * A_{ot}$	A_t = ______ square inches
B) Type of Outlet Opening (Check One)	______ $\leq$ 2" Diameter **Round** ______ 2" High **Rectangular** ______ Other: ______
C) For 2", or Smaller, **Round Opening** (Ref.: Figure 6a):	
i) Width of Trash Rack and Concrete Opening (W_{conc}) from Table 6a-1	W_{conc} = ______ inches
ii) Height of Trash Rack Screen (H_{TR})	H_{TR} = ______ inches

R0017951

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer: ____________
Company: ____________
Date: ____________
Project: ____________
Location: ____________

iii) Type of Screen (Based on Depth H), Describe if "Other"	______ S.S. #93 VEE Wire (US Filter) ______ Other: ______
iv) Screen Opening Slot Dimension, Describe if "Other"	______ 0.139" (US Filter) ______ Other: ______
v) Spacing of Support Rod (O.C.) Type and Size of Support Rod (Ref.: Table 6a-2)	______ inches ______
vi) Type and Size of Holding Frame (Ref.: Table 6a-2)	______
D) For 2" High **Rectangular Opening** (Refer to Figure 6b):	
I) Width of Rectangular Opening (W)	W = ______ inches
ii) Width of Perforated Plate Opening (W_{conc} = W + 12")	W_{conc} = ______ inches
iii) Width of Trashrack Opening ($W_{opening}$) from Table 6b-1	$W_{opening}$ = ______ inches
iv) Height of Trash Rack Screen (H_{TR})	H_{TR} = ______ inches
v) Type of Screen (based on depth H) (Describe if "Other")	______ Klemp™ KPP Series Aluminum ______ Other: ______
vi) Cross-bar Spacing (Based on Table 6b-1, Klemp™ KPP Grating). Describe if "Other"	______ inches ______ Other: ______
vii) Minimum Bearing Bar Size (Klemp™ Series, Table 6b-2) (Based on depth of WQCV surcharge)	______
4. Detention Basin length to width ratio	______ (L/W)
5 Pre-sedimentation Forebay Basin - Enter design values	
A) Volume (5 to 10% of the Design Volume in 1D)	______ acre-feet
B) Surface Area	______ acres
C) Connector Pipe Diameter (Size to drain this volume in 5-minutes under inlet control)	______ inches
D) Paved/Hard Bottom and Sides	______ yes/no

R0017952

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer: ____________________
Company: ____________________
Date: ____________________
Project: ____________________
Location: ____________________

6. Two-Stage Design	
A) Top Stage (D_{WQ} = 2' Minimum)	D_{WQ} = ______ feet Storage= ______ acre-feet
B) Bottom Stage (D_{BS} = D_{WQ} + 1.5' Minimum, D_{WQ} + 3.0' Maximum, Storage = 5% to 15% of Total WQCV)	D_{BS} = ______ feet Storage= ______ acre-feet Surf. Area= ______ acres
C) Micro Pool (Minimum Depth = the Larger of 0.5 * Top Stage Depth or 2.5 Feet)	Depth= ______ feet Storage= ______ acre-feet Surf. Area= ______ acres
D) Total Volume: Vol_{tot} = Storage from 5A + 6A + 6B Must be $\geq$ Design Volume in 1D	Vol_{tot} = ______ acre-feet
7. Basin Side Slopes (Z, horizontal distance per unit vertical) Minimum Z = 4, Flatter Preferred	Z = ______ (horizontal/vertical)
8. Dam Embankment Side Slopes (Z, horizontal distance per unit vertical) Minimum Z = 4, Flatter Preferred	Z = ______ (horizontal/vertical)
9. Vegetation (Check the method or describe "Other")	______ Native Grass ______ Irrigated Turf Grass ______ Other: ______

Notes: ____________________

R0017953

Design Procedure Form: Constructed Wetland Basin (CWB) - Sedimentation Facility

Designer: ______________
Company: ______________
Date: ______________
Project: ______________
Location: ______________

1. Basin Storage Volume	
A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	I_a = ______ % i = ______
B) Contributing Watershed Area (Area)	Area = ______ acres
C) Water Quality Capture Volume (WQCV) (WQCV $=0.9 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)$)	WQCV = ______ watershed inches
D) Design Volume: Vol = (WQCV / 12) * Area	Vol = ______ acre-feet
2. Wetland Pond Volume, Depth, and Water Surface Area	
A) Minimum Permanent Pool: $Vol_{Pool} \geq 0.75 * Vol$	Calculated Required Minimums: $Vol_{Pool} \geq$ ______ acre-feet WS Area = ______ acres, estimated Enter the Actual Design Values: $Vol_{Pool} \geq$ ______ acre-feet, final design WS Area = ______ acres, final design
B) Forebay (Volume $\geq$ 0.05 * Vol in 1D) Depth minimum = 2.5', maximum = 4.0'	Volume= ______ acre-feet Depth= ______ feet Area= ______ acres, % = ______ %
C) Outlet Pool (Area > 0.06 * Design WS Area) Depth minimum = 2.5', maximum = 4.0'	Depth= ______ feet Area= ______ acres, % = ______ %
D) Wetland Zones with Emergent Vegetation (6" to 12" deep) (Area = 50% to 70% of Design WS Area)	Depth= ______ feet Area= ______ acres, % = ______ %
E) Free Water Surface Areas (2' to 4' deep) (Area = 30% to 50% of Design WS Area)	Depth= ______ feet Area= ______ acres, % = ______ % ______ %
3 Average Side Slope Above Water Surface (4:1 or flatter)	Z = ______
A) Depth of WQCV Surcharge (above permanent pool, 2' max.)	______ feet
4. Outlet Works	
A) Outlet Type (Check One)	______ Orifice Plate ______ Perforated Riser Pipe ______ Other: ______
B) Depth at Outlet Above Lowest Perforation (H, 2' max.)	H = ______ feet
C) Required Maximum Outlet Area per Row, (A_o)	A_o = ______ square inches
D) Perforation Dimensions (Refer to Figure 5 in W.Q. Str. Det.): **(Enter one only):** i) Circular Perforation Diameter **OR** ii) 2" Height Rectangular Perforation Width	 D = ______ inches, **OR** W = ______ inches

R0017954

Design Procedure Form: Constructed Wetland Basin (CWB) - Sedimentation Facility

Designer: ____________
Company: ____________
Date: ____________
Project: ____________
Location: ____________

E) Number of Columns (nc)	nc = ______ Number
F) Actual Design Outlet Area per Row (A_o)	A_o = ______ square inches
G) Number of Rows (nr)	nr = ______ Number
H) Total Outlet Area (A_{ot})	A_{ot} = ______ square inches
5. Trash Rack	
A) Needed Open Area: $A_t = 0.5 * (\text{Figure 7 Value}) * A_{ot}$	A_t = ______ square inches
B) Type of Outlet Opening (Check One)	______ ≤ 2" Diameter **Round** ______ 2" High **Rectangular** ______ Other: ______
C) For 2", or Smaller, **Round Opening** (Ref.: Figure 6a):	
i) Width of Trash Rack and Concrete Opening (W_{conc}) from Table 6a-1	W_{conc} = ______ inches
ii) Height of Trash Rack Screen (H_{TR})	H_{TR} = ______ inches
iii) Type of Screen (Based on Depth H), Describe if "Other"	______ S.S. #93 VEE Wire (US Filter) ______ Other: ______
iv) Screen Opening Slot Dimension, Describe if "Other"	______ 0.139" (US Filter) ______ Other: ______
v) Spacing of Support Rod (O.C.) Type and Size of Support Rod (Ref.: Table 6a-2)	______ inches ______
vi) Type and Size of Holding Frame (Ref.: Table 6a-2)	______
D) For 2" High **Rectangular Opening** (Refer to Figure 6b):	
I) Width of Rectangular Opening (W)	W = ______ inches
ii) Width of Perforated Plate Opening (W_{conc} = W + 12")	W_{conc} = ______ inches
iii) Width of Trashrack Opening ($W_{opening}$) from Table 6b-1	$W_{opening}$ = ______ inches
iv) Height of Trash Rack Screen (H_{TR})	H_{TR} = ______ inches
v) Type of Screen (based on depth H) (Describe if "Other")	______ Klemp™ KPP Series Aluminum ______ Other: ______
vi) Cross-bar Spacing (Based on Table 6b-1, Klemp™ KPP Grating). Describe if "Other"	______ inches ______ Other: ______

Design Procedure Form: Constructed Wetland Basin (CWB) - Sedimentation Facility

Designer: ______________________
Company: ______________________
Date: ______________________
Project: ______________________
Location: ______________________

vii) Minimum Bearing Bar Size (Klemp™ Series, Table 6a-2) (Based on depth of WQCV surcharge)	______________________
6. Basin Use for Quantity Controls (Check one or describe if "Other")	______ Detention within the facility ______ Detention upstream of the facility ______ Other: ______________ ______________________
7. Basin length to width ratio	________ (L/W)
8. Basin Side Slopes (Z, horizontal distance per unit vertical)	________ (horizontal/vertical)
9 Annual/Seasonal Water Balance (Q_{net} has to be positive)	Q_{inflow} ________ acre-feet/year Q_{evap} ________ acre-feet/year $Q_{seepage}$ ________ acre-feet/year $Q_{E.T}$ ________ acre-feet/year Q_{net} ________ acre-feet/year
10 Vegetation (Check the method being applied or describe)	______ Native Grass ______ Irrigated Turf Grass Side Slopes ______ Wetland Species in Pool* ______ Other: ______________ ______________________ *Describe Species Density and Mixl. ______________________ ______________________ ______________________ ______________________ ______________________

Notes: ____

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Design Procedure Form: Retention Pond (RP) - Sedimentation Facility (Sheet 1 of 3)

Designer: ______________________
Company: ______________________
Date: ______________________
Project: ______________________
Location: ______________________

1. Basin Storage Volume A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) B) Contributing Watershed Area (Area) C) Water Quality Capture Volume (WQCV) (WQCV =0.8 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)) D) Design Volume: Vol = (WQCV / 12) * Area	I_a = ______ % i = ______ Area = ______ acres WQCV = ______ watershed inches Vol = ______ acre-feet
2. Permanent Pool A) Volume: Vol_{Pool} = (1.0 to 1.5) * Vol B) Average Depth Zone 1 = Littoral Zone - 6 to 12 inches deep Zone 2 = Deeper Zone - 4 feet to 8 feet deep C) Maximum Zone 2 Pool Depth (not to exceed 12 feet) D) Permanent Pool Water Surface Area (Estimated Minimum) (Zone 1 - Littoral Zone = 25% to 40% of the total surface area) (Zone 2 - Deeper Zone = 60% to 75% of the total surface area) Total Estimated Minimum Surface Area (A_{Total})	______ acre-feet ______ feet Zone 2 ______ feet Depth = ______ feet % = ______ acres = ______ % = ______ acres = ______ % = ______ acres = ______
3. Annual/Seasonal Water Balance (Q_{net} has to be positive)	Q_{inflow} ______ acre-feet/year Q_{evap} ______ acre-feet/year $Q_{seepage}$ ______ acre-feet/year $Q_{E.T.}$ ______ acre-feet/year Q_{net} ______ acre-feet/year
2. Outlet Works A) Outlet Type (Check One) B) Depth at Outlet Above Lowest Perforation (H) C) Required Maximum Outlet Area per Row, (A_o) D) Perforation Dimensions **(enter one only)**: i) Circular Perforation Diameter **OR** ii) 2" Height Rectangular Perforation Width E) Number of Columns (nc)	______ Orifice Plate ______ Perforated Riser Pipe ______ Other: ______ ______ H = ______ feet A_o = ______ square inches D = ______ inches, OR W = ______ inches nc = ______ Number

R0017957

Design Procedure Form: Retention Pond (RP) - Sedimentation Facility (Sheet 2 of 3)

Designer: ____________________
Company: ____________________
Date: ____________________
Project: ____________________
Location: ____________________

F) Actual Design Outlet Area per Row (A_o)	A_o = ________ square inches
G) Number of Rows (nr)	nr = ________ Number
H) Total Outlet Area (A_{ot})	A_{ot} = ________ square inches
5. Trash Rack	
A) Needed Open Area: $A_t = 0.5 * (\text{Figure 7 Value}) * A_{ot}$	A_t = ________ square inches
B) Type of Outlet Opening (Check One)	________ ≤ 2" Diameter **Round** ________ 2" High **Rectangular** ________ Other: ________ ________
C) For 2", or Smaller, **Round Opening** (Ref.: Figure 6a):	
I) Width of Trash Rack and Concrete Opening (W_{conc}) from Table 6a-1	W_{conc} = ________ inches
ii) Height of Trash Rack Screen (H_{TR})	H_{TR} = ________ inches
iii) Type of Screen (Based on Depth H), Describe if "Other"	________ S.S. #93 VEE Wire (US Filter) ________ Other: ________ ________
iv) Screen Opening Slot Dimension, Describe if "Other"	________ 0.139" (US Filter) ________ Other: ________ ________
v) Spacing of Support Rod (O.C.) Type and Size of Support Rod (Ref.: Table 6a-2)	________ inches ________
vi) Type and Size of Holding Frame (Ref.: Table 6a-2)	________
D) For 2" High **Rectangular Opening** (Refer to Figure 6b):	
I) Width of Rectangular Opening form 4.D.ii. (W)	W = ________ inches
ii) Width of Perforated Plate Opening (W_{conc} = W + 12")	W_{conc} = ________ inches
iii) Width of Trash Rack Opening ($W_{opening}$) from Table 6b-1	$W_{opening}$ = ________ inches
iv) Height of Trash Rack Screen (H_{TR})	H_{TR} = ________ inches
v) Type of Screen (based on depth H) (Describe if "Other")	________ Klemp™ KPP Series Aluminum ________ Other: ________ ________
vi) Cross-bar Spacing (Based on Table 6b-1, Klemp™ KPP Grating). Describe if "Other"	________ inches ________ Other: ________ ________

Design Procedure Form: Retention Pond (RP) - Sedimentation Facility (Sheet 3 of 3)

Designer: ______________________
Company: ______________________
Date: ______________________
Project: ______________________
Location: ______________________

vii) Minimum Bearing Bar Size (Klemp™ Series, Table 6a-2) (Base on depth of WQCV surcharge)	______________________
6. Basin length to width ratio	________ (L/W)
7. Basin Side Slopes (Z:1) A) Above the Permanent Pool: Z= B) Below the Permanent Pool Z= Z=	 ________ (horizontal/vertical) Zone 1= ________ (horizontal/vertical) Zone 2= ________ (horizontal/vertical)
8. Dam Embankment Side Slopes Z=	________ (horizontal/vertical)
9. Vegetation (Check the type used or describe if "Other")	______ Native Grass ______ Irrigated Turf Grass ______ Emergent Aquatic Species* ______ Other: ______________ ______________________ *Specify types and densities: ______________________ ______________________ ______________________
12. Forebay Storage (5% to 10% of Design Volume in 1D)	Storage= ________ acre-feet
13. Underdrains	________ yes/no

Notes: ____
____
____
____

R0017959

Design Procedure Form: Constructed Wetlands Channel (CWC) - Sedimentation Facility

Designer: ______________________
Company: ______________________
Date: ______________________
Project: ______________________
Location: ______________________

1. Design Discharge (total)	Q_2 = ________ cfs Q_{100} = ________ cfs
2. Channel Geometry (New Channel - No Wetland Veg. in Bottom) A) Channel Side Slopes (Z:1, i.e., H/V) ($Z \geq 2.5$) B) 2-Year Design Flow Depth (D_2) Maximum D_2 = 4', Minimum D_2 = 2' C) Bottom width of the channel (B_2) - 8-foot minimum D) Top width of the 2-Year Design Water Surface (W_2)	Z = ________ (horizontal/vertical) D_2 = ________ feet B_2 = ________ feet W_2 = ________ feet
3. Longitudinal Slope (Based on a Manning's n = 0.03 for the 2-year Channel, velocity set to 2 fps)	S = ________ feet/feet
4. Final Channel Goemetry - Wetland Vegetation in Bottom) (Based on a Manning's n = 0.08) A) Calculated channel geometry required to maintain design discharge during a 2-year event with mature vegetation B) Calculated discharge and velocity during a 2-year event with mature vegetation C) Geometry and velocity to use for the 100-year discharge if composite channel section is used.	Z = ________ feet D_2 = ________ feet B_2 = ________ feet W_2 = ________ feet Q_2 = ________ cfs V_2 = ________ fps D_{100} = ________ feet B_{100} = ________ feet W_{100} = ________ feet V_{100} = ________ fps
5. Number of grade control structures required	________ number
6. Vegetation (Check the type or describe "Other")	______ Native Grass ______ Irrigated Turf Grass ______ Wetland Species ______ Other: ______________

Notes: ____

R0017960

APPENDIX

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APPENDIX A

MODEL ORDINANCE FOR EROSION AND SEDIMENTATION CONTROL
(Revised August 28, 1991)

AN ORDINANCE TO AMEND THE CODE OF THE CITY (COUNTY) OF ____________________ BY ADDING A NEW CHAPTER RELATING TO EROSION AND SEDIMENT CONTROL, AND ADOPTING BY REFERENCE THE PUBLISHED CRITERIA FOR "EROSION AND SEDIMENT CONTROL FOR CONSTRUCTION ACTIVITIES" OF THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, BY ADDING A NEW CHAPTER, WHICH NEW CHAPTER SHALL BE DESIGNATED AS CHAPTER _____ OF TITLE _________ OF SAID CODE.

THE CITY (COUNTY) OF __________________________________, ORDAINS;

Title ________ of the Code of the City (County) of __________________________, is amended by adding a new Chapter _______ - Grading and Soil Erosion Control, which shall read as follows:

CHAPTER NO.

GRADING AND SOIL EROSION CONTROL

Section 1. Legislative Findings. The City Council (Board of County Commissioners) hereby finds that excessive quantities of soil are eroding from certain areas that are undergoing development for non-agricultural uses such as housing and commercial developments, industrial areas, recreational facilities, and roads. This erosion makes necessary costly repairs to gullies, washed out fills, roads and embankments. The resulting sediment clogs storm sewers and road ditches, and leaves deposits of silt in streams, lakes and reservoirs and is considered a significant water pollutant.

Section 2. Purposes. The purpose of this Ordinance (Resolution) is to prevent soil erosion and sedimentation from leaving construction sites that occur from non-agricultural development and construction activities within the City (County) by requiring proper provisions for water disposal and the protection of soil surfaces during and after construction, in order to promote the safety, public health, convenience and general welfare of the community (County).

Any person who undertakes or is responsible for an undertaking which involves earth disturbance is ultimately responsible to see that soil erosion and sedimentation as well as changed water flow characteristics resulting therefrom are controlled to the extent necessary to avoid damage to property and to avoid pollution of receiving waters. Nothing in this Ordinance (Resolution) shall be taken or construed as lessening or modifying the ultimate responsibility of such persons. Nor do the permit requirements of this Ordinance (Resolution) imply the assumption of any liability therefor on the part of the City (County). The standards, criteria and requirements of this Ordinance (Resolution) are to be seen as minimum standards which are not necessarily adequate to meet the highly variable conditions which must be covered by effective control measures. Compliance with the requirements of this Ordinance (Resolution) may not, therefore, of itself discharge such person's responsibility to provide effective control measures.

Section 3. Definitions. The following definitions shall apply in the interpretation and enforcement of this Chapter.

(1) "Accelerated soil erosion" - The increased migration and movement of soils on all land surfaces that occur as a result of man's activities.

(2) "Inspector" - The chief of the __________ Department (insert department title) of the City (County) or his duly authorized representative.

(3) "Certificate of completion" - A signed written statement by a licensed professional engineer working for the applicant stating that all construction, all earth disturbance work, and all permanent soil erosion control measures were inspected by the engineer and were installed in strict compliance with the approved plans and specifications.

(4) "City (County) Engineer" - The City (County) Engineer of the City (County) or his duly authorized representative.

(5) "Earth disturbance" - A man-made change in the natural cover or topography of land, including all grading, cut and fill, building, paving and other activities, which may result in or contribute to soil erosion or sedimentation of the waters of the State.

(6) "Erosion" - The process by which the ground surface is worn away by action of wind, water, gravity, or a combination thereof.

(7) "Excavation" - Any act by which soil or rock is cut into, dug, quarried, uncovered, removed, displaced, relocated, or stockpiled, and also included shall be the conditions resulting therefrom.

(8) "Filling" - Any act by which soil, rock or other construction materials are placed, stockpiled, dumped, or a combination thereof onto the surface of the earth that may exposed to rain or wind.

(9) "Flood plain" - An area adjacent to a watercourse, which area is subject to flooding as the result of the occurrence of the 100-year flood and which area thus is so adverse to past, current, or foreseeable construction or land use as to constitute a significant hazard to public health and safety or property.

(10) "Grading" - Any stripping, excavating, filling, stockpiling, or any combination thereof, and also included shall be the land in its excavated or filled condition.

(11) "Grading permit" - A permit issued to authorize work to be performed under this Ordinance.

(12) "Land use" - A use of land which may result in an earth disturbance, including, but not limited to, subdivision, residential, commercial, industrial, recreational, or other development, private and public highway, road and street construction, drainage construction, logging operations, agricultural practices, and mining.

(13) "Limits of allowable erosion" - The natural or historic rate of soil loss.

(14) "Permanent soil erosion control measures" - Those control measures which are installed or constructed to control soil erosion and which are maintained after completion of all grading and earth disturbance activities.

(15) "Person" - A natural person, firm, corporation, partnership, or association.

(16) "Slope" - Slope of land measured in horizontal distance necessary for the land to fall or rise one foot, expressed by horizontal distance in feet to one vertical foot.

(17) "Stripping" - Any activity which removes or significantly disturbs the vegetative surface cover including clearing and grubbing operations.

(18) "Temporary soil erosion control measures" - Interim control measures which are installed or constructed and maintained whenever grading or other earth disturbance is to occur for the purpose of control soil erosion until permanent soil erosion control is effected.

Section 4. Compliance with Chapter Required for Site Plan or Plat Approval. No site plan, plot plan, or plat shall be approved under Chapters ______ and ______ of this Code unless said site plan, plot plan, or plat shall include soil erosion and sediment control measures consistent with the requirements of this Chapter and related land development regulations.

Section 5. Compliance with Chapter Required for Occupancy. No certificate of occupancy for any building shall be issued under Chapter ______ of this Code unless the applicant for said Certificate of Occupancy submits a Certificate of Completion to the City (County) and said Certificate of Completion is approved by the City (County) Engineer.

Section 6. Adoption by reference of Erosion and Sediment Control Criteria. There is hereby adopted by reference, as a part of this ordinance (resolution), as if fully set forth herein, that certain code consisting of the published criteria of The Urban Drainage and Flood Control District, adopted by said District on ______________ 1991, effective on the _______ day of _______________, 1991, known as "Erosion and Sediment Control for Construction Activities," published on _________________, 1991, which shall be known and referred to in this ordinance (resolution) by that name. The Inspector and the City (County) Engineer shall be guided by and shall apply the criteria contained in said code in the administration of this ordinance (resolution).

Section 7. Permits and Fees.

(1) Permit requirement. Except as exempted by sections of this ordinance (resolution), no person shall do any grading, stripping, excavating, or filling, or undertake any earth disturbance, unless a valid grading permit is issued by the City (County). Issuance by City (County) does not exempt the parties from obtaining any permits required by State of Colorado or the Federal Government.

(2) Permit application. A separate application shall be required for each grading permit, along with plans, specifications, and timing schedules for all earth disturbance. The plans shall be prepared under the supervision of a professional engineer licensed in the State of Colorado experienced in soil erosion and sedimentation control methods and techniques.

(3) Application data required. The plans and specifications shall include an Erosion and Sedimentation Control Plan and a Site Plan, which shall include and contain all of the requirements of Section 1.4 of the "Erosion and Sediment Control for Construction Activities".

(4) Fees. At the time of filing an application for a grading permit, a non-refundable filing fee of _______________________________________ Dollars $__________________ shall be paid to the City (County) Treasurer. An additional non-refundable fee of ______________________________ Dollars per acre of site area involved will be charged for plan review and site inspections (with a minimum fee of _______________________________ Dollars $___________________ for such review and inspection).

Section 8. Bond Requirement. A grading permit shall not be issued unless the permittee shall first post with the City (County) Engineer a bond executed by the landowner and a corporate surety with authority to do business in this State as a surety, or at the option of the City (County) Engineer, secured by a letter of credit drawn upon a bank doing business in Colorado, or having a Colorado correspondent bank at which such letter of credit may be collected.

The bond and letter of credit, whichever is used, shall be in a form approved by the City (County) Attorney, payable to the City (County), and in the amount of the estimated total cost of all temporary or permanent soil erosion control measures. The total cost shall be estimated by the City (County) Engineer or Building Inspector. The bond, and letter of credit, whichever is used, shall include penalty provisions for failure to complete the work on schedule as specified on the grading permit. In lieu of a surety bond or letter of credit, the applicant may file with the City (County) a cash bond or other instrument of credit which gives the City (County) at least equal security protection, approved by the City (County) Attorney in the amount equal to that which would be provided for in the surety bond or letter of credit.

Every bond and letter of credit or other instrument of credit shall include and every cash deposit shall be made on the conditions that the permittee shall comply with all of the provisions of this ordinance (resolution) and all of the terms and conditions of the grading permit, and shall complete all of the work contemplated under the grading permit within the time limit specified in the grading permit, or if no time limit is specified, within 180 days after the date of issuance of the grading permit.

A bond and surety thereon, or letter of credit, whichever is used, will be released to applicant four hundred ten (410) days after the Certificate of Completion has been approved by the City (County) Engineer, provided the City (County) Engineer, after field inspection, is satisfied the work completed under the grading permit is functioning as represented by applicant, or in the event defects are identified by the City (County) Engineer the applicant satisfactorily corrects all the defects identified in writing by the City (County) Engineer and said corrections are accepted in writing by the City (County) Engineer.

Section 9. Extension of Time. If the permittee is unable to complete the work within the specified time, at least ten (10) days prior to the expiration of the permit, a written request to the City (County) Engineer for an extension of time shall be submitted setting forth the reasons for the requested extension. In the event such an extension is warranted, the City (County) Engineer may grant additional time for the completion of the work, but no such extension shall release the owner or surety on the bond or the issuer of the letter of credit, or the person furnishing the instrument of credit or cash bond.

Section 10. Failure to Complete the Work. In the event of failure to complete the work or failure to comply with all the requirements, conditions, and terms of permit, the City (County) Engineer may order such work as is necessary to eliminate any danger to persons or property and to leave the site in a safe condition and he may authorize completion of all necessary temporary or permanent soil erosion control measures. The permittee and the surety executing the bond or the issuer of the letter of credit, or person issuing the instrument of credit or making the cash deposit shall continue to be firmly bound under a continuing obligation for the payment of all necessary costs and expenses that may be incurred or expended by the City (County) in causing any and all such work to be done. In the case of a cash deposit, any unused portion thereof shall be refunded to the permittee.

Section 11. Denial of Permit. Grading permits shall not be issued where:

(1) The proposed work would cause hazardsto the public safety and welfare; or

(2) The work as proposed by the applicant will damage any public or private property or interfere with any existing drainage course in such a manner as to cause damage to any adjacent property or result in the deposition of debris or sediment on any public way or into any waterway or create an unreasonable hazard to persons or property; or

(3) The land area for which grading is proposed is subject to geological hazard to the extent that no reasonable amount of corrective work can eliminate or sufficiently reduce settlement, slope instability, or any other such hazard to persons or property; or

(4) The land area on which the grading is proposed may lie within the designated flood plain of any stream or watercourse (not specifically designated by the City (County) as an area subject to flood hazard), unless a hydrologic report, prepared by a professional engineer, is submitted to certify that the proposed grading will have, in his professional opinion, no detrimental influence on the public welfare or upon the total development of the watershed and is also consistent with flood plain ordinances and Federal Emergency Management Agency regulations.

Section 12. Modifications of Approved Plans. All proposed modifications of the approved grading plan must be submitted along with all supporting materials, to the City (County) Engineer. No work in connection with the proposed modifications shall be permitted without prior approval of the City (County) Engineer, approval for which may be issued if the applicant can demonstrate that the modifications will provide soil erosion controls equivalent to, or better that the originally approved soil disturbance plans.

Section 13. Responsibility of Permittee. During grading operations the permittee shall be responsible for:

(1) The prevention of damage to any public utilities or services within the limits or grading and along any routes of travel of the equipment;

(2) The prevention of damage to adjacent property (No person shall grade on land so close to the property line as to endanger any adjoining public street, sidewalk, alley, or any public or private property without supporting and protecting such property from settling, cracking, or other damage which might result).

(3) Carrying out the proposed work in accordance with the approved plans and in compliance with all the requirements of the permit and this ordinance (resolution);

(4) The prompt removal of all soil, miscellaneous debris, materials applied, dumped, or otherwise deposited on public streets, highways, sidewalks, or other public thoroughfares or any other non-authorized offsite location, during transit to and from the construction site, or otherwise, where such spillage constitutes a public nuisance, trespass or hazard in the determination of the City (County) Engineer or a Court of competent jurisdiction.

Section 14. General Requirements.

(1) All temporary erosion control facilities and all permanent facilities intended to control erosion of any earth disturbance operation shall be installed before any earth disturbance operations take place.

(2) Any earth disturbances shall be conducted in such a manner so as to effectively reduce accelerated soil erosion and resulting sedimentation, and should not exceed the erosion expected to occur for the site in is totally undeveloped state.

(3) All persons engaged in earth disturbances shall design, implement, and maintain acceptable soil erosion and sedimentation control measures, in conformance with the erosion control technical standards adopted by the City.

(4) All earth disturbances shall be designed, constructed and completed in such a manner so that the exposed area of any disturbed land shall be limited to the shortest possible period of time.

(5) Sediment cause by accelerated soil erosion shall be removed from runoff water before it leaves the site of the earth disturbance.

(6) Any temporary or permanent facility designed and constructed for the conveyance of water around, through, or from the earth disturbance area shall be designed to limit the water flow to a non-erosive velocity.

(7) Temporary soil erosion control facilities shall be removed and earth disturbance areas graded and stabilized with permanent soil erosion control measures pursuant to standards and specifications prescribed in accordance with the provisions of the "Erosion and Sediment Control for Construction Activities" and in accordance with the permanent erosion control features shown on the soil stabilization plan approved by the City (County).

(8) Permanent soil erosion control measures for all slopes, channels, ditches, or any disturbed land area shall be completed within fourteen (14) calendar days after final grading or the final earth disturbance has been completed. When it is not possible to permanently stabilize a disturbed area after an earth disturbance has been completed or where significant earth disturbance activity ceases, temporary soil erosion control measures shall be implemented within fourteen (14) calendar days. All temporary soil erosion control measures shall be maintained until permanent soil erosion measures are implemented.

Section 15. Maintenance Requirements. Persons carrying out soil erosion and sediment control measures under this Chapter, and all subsequent owners of property concerning which such measures have been taken, shall maintain all permanent erosion control measures, retaining wall, structures, plantings, and other protective devices. Should the applicant or any of the subsequent property owners fail to adequately maintain the permanent erosion control facilities, retaining walls, structures, plantings, and other protective devices, the City (County) reserves the authority, after properly notifying the owner of needed maintenance and the owner failing to respond to the City's (County's) demand for such maintenance to enter affected property, provide needed maintenance and to charge the owner for the work performed by the City (County) or its contractors.

Section 16. Minimum Design Standards for Erosion and Sediment Control. All erosion control plans and specifications including extensions of previously approved plans shall include provisions for erosion and sediment control in accordance with the "Erosion and Sediment Control for Construction Activities". Erosion control plans are required on sites which are:

(1) Five (5) acres in size or larger, and all sites smaller than five (5) acres if they are a part of a total development or subdivision that is larger than five (5) acres in size; or

(2) Any development containing 15 dwelling units; or

(3) Where physical features have a cumulative effect and will create erosion problems such as:

a. Steep slopes - 8-feet (horizontal) to 1-foot (vertical) or steeper, and

b. Significantly erodible soils - "K" in the universal soil loss equation is greater than or equal to 0.25;

Section 17. Variances and Exceptions.

(1) No permits shall be required for the following:

(a) Agricultural use of land zoned agricultural.

(b) Grading or an excavation below finished grade for basements, footings, retaining walls, or other structures on plots zoned R1 - R3 of less than five (5) acres in size unless required otherwise under Section 16 above.

(c) A sidewalk or driveway authorized by a valid permit under Chapters ________ of ________.

(d) Gravel, sand, dirt or topsoil removal as authorized pursuant to approval of the Colorado Mined Land Reclamation Board, provided said approval includes an erosion plan that meets the minimums specified by this ordinance.

(e) Sites smaller than five (5) acres which are not a part of a larger development and which constitute an infill of an established older development within the City.

(f) Where the City (County) Engineer certifies in writing that the planned work and the final structures or topographical changes will not result in or contribute to soil erosion or sedimentation and will not interfere with any existing drainage course in such a manner as to cause damage to any adjacent property or result in the deposition of debris or sediment on any public way, will not present any hazard to any persons or property and will have no detrimental influence upon the public welfare or upon the total development of the watershed.

(g) Even though no permits are required under subsections (1)(a), (b), (c), (d), and (e) of this section, those operations and construction activities which are exempted from obtaining permits must comply with the rules and regulations concerning grading and erosion specified in this Chapter, and shall provide appropriate controls to retain soil erosion on the construction site.

(2) Where it is alleged that there is error or misinterpretation in any order, requirements, decisions, grant or refusal made by the City (County) Engineer, the (chose as appropriate: Deputy City Manager, Manager of Public Works, Public Works Director, County Manager, Chairman of the Board of County Commissioners) may appoint a technical hearing board that shall have the power to hear specific applications and all complaints regarding the decisions of the City (County) Engineer and to determine if the decisions of the City (County) Engineer were based on a misinterpretation of the requirements of this Chapter and referenced criteria. Whenever it is determined that an interpretation error was made, the case will be returned to City (County) Engineer, along with the board's recommendations on how the Engineer's decision could be modified to made consistent with the provisions of this Chapter.

* *In absence of this, or another similar appeals process, resort directly to court would be the only remedy, which may not be desired as a matter of policy. If such policy is desired, however, it is suggested it be spelled out by substituting for (2) above, the following, or a similar subsection:*

(2) Review of any order, requirement, decision, grant or refusal made by the City (County) Engineer, and claimed to be illegal, shall be by the District Court pursuant to the Colorado Rules of Civil Procedure.

Section 18. Inspection. The requirements of this Chapter shall be enforced by the City (County) Engineer. The City (County) Engineer shall inspect the work and shall require the owner to obtain services to provide adequate on-site inspection and/or compaction testing by a soil engineer, approved by the City (County) Engineer, unless he determines that such inspection requirements may be waived due to the non-hazardous nature of the grading.

Upon satisfactory execution of all approved grading plans and other requirements, the City (County) Engineer shall issue a certification of completion. If the City (County) Engineer finds any existing conditions not as stated in any application, grading permit or approved plan, he may refuse to approve further work until a revised grading plan which will conform to the existing condition has been prepared and approved.

If the City (County) Engineer finds that eroded soils are leaving the construction site, the City (County) Engineer may direct the owner(s) or his agents or his contractor on the site by written order to install any and all erosion controls that are deemed necessary to prevent said soil erosion from migrating off site. It shall be the duty of the owner(s) and his agent(s) and contractor(s) immediately to take all necessary steps to comply with such order and otherwise to take all necessary steps to prevent such migration off premises or entering receiving waters. Delivery of such a written order by the City (County) Engineer to the owner's agent or contractor shall be deemed to be notice thereof to and binding upon the owner.

Section 19. Enforcement. Notwithstanding the existence or pursuit of any other remedy, the City (County) may maintain an action in its own name in any court of competent jurisdiction for an injunction or other process against any person to restrain or prevent violations of this ordinance (resolution).

The City (County) Engineer, or his duly authorized agents, may enter at all reasonable times in, or upon, any private or public property for the purpose of inspecting and investigating conditions and practices which may be a violation of this ordinance (resolution).

APPENDIX B

EXAMPLE EROSION AND SEDIMENT CONTROL PLAN

PREPARED FOR:

C.D. DEVELOPMENT INC.
1234 A STREET
DENVER, COLORADO 80200
PHONE (303)555-0000

PREPARED BY:

ESC CONSULTANTS, INC.
43560 SQUARE FEET STREET
SUITE 640
DENVER, COLORADO 80200
PHONE: (303) 555-1212

SEPTEMBER, 1992

I. Introduction

Name, Address and Telephone Number

Owner:

C.D. DEVELOPMENT INC.
1234 A STREET
DENVER, COLORADO 80200
PHONE (303)555-0000

Erosion Control Consultant

ESC CONSULTANTS, INC.
43560 SQUARE FEET STREET
SUITE 640
DENVER, COLORADO 80200
PHONE: (303) 555-1212

Project Description

The Project consists of the development of a 6.2 acre parcel with two office buildings. The project is located in the SW quarter of Section #, Township, Range of the 6th principal meridian located in County, Colorado. The project involves grading of 5.2 acres of the parcel, constructing two office buildings, two parking lots, an access road, a box culvert over Dry Creek and associated site utilities.

Existing Site Conditions

Most of the existing site is vegetated with native grass. The plant density is estimated to be 50% coverage of the ground surface. Cottonwood trees and other riparian vegetation are found adjacent to Dry Creek. The site drains to Dry Creek except the southeast portion which drains offsite to the southeast. About 0.2 acres of wetlands are found next to Dry Creek. The riparian and wetland vegetation will not be disturbed by the site development. The existing slopes on the site range from 2% to 19% adjacent to the Creek.

Adjacent Areas

Surrounding development consists of office and commercial development. The site is bounded by Broadway and Monroe Streets. Dry Creek bisects the site. The proposed improvements to Dry Creek are limited to a box culvert and preservation of the 100-year floodplain (Refer to the Drainage Report for the Site).

Soils

Existing site soils consists of Ascalon sandy loam and Nunn sandy clay loam on the uplands and alluvial soils next to Dry Creek. Ascalon sandy loam is well drained with moderate permeability (Hydrologic soil group B) and has a slight erosion hazard. Nunn sandy clay loam is well drained with moderately slow permeability (Hydrologic soil group C) and presents a moderate erosion hazard. The alluvial soils adjacent to the Creek will not be disturbed.

II. Erosion and Sediment Control Plan

Volumes and Areas Impacted

The site will be graded with topsoil stripped and stockpiled. The total quantity of cut and fill is 3,500 cubic yards. The cut and fill is balanced, that is, no fill will be imported to the site. The access road, building site and parking areas will be graded, then covered with granular base course. Other graded areas will be mulched until permanent landscaping is installed.

Erosion and Sediment Control Measures

The erosion control measures for the site are shown on the "Sample Erosion and Sedimentation Control Plan." (Note: Proposed contours are not shown on this example plan for clarity; however, proposed contours are required to be shown on the site plan.) Offsite drainage from the north is diverted to the east along Broadway Avenue. Offsite drainage from the west is diverted to the south along Monroe Road. The area southeast of the proposed parking lot for Building "B" drains offsite. This area will remain undisturbed and will be protected with a silt fence. A stabilized construction entrance will be provided at the access point off Monroe Road. Diversion channels will be constructed near Dry Creek to collect runoff from the building areas and route flows to sediment basins. Each sediment basin collects runoff from 1.0 acre and will be excavated below grade. The sediment basins will be about 30 feet square and about two feet deep (show details) below the outlet. Sediment basins will have a surcharge

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volume of 1,800 cubic feet above the outlet. Straw bale barriers will be anchored next to the creek for the areas where runoff is not intercepted by the diversion channels.

Schedule

The construction schedule is as follows:

Install Construction Entrance, Sediment basins and Straw Bale Barriers:	September 15 - September 30
Site Grading:	September 30 - October 15
Install Base Course and Mulch All Exposed Soil Areas:	October 15 - October 20
Utility and Building Construction:	October 20 - April 1
Paving and Landscaping:	April 1 - April 15
Removal of Erosion Control Measures:	April 15 - April 20

The schedule will minimize the exposure of unprotected areas to less than 30 days. The perimeter controls will be installed prior to site grading.

Permanent Stabilization Measures

Permanent landscaping will include bluegrass sod, zeriscape plantings and trees and shrubs. The two sediment traps will be converted to the site detention ponds after sod is installed (Refer to the site Drainage Report for the detention requirements). The box culvert will be constructed early in the construction period to provide access across the creek during construction.

Stormwater Management Considerations

Stormwater will sheet flow from the building areas towards the creek, then be intercepted and routed to sediment traps during construction. All areas that will not be intercepted by the diversions will be protected with straw bale barriers. Post-development stormwater quality control will be provided by the vegetated filter strip adjacent to Dry Creek.

Construction Materials and Equipment

The contractor shall store all construction materials and equipment and shall provide maintenance and fueling of equipment in confined areas on site from which runoff will be contained and filtered.

Maintenance

The erosion control measures will be inspected weekly during construction. Sediment traps will be cleaned of excessive sediment if necessary. Erosion control blankets in the diversion channels will be checked after runoff events. Straw bale barriers will be checked for undermining and bypass and repaired or expanded as needed. Mulching of bare soils will be checked regularly and areas where it was lost or damage will be remulched within seven working days when needed.

Cost Estimate

The estimated cost of the erosion control measures is $7,320. A total of 780 linear feet of silt fences and straw bale barriers will be constructed at an estimated cost of $4.00 per foot. The two sediment traps involve excavation at a cost of $250 each. The diversion channels will be lined with a coconut fiber blanket at an estimated cost for grading and the blanket of $7.50 per linear foot for the 400 linear feet to be installed. The construction entrance will require 10 cubic yards of material at $10 per cubic yard. Site mulching and it maintenance prior to final revegetation is estimated to cost $500,000.

Calculations

Calculations for the diversion channels and sediment traps are provided herein. Details for the erosion control measures can be found in Figures C-5, C-6, C-7, C-8, C-9, C-12, C-13, C-15, and C-15A of the *Erosion Control Chapter* of Volume 3 of the *Urban Storm Drainage Criteria Manual*. (The figures are not included with this example to save space but shall be included with the erosion and sediment control plans submitted to the local jurisdiction.)

Slope Diversion Channel Sizing:

$Q = C\ I\ A$

$C = 0.2$ (From Table 3-1, USDCM, Runoff)

(Weighted average of undeveloped and parking areas.)

$I_{2\text{-yr}} = 2.6''/\text{hour}$ (From Fig. 5-1, USDCM, Rainfall)

$A = 2.0$ acres each

$Q = 0.2 \times 2.6 \times 2.0 =$ 1.04 cfs

Try a triangular channel with depth of 0.5 ft and four to one sideslopes. (Actual depth will be 1.0 ft. allowing 0.5 ft. as freeboard.)

Proposed Slope = 0.75%

$A = 1\ \text{ft}^2$, $P = 4.47$ ft. $R = 0.224$ ft.

Use a fiber blanket for erosion control.

$n = 0.035$

from Manning's Equation:

$V = 1.486/0.035 \times (.0075)^{1/2} = 1.35$ feet per second

$Q = A\ V = 1.35$ cfs

(more than 1.04 so this channel section is acceptable)

Check Erosion potential:

$\tau = \gamma\ d\ s$ (Shear Stress Formula)

$\tau = 62.4 \times 0.5 \times 0.0075 = 0.23\ \text{lb/ft}^2$

from HEC-15, $\tau_{allowable} = 0.65\ \text{lb/ft}^2$

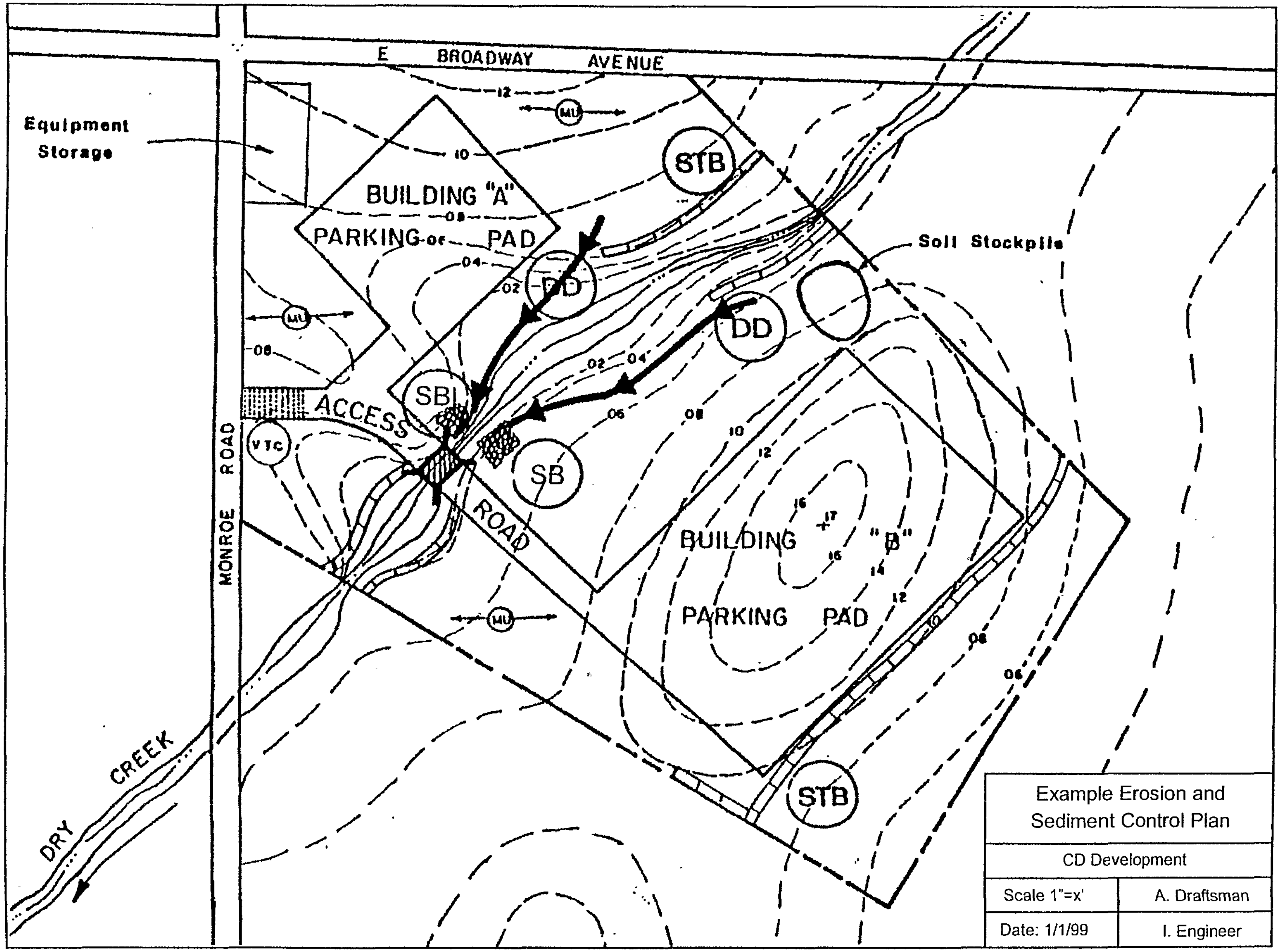
τ_{actual} is less than $\tau_{allowable}$ so the diversions should be stable.

Sediment Basins

Tributary Area = 1.0 acres

Required Volume = $1{,}800\ \text{ft}^3/\text{acre} \times 1.0\ \text{acre} = 1{,}800\ \text{ft}^3$

Use a 30 ft. x 30 ft. x 2.0 ft. deep sediment basin


E BROADWAY AVENUE
Equipment Storage
BUILDING "A" PARKING PAD
STB
DD
Soil Stockpile
SBI
ACCESS ROAD
VTC
SB
MONROE ROAD
MU
BUILDING "B" PARKING PAD
DRY CREEK
Example Erosion and Sediment Control Plan
CD Development
Scale 1"=x'
A. Draftsman
Date: 1/1/99
I. Engineer

APPENDIX C

GLOSSARY OF TERMS

Erodibility - The susceptibility of a particular soil type to erosion by water or wind.

Erosion - The wearing away of the land surface by water, wind, ice or other geological agents, including the detachment and movement of soil or rock fragments by water, wind, ice, or gravity.

Erosion Control Measures - Practices that slow or stop erosion.

Final Stabilization - Completion of all land disturbing activities, removal of all temporary sediment controls, establishment of vegetative cover on exposed soil areas, and installation of permanent roads and structural stormwater quality best management practices.

Land Disturbing Activity - Grading, cut, fill, stockpiling of dirt, removal of vegetation, or any other alteration or disturbance of the ambient land surface.

Mapping Unit - Soil name and symbol given in the Soil Conservation Service Soil Survey for each soil type. Most areas of the Denver metropolitan area are included in a soil survey. In older urban portions of the City and County of Denver, soils analysis will be needed to determine soil types.

Permanent - Installation of land-surface cover, or erosion and sediment control measures, that will remain in place for a long period of time.

Sedimentation - The process of solid materials, both inorganic (mineral) and organic, coming to rest on the earth's surface either above or below sea level.

Sediment - Particulate solid material, either inorganic or organic, that will settle or be deposited in a liquid under the force of gravity.

Sediment Barrier - Straw bale barrier (dike) or a silt fence.

Sediment Basin - A depression, either excavated or formed by a dam, that holds water and debris and facilitates sedimentation of soil particles. Normally used for drainage areas equal to and greater than 1.0 acre.

Temporary - Installation of erosion or sediment control measures, either structural or nonstructural, that are planned to be removed or inactivated after a period of time.

Viable Vegetative Cover - A measure of performance for establishment of appropriate vegetative cover (or density) on sites planned for revegetation for the period of duration of successful growth as approved by the city and county of jurisdiction.

United States
Environmental Protection
Agency

Office Of Water
(4204)

EPA 833-R-99-001
October 1999

Report To Congress On The Phase II Storm Water Regulations

R0017979

Report to Congress
on the
Phase II Storm Water Regulations

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I. INTRODUCTION

A. PURPOSE OF REPORT TO CONGRESS

EPA provides this Report to Congress in compliance with Section 431(a) of the Departments of Veterans Affairs and Housing and Urban Development and Independent Agencies Appropriations Act of 2000, Pub. L. No. 106-74 (1999) ("Appropriations Act"). The Appropriations Act directs the Administrator of the Environmental Protection Agency ("EPA") to submit two reports to the Committee on Environment and Public Works in the Senate and the Committee on Transportation and Infrastructure in the House of Representatives. The first of the reports is to address several issues related to EPA rulemaking to implement Section 402(p)(6) of the Clean Water Act ("CWA"). This rulemaking is also referred to as the Storm Water Phase II rule. Section 431(a) of the Appropriations Act directs the Administrator to submit a report containing:

> (1) an in-depth impact analysis on the effect the final regulations will have on urban, suburban, and rural local governments subject to the regulations, including an estimate of --
>
> > (A) the costs of complying with the 6 minimum control measures described in the regulations; and
> >
> > (B) the costs resulting from the lowering of the construction threshold from 5 acres to 1 acre;
>
> (2) an explanation of the rationale of the Administrator for lowering the construction site threshold from 5 acres to 1 acre, including --
>
> > (A) an explanation, in light of recent court decisions, of why a 1-acre measure is any less arbitrarily determined than a 5-acre measure; and
> >
> > (B) all qualitative information used in determining an acre threshold for a construction site;
>
> (3) documentation demonstrating that storm water runoff is generally a problem in communities with populations of 50,000 to 100,000 (including an explanation of why the coverage of the regulation is based on a census-determined population instead of a water quality threshold); and
>
> (4) information that supports the position of the Administrator that the Phase II storm water program should be administered as part of the National Pollutant Discharge Elimination System under section 402 of the Federal Water Pollution Control Act (33 U.S.C. 1342).

Section 431(c) of the Appropriations Act directs EPA to publish the reports in the Federal Register for public comment. The Appropriations Act does not specify whether EPA should seek and respond to public comment on the reports prior to submitting them to the Committees. Section 431(a) does provide, however, that the Administrator shall not promulgate the Phase II rule until submitting the Section 431(a) report to the Committees. EPA is subject to a judicial consent decree in NRDC v. Browner, (D.D.C., Civ. No. 95-634 PLF) to take final action by October 29, 1999 on the Phase II rule proposed earlier. The Appropriations Act does not relieve EPA from the timing of this rulemaking obligation. Therefore, EPA will invite public comment on the Section 431(a) report after submitting it to the Committees. EPA will carefully review and evaluate comments received and determine whether the comments warrant further action regarding the October 29, 1999, final rule.

As noted above, on October 29, 1999, the Administrator of EPA will take final action on a notice of proposed rulemaking under CWA section 402(p)(6), 33 U.S.C. § 1342(p)(6). On January 9, 1998, at 63 Fed. Reg. 1536, EPA proposed to expand the National Pollutant Discharge Elimination System (NPDES) permitting program for storm water to apply to discharges from certain small municipal separate storm sewer systems (MS4s) and from construction activity generally disturbing between one and five acres of land surface. Although EPA designated for regulation discharges from these two categories, the rulemaking would also allow for waivers (for subsequent exclusion from regulation of certain sources in these categories) and designation (for subsequent inclusion of certain sources that fall outside of the categories). Waivers would be available based on criteria by which the NPDES permitting authority would determine a low potential for adverse water quality impact, and the permitting authority would designate additional sources on a localized basis when necessary to protect or remedy localized adverse water quality impacts.

Rulemaking under CWA section 402(p)(6) is to be based on a study that EPA was directed to provide to Congress under CWA section 402(p)(5). Section 402(p)(5) provides that:

> The Administrator, in consultation with the States, shall conduct a study for the purposes of -
>
> (A) identifying those stormwater discharges or classes of stormwater discharges for which permits are not required pursuant to [CWA sections 402(p)(1) and (p)(2)];
>
> (B) determining, to the maximum extent practicable, the nature and extent of pollutants in such discharges; and
>
> (C) establishing procedures and methods to control stormwater discharges to the extent necessary to mitigate impacts on water quality.

CWA section 402(p)(5) directed EPA to provide reports to Congress on the different components of this study. In proposing the regulations under CWA section 402(p)(6), EPA identified the reports to Congress comprising the study described in CWA section 402(p)(5), specifically, *Storm Water Discharges Potentially Addressed by Phase II of the National Pollutant Discharge Elimination System Storm Water Program: Report to Congress* (U.S. EPA, 1995, EPA 833-K-

94-002). Today's report under section 431(a) of the Appropriations Act is a supplement to the study described in CWA section 402(p)(5).

B. PURPOSE OF THE PHASE II RULE

The Phase II rule would establish a cost effective, flexible approach for reducing environmental harm by storm water discharges from many point sources of storm water that are currently unregulated. Some of the costs of implementing the Phase II rule are discussed in Chapter II of this report. A summary of the rule's benefits are described below. EPA's Economic Analysis of the Final Phase II Storm Water Rule fully analyzes the costs and benefits expected from implementation of the rule.

The environmental harm currently caused by discharges from municipal separate storm sewer systems (MS4s) and construction activity is well documented:

- Urbanization alters the natural infiltration capability of the land and generates a host of pollutants that are associated with the activities of dense populations, thus causing an increase in storm water runoff volumes and pollutant loadings in storm water discharged to receiving water bodies.

- The National Urban Runoff Program (NURP) Study (U.S. EPA 1983) indicated that discharges from MS4s draining runoff from residential, commercial, and light industrial areas carried more than ten times the annual loadings of total suspended solids as did discharges from municipal sewage treatment plants that provide secondary treatment, and somewhat higher annual loadings of chemical oxygen demand (COD), total lead, and total copper.

- The National Water Quality Inventory (305(b)), 1996 report to Congress shows that urban runoff/storm sewer discharges affect 13% of impaired rivers, 21% of impaired lakes and 45% of impaired estuaries.

- Urban storm water runoff, sanitary sewer overflows, and combined sewer overflows have become the largest causes of beach closings in the United States in the past three years. A survey of coastal and Great Lakes communities found that more than 1,500 beach closings and advisories were attributable to storm water runoff in 1998 based on EPA data supplemented with additional data (Natural Resources Defense Council. 1998. "Testing the Waters Volume VIII-Has Your Vacation Beach Cleaned Up Its Act?" New York, NY). Recreational bathers are at the highest risk for contracting illnesses such as gastroenteritis, typhoid, dysentery, hepatitis, skin rashes, and respiratory infections.

- The MS4 program will address illicit discharges, which can contribute high levels of pollutants, including heavy metals, toxic substances, oil and grease, solvents, nutrients, viruses and bacteria into receiving water bodies.

- The NURP study found that pollutant levels from illicit discharges were high enough to significantly degrade receiving water quality and threaten aquatic, wildlife, and human health.

- Discharges from construction activity impact the biological, chemical, and physical integrity of receiving waters. A number of pollutants are preferentially absorbed onto particles found in fine sediment. Estimates indicate that 80 percent of the phosphorus and 73 percent of the Kjeldahl nitrogen in streams is associated with eroded sediment from construction and other activities.

- Sediment yields from smaller construction sites are as high as or higher than the 20 to 150 tons/acre/year measured from larger sites.

- Siltation is the largest cause of impaired water quality in rivers and the third largest cause of impaired water quality in lakes, according to the 305(b) Report to Congress.

The implementation of the six minimum measures identified for small MS4s should significantly reduce pollutants in urban storm water compared to existing levels and do so in a cost effective manner. Similarly, the implementation of best management practice ("BMP") controls at small construction sites should also result in a significant reduction in pollutant discharges and an improvement in surface water quality. EPA's Economic Analysis of the Final Phase II Storm Water Rule details the expected benefits from implementation of the rule. These benefits include:

- Enhanced Commercial Fishing: Commercial fisheries are a significant part of the nation's economy. In 1997, the commercial shellfish catch was worth $1.04 Billion and the finfish catch was worth $581 Million. 18% of surveyed estuary miles identified storm water as a significant source of impairment.

- Enhanced Recreational and Subsistence Fishing: The potential value of marine recreational fishing is $1.1 Billion to $11.3 Billion annually. Pollutants in storm water may result in eliminating or decreasing the numbers or size of sport fish or shellfish in receiving waters. In September 1996, there were 2,196 fish consumption advisories and about 25% of waters designated for fishing did not support that use.

- Enhanced Opportunities for Boating: Storm water controls offer benefits to boaters by reducing sediment and other pollutants in waters, increasing water clarity and enhancing the experience for boating users. EPA estimates that pollution reduction due to Phase II controls may result in 3,000 currently non-boatable miles of river becoming boatable.

- Enhanced Opportunities for Swimming: EPA estimates that Americans participated in 1.3 billion non-pool swimming days. EPA estimates that at least 28% of these trips are to either marine or fresh water that is impacted by runoff from Phase II sources. For example, in 1998, storm water runoff caused beach closures that resulted in the loss of an estimated 86,000 individual trips to beaches impacted by Phase II sources.

- Enhanced Opportunities for Noncontact Recreation: Activities like picnicking, jogging, biking, camping and hunting do not necessitate direct contact with water, but water quality affects the ability to enjoy these activities when in close proximity to water. Storm water controls reduce turbidity, odors, floating trash and other pollutants and allow waters to be used as focal points for recreation, enhancing the experience of current and future users.

- Enhanced Nonconsumptive Wildlife Uses: An estimated 76.1 million people participated in observing wildlife and waterfowl in 1991. Storm water controls that result in greater numbers or diversity of viewable wildlife species will produce benefits.

- Reduced Flood Damage: Storm water runoff controls may mitigate flood damage by addressing problems due to the diversion of runoff, insufficient storage capacity, and reduced channel capacity from sedimentation.

- Drinking Water Benefits: Storm water was identified as a major source of impairment in rivers, streams, lakes, reservoirs and ponds. Pollutants from storm water runoff, such as solids, toxic pollutants (including pesticides) and bacteria, may impose additional costs for treatment or even render the water unusable for drinking.

- Water Storage Benefits: Storm Water is a major source of impairment for reservoirs. The heavy load of solids deposited by storm water runoff can lead to rapid sedimentation of reservoirs and the loss of needed water storage capacity.

- Navigational Benefits: Storm water also delivers high sediment loads to rivers and harbors critical to navigation and commerce. Where waters are used for navigation, solids must be dredged and disposed of to maintain the utility of the waterway. An estimated 5% of these sediments (12.6 million cubic yards of material) is attributed to storm water runoff from roads and constructions sites. Storm water controls will reduce the rate and amount of sediment loadings.

- Reduced Illness from Consuming Contaminated Seafood: Storm water controls may reduce the presence of pathogens in seafood caught by commercial or recreational anglers. Researchers have estimated 2,700 cases of illness annually from raw or partially cooked contaminated seafood.

- Reduced Illness from Swimming in Contaminated Water: Epidemiological studies have indicated that swimmers in water contaminated by storm water runoff are more likely to experience illness than those that swim farther from a storm water outfall. By reducing illicit connections and other sources of pathogens in storm water, EPA estimates that up to 500,000 cases of illness will be avoided annually.

- Enhanced Aesthetic Value: When storm water affects the appearance or quality of a water body, the desirability of working, living, traveling or owning property near that water body is similarly affected. Improvements in water quality due to reductions in storm water pollution will result in benefits as these waters recover and become more desirable locations near which people want to live, work, travel or own property.

Thus, the rule will result in significant monetized financial, recreational and health benefits, as well as benefits that EPA has been unable to monetize.

II. IMPACT OF PHASE II RULE ON LOCAL GOVERNMENTS

This section responds to the Appropriations Act's direction to provide a report containing:

"(1) an in-depth impact analysis on the effect the final regulations will have on urban, suburban, and rural local governments subject to the regulations, including an estimate of-
(A) the costs of complying with the 6 minimum control measures described in the regulations; and
(B) the costs resulting from the lowering of the construction threshold from 5 acres to 1 acre;"

A. SUMMARY OF PHASE II RULE REQUIREMENTS

EPA conducted an in-depth impact analysis of the effect of the final Storm Water Phase II Rule on local governments. Two provisions of the Phase II rule are expected to result in compliance costs for local governments. These are the provision requiring certain municipalities to regulate discharges from their municipal separate storm sewer systems (MS4s) and the provision which extends the storm water construction program to cover sites between one and five acres in size. The analysis considers potential cost impacts to all local governments, including urban, suburban and rural governments, and provides insight into the differing situations of small or very small local governments. Based on this analysis, EPA determined that the Phase II rule is not expected to have a significant impact on a substantial number of local governments.

<u>Municipal Storm Water Program:</u>

The Phase II Rule would automatically designate for regulation discharges from small MS4s located in urbanized areas, and require that NPDES permitting authorities examine for potential designation, at a minimum, a particular subset of discharges from small MS4s located outside of urbanized areas. The MS4 provision would result in costs primarily for local governments in urbanized areas. An urbanized area is defined by the U.S. Census Bureau as an area with a population of at least 50,000 and a minimum average population density of more than 1,000 people per square mile. Thus, this rule would primarily affect suburban and urban local governments, because these MS4s are more likely to be located in urbanized areas. Rural local governments may be designated on a case-by-case basis if the permitting authority determines that they have a significant impact on water quality. The Phase I storm water program addressed runoff from "medium" and "large" MS4s, generally those discharges from governmental jurisdictions serving populations of 100,000 or more people. The Phase II Storm Water regulations will address discharges from smaller MS4s. The rule also would allow MS4s that are automatically designated because they are within an urbanized area to obtain a waiver from the otherwise applicable requirements if the discharges from small MS4s are not causing impairment of a receiving water body. Qualifications for the waivers vary depending on whether the MS4 serves a population under 1,000 or a population under 10,000.

Under the Phase II rule, a storm water discharge control program that meets the requirements of six minimum control measures would be administered within the jurisdiction of all regulated small MS4s. Small MS4 operators would design and administer the program, or would arrange with other government entities (including operators of nearby larger MS4s) to do so. These minimum control measures would consist of: public education and outreach on storm water impacts, public involvement/ participation, illicit discharge detection and elimination, construction site storm water runoff control, post-construction storm water management in new development and redevelopment, and pollution prevention/good housekeeping for municipal operations. The Agency provides an analysis of the costs to local governments of implementing the six municipal minimum control measures in Section B below.

Municipal Construction:

The 1990 Phase I rule required all operators of construction activity disturbing five or more acres of land surface to apply for an NPDES permit for any resulting point source discharges of storm water.[1] The construction provisions of the Phase II rule would extend similar requirements to construction projects that disturb between one and five acres of land. This provision would impose additional requirements on small construction projects of local governments, regardless of whether the local government is urban, suburban or rural. The rule excludes routine road maintenance from the definition of construction, thereby excluding many municipal public works projects. EPA expects that most new one to five acre road construction projects are likely to be built in conjunction with either larger development projects or State and Federal transportation programs and at least partially funded by these other sources. The Phase II rule would also provide waivers from coverage based on the potential to discharge storm water and cause a significant impact to water quality. EPA's analysis of construction starts concluded that the additional requirement for municipally constructed projects should not have a significant impact on a substantial number of the local governments subject to the regulation. EPA reports on its analysis of the costs to local governments of implementing the soil erosion control provisions for their construction sites between one and five acres in Section C below.

Regulatory Flexibility:

In promulgating Storm Water Phase II, EPA examined regulatory flexibility issues and potential cost impacts on small entities, including small local governments. In order to solicit input from potentially regulated small entities, EPA convened a Small Business Regulatory

[1] On December 18, 1991, Congress enacted the Intermodal Surface Transportation Efficiency Act (ISTEA), which postponed NPDES permit application deadlines for most storm water discharges associated with industrial activity at facilities that are owned or operated by small municipalities, including construction activity over five acres.

Enforcement Flexibility Act (SBREFA) Panel which included small local government representatives as well as other stakeholders. EPA conducted an analysis and determined that the rule was expected not to have a significant impact on a substantial number of small local governments or other small entities. However, in order to provide additional flexibility for small local governments, EPA included several programmatic options and potential waivers for small governments.

The rule would allow for a great deal of flexibility by providing various options for obtaining permit coverage and satisfying the required minimum control measures. For example, the NPDES permitting authority would be able to incorporate by reference qualifying State, Tribal, or local programs in a NPDES general permit and recognize existing responsibilities among different governmental entities for the implementation of minimum control measures. In addition, a regulated small MS4 could participate in the storm water management program of an adjoining regulated MS4 and could arrange to have another governmental entity implement a minimum control measure for them. The rule also provides potential waivers for MS4s serving a population less than 10,000 and also for construction projects not expected to significantly impair water quality. Therefore, Storm Water Phase II is not expected to have a significant impact on a substantial number of small local governments, and offers significant flexibility to those local governments in implementing provisions of the rule which may result in compliance cost impacts.

B. Impacts of the Municipal Minimum Control Measures on Local Governments

EPA estimated that the overall annual cost to local governments of implementing a storm water program based on the six minimum measures would be $297 million. EPA developed this estimate using actual program cost information from Phase II communities with existing storm water programs. The estimate assumes that all of the 5,040 Phase II designated municipalities would incur program costs and that costs are related to the size of the community served. Therefore, the Agency probably overestimates national costs because permitting authorities can waive permitting requirements for MS4s serving up to 10,000 people.

EPA conducted an in-depth analysis of the potential cost of complying with the six minimum measures on local governments in urbanized areas. These local governments are primarily urban and suburban, although a few rural governments may be designated by States to be included in the program based on potential water quality impacts. While the total regulatory costs associated with Phase II include all sizes of local government, EPA specifically considered the impacts to small local governments as required under the Regulatory Flexibility Act, as amended by the Small Business Regulatory and Enforcement Fairness Act. In preparing the analysis, EPA compared estimated annual compliance costs with annual municipal revenues for 4,455 small local governments (municipalities with fewer than 50,000 people) and evaluated cost-to-revenue ratios for indication of significant economic impacts. The results, which are reported in the economic analyses prepared for the proposed and final rules, led EPA to conclude that there would not be a substantial economic impact on a significant number of small governments; EPA expects even less of an impact on larger governments. Below is a summary of EPA's analysis.

Cost Analysis:

EPA estimated annual costs for the municipal programs based on a fixed cost component and a variable cost component. The fixed cost component included costs for the municipal application, record keeping, and reporting activities. On average, EPA estimated annual costs of $1,525 per municipality. Variable costs include the costs associated with annual operations for the six minimum measures. EPA reviewed cost data from existing Phase I storm water programs and cost data gathered from Phase II communities by the National Association of Flood and Storm Water Management Agencies (NAFSMA). These costs reflect the actual operating costs of program elements that are comparable to the six minimum measures for municipalities representing a wide range of population sizes. EPA estimated costs on a per household basis from both data sets. Annual mean costs per household are comparable across the data sets: $8.93 (NASFMA) and $8.85 (Phase I).

Total annual cost for each of the 4,455 municipalities was calculated as the sum of the $1,525 fixed cost and the urbanized area household estimate multiplied by the per household cost based on the NAFSMA data.[2] For example, a municipality with 5,000 households would have a total program cost of:

$$\$46,175 = \$1,525 + (5,000 * \$8.93).$$

Small Local Governments:

EPA estimated municipality revenues based on state-level revenue data collected by the U.S. Bureau of the Census 1992 Census of Governments. The Bureau of the Census reports municipal government revenues by population size for eight size categories including three used by EPA: less than 10,000, 10,000 to 24,999, and 25,000 to 49,999. For every state, EPA gathered the aggregate municipal revenue data and aggregate municipal population data reported by the Bureau of the Census for these three size categories.[3] EPA then divided revenue by population to obtain revenue per capita for each size category within each state. EPA merged this data set with the Phase II municipality population data set and multiplied the appropriate per capita revenue estimates by the Phase II urbanized area populations to obtain 4,455 estimates of annual municipal revenues.

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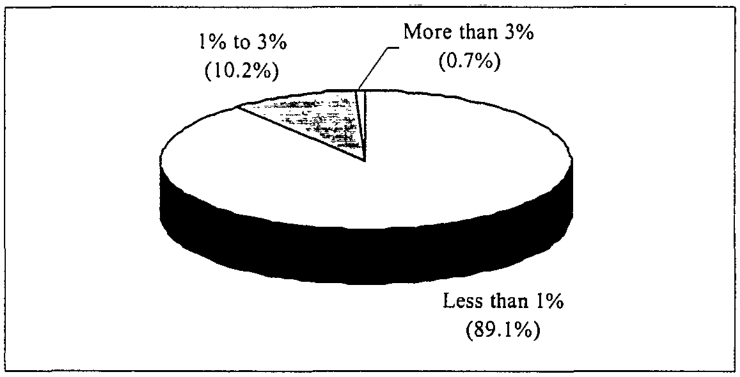
[2] Based on Census data, EPA used a conversion factor of 2.62 people per household to obtain household estimates for the Phase II communities.

[3] EPA did not adjust municipal revenue from their 1991 values to 1998 values, which is the unit of measure EPA used for costs. There is no standard adjustment factor for municipal revenues. Thus, the cost-to-revenue ratio probably overstates the cost impact.

Finally, EPA divided the 4,455 cost estimates by the 4,455 revenue estimates to obtain cost-to-revenue ratios. EPA categorized these ratios according to whether they were less than 1% (i.e., cost is less than 1% of revenue), between 1% and 3%, and greater than 3%. Figure A summarizes the results, showing that the cost-to-revenue ratios were less than 1% for 89% of the Phase II municipalities and greater than 3% for less than 1% of municipalities.

Under, the Phase II rule, the permitting authority could waive permitting requirements for systems serving less than 1,000 people. All of the municipalities with cost-to-revenue ratios that are greater than 3% have populations less than 1,000 people, and may qualify for a waiver. Consequently, the flexibility of the rule addresses any potentially significant adverse cost impacts. Because no Phase II municipality with a population of more than 6,000 had a cost-to-revenue ratio of more than 1%, EPA does not expect this provision will have significant economic impacts on the 585 municipalities with populations larger than 50,000.

Figure A. Summary of Cost-to-Revenue Ratios for 4,455 Phase II Municipalities with Populations Less than 50,000



C. Costs of the Soil Erosion Control Provision on Local Governments

EPA's cost analysis for the soil erosion control provision multiplies cost estimates per construction site for soil erosion control measures and administrative costs by the number of construction sites potentially affected by the rule. EPA estimates that the rule would apply to approximately 110,223 currently unregulated construction starts per year (using 1998 estimates) out of a total of 528,499 construction starts. Annual costs associated with installing the soil erosion controls and completing permitting activities is estimated as $505 million. Less than 0.5% (< $500,000) is expected to accrue from local governments.

Cost Analysis:

Most soil erosion control costs would accrue to the private sector, primarily to dischargers in the construction industry. However, local governments may also incur soil erosion control costs for discharges from public works projects that disturb between one and five acres (costs borne either directly by the local government or indirectly through a contractor). Since routine road maintenance is excluded from coverage under Storm Water Phase II, those public works starts are excluded from analysis. EPA used the site-based estimates of soil erosion control costs that it developed for the economic analysis of the final rule and Bureau of Census construction start data to estimate the expected annual impact on local governments. Table A summarizes the two types of costs by site size that a construction company or public works department may incur.

Table A. Summary of Site-Based Soil Erosion Control Costs

Cost	1 Acre Site	3 Acre Site	5 Acre Site
Administrative [a]	$937	$937	$937
Soil Erosion Control BMPs [b]	$1,206	$4,598	$8,709
Total Cost	$2,143	$5,535	$9,646
Annualized Cost (7%)[c]	$202	$522	$910

Notes:
a. These activities would include costs to submit a notice of intent to be covered by a general permit, to notify the municipality, to develop a storm water pollution prevention plan, to retain records, and to file a notice of termination from a general permit.
b. BMPs (best management practices) costs are based on combinations of the following that differ across sites with different sizes, slopes, and soil types: silt fence, mulch, seed/mulch, stabilized entrance, stone check dam, earth dike, and sediment traps.
c. Annualized cost assumes a 20-year period and a 7% cost of capital. The capitalization factor is 0.09439.

Small Local Governments:

There are four categories of local governments which may experience costs of compliance associated with the Phase II rule. These are:

1) Phase I jurisdictions (subject to Phase II requirements for construction between one and five acres; already required to have a municipal storm water program),
2) Phase II jurisdiction above 50,000 population (subject to Phase II municipal and construction requirements),
3) Phase II jurisdictions below 50,000 population (subject to Phase II municipal and construction requirements; subject to SBREFA review), and
4) Jurisdictions that are not required to have a municipal storm water program under

Phase I or Phase II (subject to Phase II requirements for construction).

The greatest potential economic impact of the soil erosion control provision is expected to be on the third category, because they would incur soil and erosion control costs in addition to annual program costs for the six minimum measures, and because of their smaller size. Therefore, the analysis below focuses on the impacts on these small local governments.

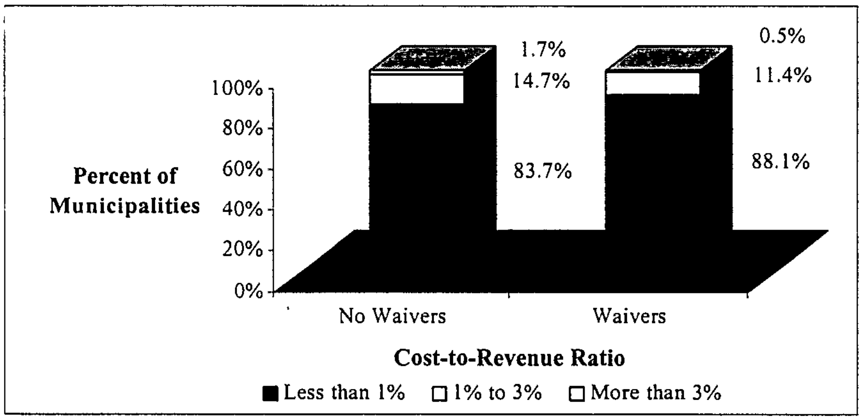
To evaluate the severity of potential impact, EPA used the Bureau of the Census construction start database to estimate the annual number of construction starts in Phase II municipalities that are classified by the Bureau of the Census as a "public works" start, excluding routine road maintenance. The data showed that 2% of municipalities are expected to have a 1-acre start, 2% are expected to have a 3-acre start and 1% are expected to have a 5-acre start. These results indicate that local governments would not incur soil and erosion control costs on an annual basis, because they would not necessarily have Phase II construction starts in any given year. As a conservative assumption (i.e., tending to overstate costs), EPA annualized the costs over a 20-year period, assuming a 7% cost of capital (see Table A). The 20-year assumption is conservative because it implies higher construction rates than the data suggest [i.e., 1-acre site (5%), 3-acre site (5%), and 5-acre site (5%)]. EPA then added the annualized values to obtain an annual cost of $1,634 per municipality for the soil erosion control provision.

Because the soil erosion control provision of the Phase II rule would apply to discharges from construction sites between one and five acres regardless of location, local governments other than Phase II designated municipalities could incur costs. EPA compared the annualized value across all site sizes of $1,634 to the national mean estimate of local government revenues. For the smallest municipality size category, the mean annual revenue was $1.4 million (1991 dollars; 1992 Census of Governments). The cost-to-revenue ratio for the smallest size category is well below 1%.

Finally, EPA then added the cost of complying with the Phase II soil erosion program for small construction to the cost-to-revenue ratios for the MS4 program discussed above to evaluate the combined impact on Phase II municipalities of the municipal minimum measures and soil erosion control costs that may be borne directly or indirectly (passed through from construction companies). Based on this revised cost-to-revenue analysis, the combined costs are not expected to have a significant economic impact on a substantial number of designated Phase II municipalities.

Figure B summarizes the cost-to-revenue impacts for all 4,455 Phase II municipalities with populations less than 50,000 (bar on left). Figure B also summarizes impacts for these Phase II municipalities assuming that the municipalities with populations below 1,000 are granted waivers so they incur soil erosion control costs as regulated small construction site dischargers but no program costs as small MS4 dischargers (bar on right). In either case, a vast majority of municipalities would not incur annual costs that are greater than 1% of revenues and fewer than 2% of municipalities would incur costs that are greater than 3% of revenues. Therefore, EPA concluded that the Phase II rule would not have a significant impact on potentially regulated small local governments.

Figure B. Summary of Cost-to-Revenue Ratios Revised to Include Soil Erosion Control Costs for 4,455 Phase II Municipalities with Populations under 50,000



* "No Waivers" estimates costs assuming (for the purpose of this analysis) that no small local governments with populations below 1,000 receive a waiver and, therefore, are subject to both the municipal and the soil erosion provisions of Phase II. Even if this were to occur, the potential impacts are not significant.

III. RATIONALE FOR THE ONE ACRE CONSTRUCTION THRESHOLD

This section responds to the Appropriations Act's direction to provide a report containing:

"(2) an explanation of the rationale of the Administrator for lowering the construction site threshold from 5 acres to 1 acre, including --
(A) an explanation, in light of recent court decisions, of why a 1-acre measure is any less arbitrarily determined than a 5-acre measure; and
(B) all qualitative information used in determining an acre threshold for a construction site;"

BACKGROUND

In 1990, EPA promulgated the first phase of the NPDES permit application rules for storm water. (*National Pollutant Discharge Elimination System Permit Application Requirements for Storm Water Discharges*, 55 Fed. Reg. 47990 (Nov. 16, 1990), referred to as the "Phase I" rule). As directed under CWA section 402(p)(4)(A), the Phase I rule set forth the permit application requirements for storm water discharges "associated with industrial activity," including, applicability provisions defining the term "storm water discharge associated with industrial activity." Under CWA section 402(p)(2)(B), storm water discharges associated with industrial activity were excluded from the moratorium against permitting discharges composed entirely of storm water.

Among other things, the Phase I rule defined storm water discharge associated with industrial activity to include discharges from "construction activity including clearing, grading and excavation activities except: operations that result in the disturbance of less than five acres of total land area which are not part of a larger common plan of development or sale." 40 C.F.R. 122.26(b)(14)(x). In 1992, a court ruled that the five acre threshold used for defining construction activity as "industrial activity" was improper because EPA had failed to identify information to support its position that construction activities on less than five acres are non-industrial in nature.

The Phase II rule would regulate storm water discharges from additional smaller construction activities. The rule would regulate these construction-related storm water sources under CWA section 402(p)(6) to protect water quality rather than under CWA section 402(p)(2). Designation under 402(p)(6) gives States and EPA the flexibility to waive the permit requirement for construction activity that is not likely to impair water quality, and to designate additional sources below one acre that are likely to cause water quality impairment. Thus, the one acre threshold under the Phase II rule would not be an absolute threshold like the five acre threshold that applies under the Phase I rule. The one acre threshold is reasonable for accomplishing the water quality goals of CWA section 402(p)(6) because it results in 97.5% of the total acreage disturbed by construction being designated for coverage by the NPDES storm water program, while excluding from automatic coverage the numerous smaller sites that represent 24.7% of the total number of construction sites.

Rationale for Five Acre Threshold in the Phase I Rule

In the preamble to the Phase I rule, which regulates storm water discharges from construction activity disturbing five acres or more as "storm water discharges associated with industrial activity," EPA had explained that the construction industry should be subject to storm water permitting because at a high level of intensity, construction is equivalent to other regulated industrial activities. 55 Fed. Reg. 48033. The Phase I rule regulates storm water "associated with industrial activity." EPA had proposed that the Phase I regulations apply to construction site discharges from sites disturbing down to one acre. EPA increased the size threshold to five acres for the final rule.

After a judicial challenge to the Phase I regulations, the Ninth Circuit remanded the regulation to EPA for further proceedings. NRDC v. EPA, 966 F.2d 1292, 1306 (9th Cir. 1992). To support the increased threshold (from one to five acres), the Agency had explained that larger sites typically involve heavier equipment for removing vegetation and bedrock than smaller sites. 55 Fed. Reg. 48036. The court found that EPA's rationale for increasing the limit was inadequate because the Agency cited no information to support its perception that construction activities on less than five acres are non-industrial in nature. 966 F.2d at 1306. Thus, the Court focused on the relationship between the size threshold and the statutory reference to "industrial."

Rationale for One Acre Threshold in the Phase II Rule

In lowering the threshold to one acre in the Phase II rule, the Phase II rule would not regulate discharges from small construction site as "industrial activity." Instead, EPA interprets the text of CWA section 402(p)(6) as a basis to designate small construction site discharges as sources "to be regulated to protect water quality." EPA interprets this language as less restrictive than the terms "associated with industrial activity" for the purpose of establishing an applicability threshold that is based on size alone but which may be modified by permitting authorities to account for higher and lower threat sources. In addition to water quality considerations, the text of CWA section 402(p)(6) allows for designations based on considerations of administrative feasibility by specifying that the Agency has discretion to identify sources "to be regulated."

Though the Phase II rule would not regulate a discharge from a construction site below the five acre threshold as a "discharge associated with industrial activity," the Phase II rule nonetheless responds to the Ninth Circuit's direction to conduct further rulemaking on the matter of discharges from sites disturbing more than one acre (from the Phase I proposed rule) and from sites disturbing less than five acres (from the Phase I final rule). For discharges from sources in this category, which the Agency still believes present water quality concerns based on the potential for water quality impairment due to gross sediment runoff (among other pollutants), CWA section 402(p)(6) rather than CWA section 402(p)(2)(B) and (3) provides a more sensible basis to address the sources that threaten water quality. In light of the Agency's decision to regulate these sources down to one acre to protect water quality with controls similar to those applied to Phase I sources, EPA believes it is unnecessary to examine further whether sites below five acres are "associated with industrial activity."

EPA is regulating storm water discharges from construction activity disturbing between 1 and 5 acres because the cumulative impact of many sources, and not just a single identified source, is typically the cause for water quality impairments, particularly in relation to sedimentation-related water quality standards.

The one acre threshold provides an administrative tool for more easily identifying those sites that are identified for coverage by the rule (but may receive a waiver) and those that are not automatically covered (but may be designated for inclusion). Although all construction sites less than five acres could have a significant water quality impact cumulatively, EPA is automatically designating for permit coverage only those storm water discharges from construction sites that disturb land equal to or greater than one acre. Categorical regulation of discharges from construction below this one acre threshold would overwhelm the resources of permitting authorities and might not yield corresponding water quality benefits. Construction activities that disturb less than one acre make up, in total, a very small percentage of the total land disturbance from construction nationwide (about 2.5%).

In addition to the diminishing water quality benefits of regulating all sites below one acre, the Agency relies on practical considerations in establishing a one acre threshold and not setting a lower threshold. Regardless of the threshold established by EPA, a NPDES permit can only be required if a construction site has a point source discharge. A point source discharge means that pollutants are added to waters of the United States through a discernible, confined, discrete conveyance. "Sheet flow" runoff from a small construction site would not result in a point source discharge unless and until it channelized. As the amount of disturbed land surface decreases, precipitation is less likely to channelize and create a "point source" discharge (assuming the absence of steep slopes or other factors that lead to increased channelization). Categorical designation of very small sites may create confusion about applicability of the NPDES permitting program to those sites. EPA's one acre threshold reflects, in part, the need to recognize that smaller sites are less likely to result in point source discharges. Of course, the NPDES permitting authority could designate smaller sites (below one acre, assuming point source discharges occur from the smaller designated sites) for regulation if a watershed or other local assessment indicated the need to do so. The Phase II rule would include this designation authority at 40 CFR 122.26(a)(9)(i)(D) and (b)(15)(ii).

Though location-specific water quality studies would provide the ideal information base from which to make regulatory decisions, the Phase II rule establishes one acre as a default standard for regulation in the absence of location-specific studies. The rule does account for location-specific water quality information, however, for any deviation from the default standard through additional designations and waivers. The rule codifies the ability of permitting authorities to provide waivers for sites greater than or equal to one acre and designate additional discharges from small sites below one acre when location-specific information suggests that the default one acre standard is either unnecessary (waivers) or too limited (designations) to protect water quality.

<u>OTHER QUALITATIVE AND QUANTITATIVE INFORMATION ON SIZE THRESHOLDS</u>

EPA had difficulty evaluating the water quality consequences of designating specific size thresholds because, while generally proportional to the size of the disturbed site, the water quality threat posed by discharges from construction sites of differing sizes varies nationwide, depending on the local climatological, geological, geographical, and hydrological influences. In order to ensure improvements in water quality nationwide, however, the Phase II rule does not allow various permitting authorities to establish different size thresholds except based on the waiver and designation provisions of the rule. EPA believes that a national one acre threshold for automatic designation, coupled with procedures for waiving sites above one acre and for designating sites below one acre based on local water quality considerations, ensures protection against adverse water quality impacts from storm water discharges from small construction sites while not overburdening the resources of permitting authorities and the construction industry.

EPA believes that the water quality impact from small construction sites is as high as or higher than the impact from larger sites on a per acre basis. The concentration of pollutants in the runoff from smaller sites is similar to the concentrations in the runoff from larger sites. The proportion of sediment that makes it from the construction site to surface waters is likely the same for larger and smaller construction sites in urban areas because the runoff from either site is usually delivered directly to the storm drain network where there is no opportunity for the sediment to be filtered out.

The expected contribution of total sediment yields from small sites depends, in part, on the extent to which erosion and sedimentation controls are being applied. Because current storm water regulations are more likely to require erosion and sedimentation controls on larger sites in urban areas, smaller construction sites that lack such programs are likely to contribute a disproportionate amount of the total sediment from construction activities (MacDonald, L.H. 1997. <u>Technical Justification for Regulating Construction Sites 1-5 Acres in Size</u>. Unpublished report submitted to the U.S. Environmental Protection Agency, Washington). Smaller construction sites are less likely to have an effective plan to control erosion and sedimentation, are less likely to properly implement and maintain their plans, and are less likely to be inspected (Brown, W. and D. Caraco. 1997. <u>Controlling Storm Water Runoff Discharges from Small Construction Sites: A National Review</u>. Submitted to the U.S. Environmental Protection Agency, Office of Wastewater Management, Washington, DC. by the Center for Watershed Protection, Silver Spring, MD).

To confirm its belief that sediment yields from small sites are as high as or higher than the 20 to 150 tons/acre/year measured from larger sites, EPA gave a grant to the Dane County, Wisconsin Land Conservation Department, in cooperation with the USGS, to evaluate sediment runoff from two small construction sites. The first was a 0.34 acre residential lot and the second was a 1.72 acre commercial office development. Runoff from the sites was channeled to a single discharge point for monitoring. Each site was monitored before, during, and after construction.

The Dane County study found that total solids concentrations from these small sites are similar to total solids concentrations from larger construction sites. Results show that for both of the study sites, total solids and suspended solids concentrations were significantly higher during construction than either before or after construction. For example, preconstruction total solids concentrations averaged 642 mg/L during the period when ryegrass was established, active construction total solids concentrations averaged 2,788 mg/L, and post-construction total solids concentrations averaged 132 mg/L (on a pollutant load basis, this equaled 7.4 lbs preconstruction, 35 lbs during construction, and 0.6 lbs post-construction for total solids). While this site was not properly stabilized before construction, after construction was complete and the site was stabilized, post-construction concentrations were more than 20 times less than during construction. The results were even more dramatic for the commercial site. The commercial site had one preconstruction event, which resulted in total solids concentrations of 138 mg/L, while active construction averaged more than 15,000 mg/L and post-construction averaged only 200 mg/L (on a pollutant load basis, this equaled 0.3 lbs preconstruction, 490 lbs during construction, and 13.4 lbs post-construction for total solids). The active construction period resulted in more than 75 times more sediment than either before or after construction (Owens, D.W., P. Jopke, D.W. Hall, J. Balousek and A. Roa. 1997. "Soil Erosion from Small Construction Sites in Dane County, Wisconsin." Draft Report. USGS and Dane County Land Conservation Department, WI).

Construction start data indicates that excluding construction sites below one acre from coverage under the Phase II rule would exclude a significant percentage of sites from automatic coverage while only excluding a small percentage of the total acreage. As is indicated in Table B, by choosing a nationwide threshold of one acre, the Phase I and Phase II rules will together address 97.5% of the national disturbed acreage yet will only regulate 75.3% of the construction starts. The remaining construction starts (24.7% or 130,435 starts) each occur on less than one acre of disturbed land and together constitute only 2.5% of total acreage disturbed by construction.

Table B. Percentage of national disturbed acreage and construction starts addressed by regulating all construction above different thresholds

	percentage of national disturbed area controlled by regulating all sites:	number of construction starts addressed (percent of national total)
all sites	100 %	527,774 (100 %)
greater than 1.0 acres	97.5 %	397,309 (75.3 %)
greater than 2.0 acres	92.3 %	301,941 (57.2 %)
greater than 3.0 acres	87.8 %	253,224 (48.0%)
greater than 4.0 acres	83.7 %	221,471 (42.0 %)
greater than 5.0 acres	78.1 %	188,425 (35.7 %)

* Table includes all construction starts. It does not exclude starts already regulated by Phase I, equivalent State programs, or potential Phase II waivers.

A two acre threshold would have tripled the total number acres that would not be designated for permit coverage. A threshold below one acre would have significantly increased the number of sites regulated without significantly increasing the number of acres for which storm water controls would be required. Thus, the additional increment in water quality protection that would be achieved by a lower size threshold would have resulted in a disproportionately higher burden on the regulated community.

Conclusion On One Acre Threshold

The Ninth Circuit concluded that EPA arbitrarily defined discharges "associated with industrial activity" when the Agency established the five acre size threshold, particularly in light of the Agency's proposal to establish the threshold at one acre. The Phase II one acre threshold is not arbitrary because (1) sediment loads from disturbed land surface cause adverse impacts on water quality, (2) as site size decreases, the likelihood that precipitation will create "discernible, confined, discrete conveyances" through channelization decreases, (3) the one acre threshold is not an absolute threshold because NPDES authorities can waive the threshold for sites (and during seasons) when there is a lower potential for a discharge that would impair water quality and can designate sources below the threshold where necessary to protect water quality on a localized basis, and (4) the number of additional sites that would be regulated by a threshold below one acre is disproportionately high relative to the total number of acres disturbed by those sites.

EPA recognizes that the size criterion alone may not be a perfect predictor of the need for regulation, but effective protection of water quality depends as much on simplicity in implementation as it does on the scientific information underlying the regulatory criteria. The default size criterion of one acre will ensure protection against adverse water quality impacts from storm water discharges from small construction sites while not overburdening the resources of permitting authorities and the construction industry to implement the program to protect water quality in the first place. Further, as noted above, NPDES permit authorities can designate sources below one acre where necessary to protect water quality in a particular area, or waive sites above one acre where NPDES permit coverage under the Phase II rule is not necessary to protect water quality.

IV. STORM WATER PROBLEMS IN CENSUS DESIGNATED URBANIZED AREAS

This section responds to the Appropriations Act's direction to provide a report containing:

"(3) documentation demonstrating that storm water runoff is generally a problem in communities with populations of 50,000 to 100,000 (including an explanation of why the coverage of the regulation is based on a census-determined population instead of a water quality threshold);

BACKGROUND

In 1990, EPA promulgated the first phase of the NPDES permit application rules for storm water ("Phase I"). Phase I required NPDES permits for storm water discharges from large and medium municipal separate storm sewer systems generally serving populations of 100,000 or more. Areas with a combined sewer were not included in the total population served for Phase I.

This definition of large and medium MS4s for Phase I created so-called "donut holes." Donut holes are unregulated MS4s located within those urbanized areas that include systems covered by the Phase I storm water program, but are not currently addressed by the storm water program because the Phase I regulations specify applicability based on political jurisdiction. In other words, donut holes are geographic gaps in the existing NPDES storm water program's regulatory scheme. Storm water discharges from donut hole areas present a problem due to their adverse impacts on local waters, as well as by frustrating the attainment of water quality goals of neighboring regulated communities.

The storm water Phase II rule designates discharges from small MS4s located in urbanized areas for NPDES permit coverage. EPA adopted the Bureau of the Census definition of an urbanized area as comprising a place and the adjacent densely settled surrounding territory that together have a minimum population of 50,000 people. A permitting authority may designate additional small MS4s after the authority develops designation criteria and applies those criteria to small MS4s located outside of an urbanized area, in particular those with a population of 10,000 or more and a population density of at least 1,000 per square mile. The permitting authority may waive the requirement for a permit for any small MS4 serving a jurisdiction with a population of less than 1,000 unless storm water controls are needed because the MS4 is contributing to a water quality impairment. The permitting authority may also waive permit coverage for MS4s serving a jurisdiction with a population of less than 10,000 if all waters that receive a discharge from the MS4 have been evaluated and discharges from the MS4 do not significantly contribute to a water quality impairment or have the potential to cause an impairment. The Phase II rule also allows States with a watershed permitting approach to phase in coverage for MS4s in jurisdictions with populations under 10,000.

EPA'S RATIONALE FOR BASING REGULATION ON CENSUS-DETERMINED POPULATION RATHER THAN A WATER QUALITY THRESHOLD

EPA adopted the Bureau of the Census definition of "urbanized area" for the purposes of the Phase II rule. The existing storm water Phase I rule already covers discharges from MS4s with more than 100,000 population. Phase II would address the remaining MS4s in urbanized areas.

The Bureau of the Census defines an urbanized area as comprising a place and the adjacent densely settled surrounding territory that together have a minimum population of 50,000 people. The densely settled surrounding territory generally has at least 1,000 people per square mile. The Bureau of the Census definition of "urbanized area," adopted by EPA for the purposes of the Phase II rule, was published in the Federal Register (55 FR 42592, October 22, 1990).

EPA is using urbanized areas to automatically designate regulated small MS4s on a nationwide basis for several reasons:

(1) Water Quality Impacts from Urban Runoff

Studies and data show a high correlation between degree of development/ urbanization and adverse impacts on receiving waters due to storm water. See section A below for a full discussion of storm water impacts due to urban development.

(2) Addresses gaps in coverage

The blanket coverage within the urbanized area encourages the watershed approach and addresses the problem of "donut-holes," where unregulated areas are surrounded by areas regulated under Phase I.

(3) Pollution Prevention

This approach targets present and future growth areas as a preventative measure to help ensure water quality protection. Urbanized areas have experienced significant growth over the past 50 years. According to EPA calculations based on Census data from 1980 to 1990, the national average rate of growth in the United States during that 10-year period was more than 4 percent. For the same period, the average rate of growth within urbanized areas was 15.7 percent and the average for outside of urbanized areas was just more than 1 percent. Table C below illustrates the growth of urbanized areas for the past five Census (EPA, 1995). The new development occurring in these growing areas can provide some of the best opportunities for implementing cost-effective storm water management controls.

Table C. Growth of Urbanized Areas in the United States Between 1950 and 1990

Year	Number of Urbanized Areas	Population in Urbanized Areas (millions)			Land Area (sq. mi.)
		Total	Central Cities	Urban Fringe	
1950	157	69.2	48.4	20.9	19,728
1960	213	95.8	57.9	37.8	25,544
1970	273	120.7	65.1	55.6	35,081
1980	366	139.2	67.0	72.1	52,017
1990	405	160.4	79.7	80.7	61,520

(4) Simplified Designation and Coverage

The determination of urbanized areas by the Bureau of the Census allows operators of small MS4s to quickly determine whether they are included in the NPDES storm water program as a regulated small MS4.

Using urbanized areas as a basis for designation effectively targets resources to the most densely developed territory. The 405 urbanized areas in the United States cover only 2 percent of the total U.S. land areas yet contain approximately 63 percent of the nation's population.

DOCUMENTATION OF WATER QUALITY PROBLEMS DUE TO STORM WATER RUNOFF FROM URBANIZED AREAS

EPA has compiled a number of studies demonstrating that storm water runoff is generally a problem in urbanized areas. This information is divided into storm water impacts due to urban development (section A below) and other discharges to municipal storm sewers (section B below). The Appropriations Act specifically requested that this report provide "documentation demonstrating that storm water runoff is generally a problem in communities with populations of 50,000 to 100,000." While 50,000 is the population threshold used by the Bureau of the Census for defining urbanized areas and EPA adopted the Census definition for the purpose of automatic designation in the Phase II rule, the studies below indicate that water quality impacts will occur in these areas and potentially in areas with lower population densities as well. The Phase II rule would allow the lower population density areas to be designated on a case by case basis.

A. Storm Water Impacts Due to Urban Development

EPA's 1995 Storm Water Phase II Report to Congress (EPA, 1995) and the Coastal Zone Management Measures Guidance (EPA, 1992) describe the impacts from urbanization. Urbanization impacts water quality principally through changes in hydrology and increases in pollutant loadings. Increases in population density and imperviousness due to urbanization can result in significant changes to stream hydrology including:

- increased peak discharges compared to predevelopment levels;
- increased volume of urban runoff produced by each storm in comparison to predevelopment conditions;
- decreased time needed for runoff to reach the stream, particularly if extensive drainage improvements are made;
- increased frequency and severity of flooding;
- reduced streamflow during prolonged periods of dry weather due to reduced level of infiltration in the watershed;
- greater runoff velocity during storms due to the combined effects of higher peak discharges, rapid time of concentration, and the smoother hydraulic surfaces that occur as a result of development.

An increase in imperviousness can also significantly decrease the amount of water infiltration, reducing groundwater recharge.

The types of pollutants found in urban runoff include sediment, nutrients, oxygen-demanding substances, pathogens, road salts, hydrocarbons, heavy metals, and toxics. In addition, thermal impacts from increased temperature of urban runoff and loss of riparian habitat can severely impair aquatic organisms that have finely tuned temperature limits.

1. Urbanization and Imperviousness

Urbanization alters the natural infiltration capability of the land and generates a host of pollutants that are associated with the activities of dense populations, thus causing an increase in storm water runoff volumes and pollutant loadings in storm water discharged to receiving waterbodies (U.S. EPA, 1992). Urban development increases the amount of impervious surface in a watershed as farmland, forests, and meadowlands with natural infiltration characteristics are converted into buildings with rooftops, driveways, sidewalks, roads, and parking lots with virtually no ability to absorb storm water. Storm water and snow-melt runoff wash over these impervious areas, picking up pollutants along the way while gaining speed and volume because of their inability to disperse and filter into the ground. What results are storm water flows that are higher in volume, pollutants, and temperature than the flows in less impervious areas, which have more natural vegetation and soil to filter the runoff (U.S. EPA, 1997. Urbanization and Streams: Studies of Hydrologic Impacts. EPA 841-R-97-009. Office of Water. Washington, DC).

Studies reveal that the level of imperviousness in an area strongly correlates with the quality of the nearby receiving waters. For example, a study in the Puget Sound lowland ecoregion found that when the level of basin development exceeded 5 percent of the total impervious area, the biological integrity and physical habitat conditions that are necessary to support natural biological diversity and complexity declined precipitously (May, C.W., E.B. Welch, R.R. Horner, J.R. Karr, and B.W. May. 1997. Quality Indices for Urbanization Effects in Puget Sound Lowland Streams, Technical Report No. 154. University of Washington Water Resources Series). Research conducted in numerous geographical areas, concentrating on various variables and employing widely different methods, has revealed a similar conclusion: stream degradation occurs at relatively low levels of imperviousness, such as 10 to 20 percent (even as low as 5 to 10 percent according to the findings of the Washington study referenced above) (Schueler, T.R. 1994. "The Importance of Imperviousness." Watershed Protection Techniques 1(3); May, C., R.R. Horner, J.R. Karr, B.W. Mar, and E.B. Welch. 1997. "Effects Of Urbanization On Small Streams In The Puget Sound Lowland Ecoregion." Watershed Protection Techniques 2(4); Yoder, C.O., R.J. Miltner, and D. White. 1999. "Assessing the Status of Aquatic Life Designated Uses in Urban and Suburban Watersheds." In Proceedings: National Conference on Retrofits Opportunities in Urban Environments. EPA 625-R-99-002, Washington, DC; Yoder, C.O and R.J. Miltner. 1999. "Assessing Biological Quality and Limitations to Biological Potential in Urban and Suburban Watersheds in Ohio." In Comprehensive Stormwater & Aquatic Ecosystem Management Conference Papers, Auckland, New Zealand). Furthermore, research has indicated that few, if any, urban streams can support diverse benthic communities at imperviousness levels of 25 percent or more. An area of medium density single family homes can be anywhere from 25 percent to nearly 60 percent impervious, depending on the design of the streets and parking (Schueler, 1994).

In addition to impervious areas, urban development creates new pollution sources as population density increases and brings with it proportionately higher levels of car emissions, car maintenance wastes, pet waste, litter, pesticides, and household hazardous wastes, which may be washed into receiving waters by storm water or dumped directly into storm drains designed to discharge to receiving waters. More people in less space results in a greater concentration of pollutants that can be mobilized by, or disposed into, storm water discharges from municipal separate storm sewer systems. A modeling system developed for the Chesapeake Bay indicated that contamination of the Bay and its tributaries from runoff is comparable to, if not greater than, contamination from industrial and sewage sources (Cohn-Lee, R. and D. Cameron. 1992. "Urban Stormwater Runoff Contamination of the Chesapeake Bay: Sources and Mitigation." The Environmental Professional, Vol. 14).

2. Large-Scale Studies and Assessments

In support of Phase II's regulatory designation of MS4s in urbanized areas, the Agency relied on broad-based assessments of urban storm water runoff and related water quality impacts, as well as more site-specific studies. The first national assessment of urban runoff characteristics was completed for the Nationwide Urban Runoff Program (NURP) study (U.S. EPA. 1983.

Results of the Nationwide Urban Runoff Program, Volume 1 - Final Report. Office of Water. Washington, D.C.). The NURP study is the largest nationwide evaluation of storm water discharges, which includes adverse impacts and sources, undertaken to date.

EPA conducted the NURP study to facilitate understanding of the nature of urban runoff from residential, commercial, and industrial areas. One objective of the study was to characterize the water quality of discharges from separate storm sewer systems that drain residential, commercial, and light industrial (industrial parks) sites. Storm water samples from 81 residential and commercial properties in 22 urban/suburban areas nationwide were collected and analyzed during the 5-year period between 1978 and 1983. The majority of samples collected in the study were analyzed for eight conventional pollutants and three heavy metals.

Data collected under the NURP study indicated that discharges from separate storm sewer systems draining runoff from residential, commercial, and light industrial areas carried more than 10 times the annual loadings of total suspended solids (TSS) than discharges from municipal sewage treatment plants that provide secondary treatment. The NURP study also indicated that runoff from residential and commercial areas carried somewhat higher annual loadings of chemical oxygen demand (COD), total lead, and total copper than effluent from secondary treatment plants. Study findings showed that fecal coliform counts in urban runoff typically range from tens to hundreds of thousands per hundred milliliters of runoff during warm weather conditions, with the median for all sites being around 21,000/100 ml. This is generally consistent with studies that found that fecal coliform mean values range from 1,600 coliform fecal units (CFU)/100 ml to 250,000 cfu/100 ml (Makepeace, D.K., D.W. Smith, and S.J. Stanley. 1995. "Urban Storm Water Quality: Summary of Contaminant Data." Critical Reviews in Environmental Science and Technology 25(2):93-139). Makepeace, et al., summarized ranges of contaminants from storm water, including physical contaminants such as total solids (76 - 36,200 mg/L) and copper (up to 1.41 mg/L); organic chemicals; organic compounds, such as oil and grease (up to 110 mg/L); and microorganisms.

Monitoring data summarized in the NURP study provided important information about urban runoff from residential, commercial, and light industrial areas. The study concluded that the quality of urban runoff can be affected adversely by several sources of pollution that were not directly evaluated in the study, including illicit discharges, construction site runoff, and illegal dumping. Data from the NURP study were analyzed further in the U.S. Geological Survey (USGS) Urban Storm Water Data Base for 22 Metropolitan Areas Throughout the United States study (Driver, N.E., M.H. Mustard, R.B. Rhinesmith, and R.F. Middleburg. 1985. U.S. Geological Survey Urban Storm Water Data Base for 22 Metropolitan Areas Throughout the United States. Report No. 85-337 USGS. Lakewood, CO). The USGS report summarized additional monitoring data compiled during the mid-1980s, covering 717 storm events at 99 sites in 22 metropolitan areas and documented problems associated with metals and sediment concentrations in urban storm water runoff. More recent reports have confirmed the pollutant concentration data collected in the NURP study (Marsalek, J. 1990. "Evaluation of Pollutant Loads from Urban Nonpoint Sources." Wat. Sci. Tech. 22(10/11):23-30; Makepeace, et al., 1995).[4]

America's Clean Water - the States' Nonpoint Source Assessment (Association of State and Interstate Water Pollution Control Administrators (ASIWPCA). 1985. America's Clean Water - The States' Nonpoint Source Assessment. Prepared in cooperation with the U.S. EPA, Office of Water, Washington, DC), a comprehensive study of diffuse pollution sources conducted under the sponsorship of the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) and EPA revealed that 38 States reported urban runoff as a major cause of designated beneficial use impairment and 21 States reported storm water runoff from construction sites as a major cause of beneficial use impairment. In addition, the 1996 305(b) Report (U.S. EPA. 1998. The National Water Quality Inventory, 1996 Report to Congress. EPA 841-R-97-008. Office of Water. Washington, DC), provides a national assessment of water quality based on biennial reports submitted by the States as required under CWA section 305(b) of the CWA. In the CWA 305(b) reports, States, Tribes, and Territories assess their individual water quality control programs by examining the attainment or nonattainment of the designated uses assigned to their rivers, lakes, estuaries, wetlands, and ocean shores. A designated use is the legally applicable use specified in a water quality standard for a watershed, waterbody, or segment of a waterbody. The designated use is the desirable use that the water quality should support. Examples of designated uses include drinking water supply, primary contact recreation (swimming), and aquatic life support. Each CWA 305(b) report indicates the assessed fraction of a State's waters that are fully supporting, partially supporting, or not supporting designated beneficial uses.

In their reports, States, Tribes, and Territories first identified and then assigned the sources of water quality impairment for each impaired waterbody using the following categories: industrial, municipal sewage, combined sewer overflows, urban runoff/storm sewers, agricultural, silvicultural, construction, resource extraction, land disposal, hydrologic modification, and habitat modification. The 1996 Inventory, based on a compilation of 60 individual 305(b) reports submitted by States, Tribes, and Territories, assessed the following percentages of total waters nationwide: 19 percent of river and stream miles; 40 percent of lake, pond, and reservoir acres; 72 percent of estuary square miles; and 6 percent of ocean shoreline waters. The 1996 Inventory indicated that approximately 40 percent of the Nation's assessed rivers, lakes, and estuaries are impaired. Waterbodies deemed as "impaired" are either partially supporting designated uses or not supporting designated uses.

The 1996 Inventory also found urban runoff/discharges from storm sewers to be a major source of water quality impairment nationwide. Urban runoff/storm sewers were found to be a source of pollution in 13 percent of impaired rivers; 21 percent of impaired lakes, ponds, and

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[4] EPA notes that it is not relying solely on the NURP study to describe current water quality impairment. Rather, EPA is citing NURP as a source of data on typical pollutant concentrations in urban runoff. Recent studies have not found significantly different pollutant concentrations in urban runoff compared to the original NURP data (see Makepeace, et al., 1995; Marsalek, 1990; and Pitt, et al., 1995).

reservoirs; and 45 percent of impaired estuaries (second only to industrial discharges). In addition, urban runoff was found to be the leading cause of ocean impairment for those ocean miles surveyed.

In addition, a recent USGS study of urban watersheds across the United States has revealed a link between urban development and contamination of local waterbodies. The study found the highest levels of organic contaminants, known as polycyclic aromatic hydrocarbons (PAHs) (products of combustion of wood, grass, and fossil fuels), in the reservoirs of urbanized watersheds (U.S. Geological Survey (USGS). 1998. Research Reveals Link Between Development and Contamination in Urban Watersheds. USGS news release. USGS National Water-Quality Assessment Program).

Urban storm water also can contribute significant amounts of toxicants to receiving waters. Pitt, et. al. (1993), found heavy metal concentrations in the majority of samples analyzed. Industrial or commercial areas were likely to be the most significant pollutant source areas (Pitt, R., R. Field, M. Lalor, M. Brown 1993. "Urban stormwater toxic pollutants: assessment, sources, and treatability" Water Environment Research, 67(3):260-75).

3. Local and Watershed-Based Studies

In addition to the large-scale nationwide studies and assessments, a number of local and watershed-based studies from across the country have documented the detrimental effects of urban storm water runoff on water quality. A study of urban streams in Milwaukee County, Wisconsin, found local streams to be highly degraded due primarily to urban runoff, while three studies in the Atlanta, Georgia, region were characterized as being "the first documentation in the Southeast of the strong negative relationship between urbanization and stream quality that has been observed in other ecoregions" (Masterson, J. and R. Bannerman. 1994. "Impacts of Storm Water Runoff on Urban Streams in Milwaukee County, Wisconsin." Paper presented at National Symposium on Water Quality: American Water Resources Association; Schueler, T.R. 1997. "Fish Dynamics in Urban Streams Near Atlanta, Georgia." Technical Note 94. Watershed Protection Techniques 2(4)). Several other studies, including those performed in Arizona (Maricopa County), California (San Jose's Coyote Creek), Massachusetts (Green River), Virginia (Tuckahoe Creek), and Washington (Puget Sound lowland ecoregion), all had the same finding: runoff from urban areas greatly impair stream ecology and the health of aquatic life; the more heavily developed the area, the more detrimental the effects (Lopes, T. and K. Fossum. 1995. "Selected Chemical Characteristics and Acute Toxicity of Urban Stormwater, Streamflow, and Bed Material, Maricopa County, Arizona." Water Resources Investigations Report 95-4074. USGS; Pitt, R. 1995. "Effects of Urban Runoff on Aquatic Biota." In Handbook of Ecotoxicology; Pratt, J. and R. Coler. 1979. "Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Inhabiting the Green River, Massachusetts." Completion Report Project No. A-094. Water Resources Research Center. University of Massachusetts at Amherst.; Schueler, T.R. 1997. "Historical Change in a Warmwater Fish Community in an Urbanizing Watershed." Technical Note 93. Watershed Protection Techniques 2(4); May, C., R. Horner, J.

Karr, B. Mar, and E. Welch. 1997. "Effects Of Urbanization On Small Streams In The Puget Sound Lowland Ecoregion." Watershed Protection Techniques 2(4)).

Pitt and others also described the receiving water effects on aquatic organisms associated with urban runoff (Pitt, R.E. 1995. "Biological Effects of Urban Runoff Discharges" In Stormwater Runoff and Receiving Systems: Impact, Monitoring, and Assessment, ed. E.E Herricks, Lewis Publishers; Crunkilton, R., J. Kleist, D. Bierman, J. Ramcheck, and W. DeVita. 1999. "Importance of Toxicity as a Factor Controlling the Distribution of Aquatic Organisms in an Urban Stream." In Comprehensive Stormwater & Aquatic Ecosystem Management Conference Papers. Auckland, New Zealand).

In Wisconsin, runoff samples were collected from streets, parking lots, roofs, driveways, and lawns. Source areas were broken up into residential, commercial, and industrial. Geometric mean concentration data for residential areas included total solids of about 500-800 mg/L from streets and 600 mg/L from lawns. Fecal coliform data from residential areas ranged from 34,000 to 92,000 cfu/100 mL for streets and driveways. Contaminant concentration data from commercial and industrial source areas were lower for total solids and fecal coliform, but higher for total zinc (Bannerman, R.T., D.W. Owens, R.B. Dods, and N.J. Hornewer. 1993. "Sources of Pollutants in Wisconsin Stormwater." Wat. Sci. Tech. 28(3-5):241-59).

Bannerman, et al. also found that streets contribute higher loads of pollutants to urban storm water than any other residential development source. Two small urban residential watersheds were evaluated to determine that lawns and streets are the largest sources of total and dissolved phosphorus in the basins (Waschbusch, R.J., W.R. Selbig, and R.T. Bannerman. 1999. "Sources of Phosphorus in Stormwater and Street Dirt from Two Urban Residential Basins In Madison, Wisconsin, 1994-95." Water Resources Investigations Report 99-4021. U.S. Geological Survey). A number of other studies have indicated that urban roadways often contain significant quantities of metal elements and solids (Sansalone, J.J. and S.G. Buchberger. 1997. "Partitioning and First Flush of Metals in Urban Roadway Storm Water." ASCE Journal of Environmental Engineering 123(2); Sansalone, J.J., J.M. Koran, J.A. Smithson, and S.G. Buchberger. 1998. "Physical Characteristics of Urban Roadway Solids Transported During Rain Events" ASCE Journal of Environmental Engineering 124(5); Klein, L.A., M. Lang, N. Nash, and S.L. Kirschner. 1974. "Sources of Metals in New York City Wastewater" J. Water Pollution Control Federation 46(12):2653-62; Barrett, M.E, R.D. Zuber, E.R. Collins, J.F. Malina, R.J. Charbeneau, and G.H Ward., 1993. "A Review and Evaluation of Literature Pertaining to the Quantity and Control of Pollution from Highway Runoff and Construction." Research Report 1943-1. Center for Transportation Research, University of Texas, Austin).

4. Beach Closings/Advisories

Urban wet weather flows have been recognized as the primary sources of estuarine pollution in coastal communities. Urban storm water runoff, sanitary sewer overflows, and combined sewer overflows have become the largest causes of beach closings in the United States in the past three years. Storm water discharges from urban areas not only pose a threat to the ecological environment, they also can substantially affect human health. A survey of coastal and Great Lakes communities found that more than 1,500 beach closings and advisories where attributable to storm water runoff in 1998 (Natural Resources Defense Council. 1998. "Testing the Waters Volume VIII-Has Your Vacation Beach Cleaned Up Its Act?" New York, NY). Other reports also document public health, shellfish bed, and habitat impacts from storm water runoff, including more than 823 beach closings/advisories issued in 1995 and more than 407 beach closing/advisories issued in 1996 due to urban runoff (Natural Resources Defense Council. 1996. Testing the Waters Volume VI: Who Knows What You're Getting Into. New York, NY; NRDC. 1997. Testing the Waters Volume VII: How Does Your Vacation Beach Rate. New York, NY; Morton, T. 1997. Draining to the Ocean: The Effects of Stormwater Pollution on Coastal Waters. American Oceans Campaign, Santa Monica, CA). The Epidemiological Study of Possible Adverse Health Effects of Swimming in Santa Monica Bay (Haile, R.W., et. al. 1996. "An Epidemiological Study of Possible Adverse Health Effects of Swimming in Santa Monica Bay." Final Report prepared for the Santa Monica Bay Restoration Project) concluded that there is a 57 percent higher rate of illness in swimmers who swim adjacent to storm drains than in swimmers who swim more than 400 yards away from storm drains. This and other studies document a relationship between gastrointestinal illness in swimmers and water quality, the latter of which can be heavily compromised by polluted storm water discharges.

B. Other Discharges to Municipal Storm Sewers

In addition to runoff from storm events, municipal separate storm sewer systems may receive and ultimately discharge other materials introduced into the system. Non-storm water discharges to storm sewers come from a variety of sources, including:

- illicit connections and cross connections from industrial, commercial, and sanitary sewage sources
- leaking sanitary sewage systems
- malfunctioning on-site disposal systems (septic systems)
- improper disposal of wastes such as used oil, wastewater and litter
- spills
- infiltration of ground water contaminated by a variety of sources, including leaking underground storage tanks
- wash waters, lawn irrigation, and other drainage sources.

Studies have shown that discharges from MS4s often include wastes and wastewater from non-storm water sources. Federal regulations (§ 122.26(b)(2)) define an illicit discharge as "...any discharge to an MS4 that is not composed entirely of storm water...," with some exceptions. These discharges are "illicit" because municipal storm sewer systems are not designed to accept, process, or discharge such wastes. Sources of illicit discharges include, but are not limited to,: sanitary wastewater; effluent from septic tanks; car wash, laundry, and other industrial wastewaters; improper disposal of auto and household toxics, such as used motor oil and pesticides; and spills from roadway and other accidents.

Illicit discharges enter the system through either direct connections (e.g., wastewater piping either mistakenly or deliberately connected to the storm drains) or indirect connections (e.g., infiltration into the MS4 from cracked sanitary systems, spills collected by drain outlets, and paint or used oil dumped directly into a drain). The result is untreated discharges that contribute high levels of pollutants, including heavy metals, toxics, oil and grease, solvents, nutrients, viruses and bacteria into receiving waterbodies. The NURP study, discussed earlier, found that pollutant levels from illicit discharges were high enough to significantly degrade receiving water quality and threaten aquatic, wildlife, and human health. The study noted particular problems with illicit discharges of sanitary wastes, which can be directly linked to high bacterial counts in receiving waters and can be dangerous to public health.

Because illicit discharges to MS4s can create severe widespread contamination and water quality problems, several municipalities and urban counties performed studies to identify and eliminate such discharges. In Michigan, the Ann Arbor and Ypsilanti water quality projects inspected 660 businesses, homes, and other buildings and identified 14 percent of the buildings as having improper storm sewer drain connections. The program assessment revealed that, on average, 60 percent of automobile-related businesses, including service stations, automobile dealerships, car washes, body shops, and light industrial facilities, had illicit connections to storm sewer drains. The program assessment also showed that a majority of the illicit discharges to the storm sewer system resulted from improper plumbing and connections, which had been approved by the municipality when installed (Washtenaw County Statutory Drainage Board. 1987. Huron River Pollution Abatement Program).

In addition, an inspection of urban storm water outfalls draining into Inner Grays, Washington, indicated that 32 percent of these outfalls had dry weather flows. Of these flows, 21 percent were determined to have pollutant levels higher than the pollutant levels expected in typical urban storm water runoff characterized in the NURP study (U.S. EPA. 1993. Investigation of Inappropriate Pollutant Entries Into Storm Drainage Systems -- A User's Guide. EPA 600/R-92/238. Office of Research and Development. Washington, DC). That same document reports a study in Toronto, Canada, that found that 59 percent of outfalls from the MS4 had dry-weather flows. Chemical tests revealed that 14 percent of these dry-weather flows were determined to be grossly polluted.

Inflows from aging sanitary sewer collection systems are one of the most serious illicit discharge-related problems. Sanitary sewer systems frequently develop leaks and cracks, resulting in discharges of pollutants to receiving waters through separate storm sewers. These pollutants include sanitary waste and materials from sewer main construction (e.g., asbestos cement, brick, cast iron, vitrified clay). Municipalities have long recognized the reverse problem of storm water infiltration into sanitary sewer collection systems; this type of infiltration often disrupts the operation of the municipal sewage treatment plant.

The improper disposal of materials is another illicit discharge-related problem that can result in contaminated discharges from separate storm sewer systems in two ways. First, materials may be disposed of directly in a catch basin or other storm water conveyance. Second, materials disposed of on the ground may either drain directly to a storm sewer or be washed into a storm sewer during a storm event. Improper disposal of materials to street catch basins and other storm sewer inlets often occurs when people mistakenly believe that disposal to such areas is an environmentally sound practice. Part of the confusion may occur because some areas are served by combined sewer systems, which are part of the sanitary sewer collection system, and people assume that materials discharged to a catch basin will reach a municipal sewage treatment plant. Materials that are commonly disposed of improperly include used motor oil; household toxic materials; radiator fluids; and litter, such as disposable cups, cans, and fast-food packages. EPA believes that there has been increasing success in addressing these problems through initiatives such as storm drain stenciling and recycling programs, including household hazardous waste special collection days.

Programs that reduce illicit discharges to separate storm sewers have improved water quality in several municipalities. For example, Michigan's Huron River Pollution Abatement Program found the elimination of illicit connections caused a measurable improvement in the water quality of the Washtenaw County storm sewers and the Huron River (Washtenaw County Statutory Drainage Board, 1987). In addition, an illicit detection and remediation program in Houston, Texas, has significantly improved the water quality of Buffalo Bayou. Houston estimated that illicit flows from 132 sources had a flow rate as high as 500 gal/min. Sources of the illicit discharges included broken and plugged sanitary sewer lines, illicit connections from sanitary lines to storm sewer lines, and floor drain connections (Glanton, T., M.T. Garrett, and B. Goloby. 1992. The Illicit Connection: Is It the Problem? Wat. Env. Tech. 4(9):63-8).

V. Rationale for Using a NPDES Approach

This section responds to the Appropriations Act's direction to provide a report containing:

"(4) information that supports the position of the Administrator that the Phase II stormwater program should be administered as part of the National Pollutant Discharge Elimination System under section 402 of the Federal Water Pollution Control Act (33 U.S.C. 1342)"

EPA interprets Clean Water Act section 402(p)(6) as authorizing the Agency to develop a storm water program for Phase II sources either as part of the existing NPDES permit program or as a stand alone non-NPDES program such as a self-implementing rule. Although EPA believes that it has the discretion to not require sources regulated under CWA section 402(p)(6) to be covered by NPDES permits, the Agency has determined, for the reasons discussed below, that it is most appropriate to use NPDES permits in implementing the program to address the sources designated for regulation in Phase II. EPA believes that the NPDES program best achieves the goals of the Phase II rule for the following reasons:

- Applying an NPDES permit approach to Phase II sources allows for consistent regulation between larger MS4s and construction sites regulated under Phase I and smaller sources regulated under Phase II.
- Use of NPDES permits to regulate Phase II municipalities will allow co-permitting of small regulated MS4s with larger MS4s regulated under the existing Phase I storm water program.
- The use of NPDES permits is a familiar regulatory implementation vehicle that is well understood by State regulators and potential permittees.
- NPDES permits provide the flexibility to allow the use of general permits on a watershed basis, while also allowing site-specific controls to be developed on a case-by-case basis.
- NPDES permits allow incorporation by reference of existing State, Tribal and local programs.
- NPDES permit applications and NOIs provide important information to regulatory authorities and the public.
- NPDES permit procedures include beneficial processes for citizen participation and enforcement.
- NPDES permits are federally enforceable under the CWA.

- NPDES permit coverage provides "permit as a shield" legal protection to the permittee.

- NPDES permit coverage provides an established and predictable regulatory regime to avoid duplicative regulation under the Resource Conservation and Recovery Act and the Comprehensive Emergency Response, Compensation, and Liability Act, due to exclusions from regulation for facilities subject to NPDES permits.

In developing an approach for the Phase II rule, individual members of both the FACA Committee and the Storm Water Phase II FACA Subcommittee encouraged EPA to seek opportunities to integrate, where possible, the proposed Phase II requirements with existing Phase I requirements, thus facilitating a unified and "seamless" storm water discharge control program. EPA believes that using the NPDES framework is the best means of integrating the regulation of Phase II sources with the existing storm water program. The NPDES framework is already applied to regulated storm water sources and can be extended to the sources to be regulated in Phase II. This approach facilitates program consistency, public access to information, and program oversight.

Requiring Phase II sources to be covered by NPDES permits would help address the consistency problems currently caused by municipal "donut holes." Donut holes are gaps in program coverage where a small unregulated MS4 is located next to or within a regulated larger MS4 that is subject to an NPDES permit under the existing NPDES storm water program. The existence of such "donut holes" creates an equity problem because similar discharges may remain unregulated even though they cause or contribute to the same adverse water quality impacts. Using NPDES permits to regulate the unregulated discharges in these areas is intended to facilitate the development of a seamless regulatory program for the mitigation and control of contaminated storm water discharges in an urbanized area. For example, the Phase II rule would allow a newly regulated MS4 to join as a "limited" co-permittee with a regulated MS4 by referencing a common storm water management program. Such cooperation should be further encouraged by the fact that the minimum control measures to be required in the Phase II rule for regulated small MS4s are very similar to a number of the permit requirements for medium and large MS4s under the existing storm water program. The minimum control measures applicable to discharges from smaller MS4s under Phase II are described with slightly more generality than under the Phase I permit application regulations for larger MS4s, thus enabling maximum flexibility for operators of smaller MS4s to optimize efforts to protect water quality.

The Phase II rule would also apply NPDES permit requirements to construction sites below 5 acres that are similar to the existing requirements for those 5 acres and above. In addition, the rule would allow compliance with qualifying local, Tribal, or State erosion and sediment controls to meet the erosion and sediment control requirements of the general permits for storm water discharges associated with construction, both above and below 5 acres.

Incorporating the CWA section 402(p)(6) program into the NPDES program capitalizes upon the existing governmental infrastructure for administration of the NPDES program.

Moreover, much of the regulated community already understands the NPDES program and the way it works.

Another goal of the NPDES program approach is to provide flexibility in order to facilitate and promote watershed planning and sensitivity to local conditions. The following are some of the more significant examples of the flexibility provided by the NPDES approach:

- NPDES general permits may be used to cover a category of regulated sources on a watershed basis or within political boundaries.
- The NPDES permitting process provides a mechanism for storm water controls tailored on a case-by-case basis, where necessary.
- The NPDES permit requirements of a permittee may be satisfied by another cooperating entity.
- NPDES permits may incorporate the requirements of existing State, Tribal and local programs, thereby accommodating State and Tribes seeking to coordinate the storm water program with other programs, including those that focus on watershed-based nonpoint source regulation.

NPDES permits generally require an application or a notice of intent to trigger coverage. This information exchange assures communication between the permitting authority and the regulated community. This communication is critical in ensuring that the regulated community is aware of the requirements and the permitting authority is aware of the potential for adverse impacts to water quality from identifiable locations. The NPDES permitting process includes the public as a valuable stakeholder and ensures that the public is included and information is made publicly available.

Another concern for EPA and several of the individual FACA Subcommittee members was that the program ensure citizen participation. The NPDES approach ensures opportunities for citizen participation throughout the permit issuance process, as well as in enforcement actions. NPDES permits are also federally enforceable under the CWA.

EPA believes that the use of NPDES permits makes a significant difference in the degree of compliance with regulations in the storm water program. The Agency does not anticipate that a self-implementing rule would ensure the degree of public participation needed for the development, enforcement and revision of the storm water management program. Citizen suit enforcement has assisted in focusing attention on adverse water quality impacts on a localized, public priority basis. Citizens frequently rely on the NPDES permitting process and the availability of NOIs to track program implementation and help them enforce regulatory requirements.

NPDES permits are also advantageous to the permittee. The NPDES permit informs the permittee about the scope of what it is expected do to be in compliance with the Clean Water Act. As explained more fully in EPA's April 1995 guidance, Policy Statement on Scope of Discharge Authorization and Shield Associated with NPDES Permits, compliance with an NPDES permit constitutes compliance with the Clean Water Act (see CWA section 402(k)). In addition, NPDES permittees are excluded from duplicative regulatory regimes under the Resource Conservation and Recovery Act and the Comprehensive Emergency Response, Compensation and Liability Act under RCRA's exclusions to the definition of "solid waste" and CERCLA's exemption for "federally permitted releases."

Throughout development of the rule, State representatives sought alternatives to the NPDES approach for State implementation of the storm water program for Phase II sources. Discussions focused on an approach whereby States could develop an alternative program that EPA would approve or disapprove based on identified criteria, including that the alternative non-NPDES program would result in "equivalent or better protection of water quality." The State representatives, however, were unable to propose or recommend criteria for gauging whether a program would provide equivalent protection. EPA also did not receive any suggestions for objective, workable criteria in response to the Agency's explicit request for specific criteria (by which EPA could objectively judge such programs) in the preamble to the proposed rule.

EPA also considered suggestions that the Agency authorize Phase II to be implemented as a self-implementing rule, which would be a regulation promulgated at the Federal, State, or Tribal level to control some or all of the storm water dischargers regulated under the Phase II rule. Under this approach, a rule would spell out the specific requirements for dischargers and impose the restrictions and conditions that would otherwise be contained in an NPDES permit. It would be effective until modified by EPA, a State, or a Tribe, unlike an NPDES permit which cannot exceed a duration of five years. Some stakeholders believed that this approach would reduce the burden on the regulated community (e.g., by not requiring permit applications), and considerably reduce the amount of additional paperwork, staff time and accounting required to administer the proposed permit requirements.

EPA is sensitive to the interest of some stakeholders in having a streamlined program that minimizes the burden associated with permit administration and maximizes opportunities for field time spent by regulatory authorities. Key provisions in the Phase II rule would address some of these concerns by promoting a streamlined approach to permit issuance by, for example, using general permits for coverage of Phase II permittees and allowing the incorporation of existing programs. By adopting the NPDES approach rather than a self-implementing rule, the Phase II rule also allows for consistent regulation between larger MS4s and construction sites regulated under the Phase I rule and smaller sources regulated under Phase II.

EPA believes that it is most appropriate to use NPDES permits to implement a program to address Phase II sources. In addition to the reasons discussed above, NPDES permits provide a better mechanism than would a self-implementing rule for tailoring storm water controls on a case-by-case basis, where necessary. A self-implementing rule would not ensure the degree of public participation that the NPDES permit process provides for the development, enforcement and revision of the storm water management program. A self-implementing rule also might not have provided the regulated community the "permit shield" under CWA section 402(k) that is provided by an NPDES permit. Based on all these considerations, EPA declined to adopt a self-implementing rule approach and adopted the NPDES approach for Phase II sources.

NPDES PROGRAM IMPLEMENTATION REVIEW
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD 4
LOS ANGELES REGION

U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 9
FINAL REPORT - OCTOBER 1999

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Dear Mr. Nahai and Mr. Dickerson:

I'm pleased to provide you with the final report of EPA Region 9's review of the Los Angeles Regional Water Quality Control Board's National Pollution Discharge Elimination System (NPDES) program, conducted on June 3-5, 1998. In the 1970s and 1980s, EPA regularly reviewed delegated state environmental programs to ensure compliance with all requirements. After conducting a number of these reviews during those years, EPA Region 9 increasingly found that delegated programs in our states had few if any problems, so by the early 1990s, we had markedly reduced our state oversight activities. Last year, we resumed conducting reviews of state administered National Pollution Discharge Elimination System (NPDES) programs for several reasons. First, it had been at least five years since Region 9 had conducted reviews of state-administered NPDES programs. In part, the reviews were initiated to respond to national concerns highlighted by EPA's Office of Inspector General regarding the quality of state programs nationally. Consistency of state enforcement programs across the country - the "level playing field" concept - remains on the Inspector General's top ten list of significant issues facing EPA, and the Office of Management and Budget has expressed concern about backlogs of expired NPDES permits. For all these reasons, we re-initiated NPDES program reviews in our Region, working with the state agencies to be reviewed, to ensure effective state administration of the NPDES program.

In planning its review of the State of California, EPA focused on the Regional Boards with the largest NPDES programs–Sacramento, Los Angeles, and San Diego--and conducted its first review at the Los Angeles Regional Board. During our review of the Los Angeles Regional Board, EPA was aware of the 1997 Heal the Bay report criticizing its administration of the

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NPDES program. However, EPA's review of the Los Angeles Board is an independent, objective evaluation, based upon EPA's requirements for the NPDES program and applicable written agreements between EPA and the State of California. While our review didn't confirm or deny the specifics of Heal the Bay's review, we did note a comparable past history of weak NPDES enforcement by the Los Angeles Board. However, we also noted significant improvement by the Board over the past 2-3 years in both eliminating expired permit backlogs and in taking enforcement action. For example, since the EPA review, the Board assessed a record $2.3 million penalty against the City of Thousand Oaks for an 86 million gallon sewage spill. Also, in the past year, the Board has achieved an impressive record of enforcement actions and penalty assessments, a marked improvement over past performance, due largely to the leadership of the Regional Board, its Executive Officer, and the establishment of a separate Enforcement Unit. We commend these achievements.

Our review of the Los Angeles Board's NPDES program encompassed five main NPDES activities: permitting, compliance, pretreatment, storm water, and enforcement, over the time period from 1995 through June 1998. The enclosed Executive Summary includes commentary regarding the strengths of the Los Angeles Board's administration of the NPDES program, discussion of issues arising State-wide that require change at all the Regional Boards, the changes that are required at the Los Angeles Board, and other suggestions that EPA offers for the Los Angeles Board's consideration. In brief, the strengths in the Los Angeles Board's NPDES program include:

- Between 1995 and 1998, the Board eliminated their backlog of 70 percent-expired NPDES permits.
- The Board has an excellent review, tracking, and inspection program to assess permit compliance of major and minor NPDES permittees.
- The Board has shown leadership by developing a new data system that will replace California's current data system for dischargers.
- In the storm water program, though much more needs to be done, the Board's small staff is doing what they can to address the huge universe of regulated facilities.
- There has been significant increase in both the number of enforcement actions taken and penalties assessed, as discussed above.

Changes that need to be made by all the Regional Water Quality Control Boards in California, including the Los Angeles Board, to fully comply with all NPDES program requirements include:

- The current lack of State-wide water quality standards for toxic pollutants results in NPDES water quality permit limit problems at all the Regional Boards. Until EPA's promulgation of the California Toxics Rule and the State's adoption of the Inland Surface Waters and Enclosed Bays and Estuaries Plan's Implementation Policy, all the Regional

Water Boards should refer to EPA's *Technical Support Document for Water Quality-based Toxics Control*, and to examples of fact sheets and permits that will be provided by the State Board.

- Penalty actions need to comply with State penalty policies.
- Greater inspection presence is needed in the storm water program, which is significantly under funded State-wide.
- Pretreatment program expertise needs to be strengthened and industrial user regulation is needed.

Changes needing to be made that are specific to the Los Angeles Board to fully comply with all NPDES program requirements include:

- NPDES permits must ensure that aquatic life is protected from toxics by establishing appropriate, protective effluent limits consistent with Basin Plan objectives.
- The Los Angeles Board must carefully observe all procedural requirements in issuing NPDES permits in order to avoid potential permit challenges based on procedural grounds.
- For storm water, the Board needs to review and comment on the Los Angeles County storm water permit model program submittals, since successful implementation of this permit depends on these reviews.
- In pretreatment, the Board must complete the review and approval process for local limits programs as well as one overall pretreatment program.
- All formal enforcement actions taken by the Board must require compliance by a date certain, and contain appropriate interim effluent limits and schedule milestone dates.
- The Board's current emphasis on enforcement is commended, and needs to be continued.

Based on this review, once the required changes are made, EPA believes that the Los Angeles Board will be administering an NPDES program that meets all applicable requirements, though limited by available resources.

EPA's review provides us all with a great opportunity to ensu e that our mission, to protect public health and the environment, is successfully achieved. The enclosed evaluation focuses on the legal and policy requirements of the NPDES program, but doesn't address other perhaps less tangible aspects of our shared responsibilities, such as opportunities for leadership in environmental and public health protection. The Board's enforcement action on the Thousand Oaks spill, and the Board's record of enforcement since the Thousand Oaks action, demonstrate the kind of leadership and profile that stimulates compliance and a cleaner environment. We commend the Los Angeles Board for this record of recent action, and urge you to continue this vigorous enforcement program.

Alexis Strauss and Mike Schulz of our Water Division will be pleased to discuss this review in more detail with you if you wish. We sincerely appreciate the participation and cooperation of you and your staff, as well as that of the State Water Resources Control Board, in our shared endeavors to better manage water resources in California.

Yours,

Felicia Marcus
Regional Administrator

Enclosure

cc: Winston Hickox, CalEPA
Walt Pettit, SWRCB
John Norton, SWRCB

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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD 4
LOS ANGELES REGION

October 1999

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Attachment--Table 4, RWQCB 4 Approved Pretreatment Programs & Activities

Attachment--Table 5, Inventory of RWQCB 4 Major NPDES Actions by Year

Appendix A, State-wide NPDES Program Issues

NPDES PROGRAM IMPLEMENTATION REVIEW
LOS ANGELES REGIONAL WATER QUALITY CONTROL BOARD

EXECUTIVE SUMMARY

On June 3 through 5, 1998, the U.S. Environmental Protection Agency, Region 9 (EPA), conducted a review of the Los Angeles Regional Water Quality Control Board's (the L. A. Board, or Board) approved National Pollution Discharge Elimination System (NPDES) program. The review was conducted by EPA to assess the L. A. Board's implementation of the NPDES program, generally covered the time period from 1995 through 1998, and focused on five main NPDES activities: permitting, compliance, pretreatment, storm water, and enforcement. EPA conducted its review by evaluating a representative sample of the L. A. Board's NPDES program files, documents, quarterly and other reports, and by conducting interviews of the L. A. Board's NPDES program managers and staff. This report presents the results of EPA's review, summarized below.

The L. A. Board's jurisdiction covers nearly 4,000 square miles, services more than 10 million people, and includes approximately 390 surface water body segments, of which 40 percent are recognized as having impaired beneficial uses, including Santa Monica Bay, the Los Angeles River, and Malibu Creek. In addition, 11 Publicly Owned Treatment Works (POTWs) in the L. A. Board's jurisdiction receive discharges from industries comprising half of the total industries in California, accounting for a significant component of the toxics control accomplished in the State under the Clean Water Act. The L. A. Board regulates 44 major and 260 minor NPDES permitted facilities, regulates 345 enrollees under six different general permits, is responsible for 2,600 industrial facilities and 600 construction sites that are subject to storm water regulations, and regulates Ventura and Los Angeles Counties with municipal storm water permits, with 11 and 86 co-permittees, respectively.

EPA's NPDES program reviews conducted in California to date at the Los Angeles, San Diego, and Sacramento Regional Water Quality Control Boards have revealed issues which are applicable throughout the State of California. These issues, as agreed upon by the State Water Resources Control Board (SWRCB), all nine Regional Water Quality Control Boards (RWQCBs), and EPA, are listed below. EPA is working with the SWRCB and the RWQCBs to identify and implement solutions to these State-wide NPDES program needs, as discussed in more detail in Appendix A of this report.

- The current lack of State-wide water quality standards for toxic pollutants results in NPDES permit issuance problems at the RWQCBs.
- Adoption of NPDES permits containing compliance schedules for water quality based effluent limitations is not allowable, unless an authorizing provision is contained in the

applicable water quality control plan. This issue is not applicable to the Oakland and Sacramento RWQCBs, which have the necessary authorizing provisions.

- Appropriate receiving water limitations language, for which acceptable model language has been developed by EPA, the SWRCB, and the California Storm Water Quality Task Force, needs to be included in all forthcoming municipal storm water permits.
- Permit fact sheets/statements of basis need to clearly establish that permits are consistent with applicable statutes, regulations, and policy.
- Copies of inspection reports of major permittees, as well as copies of responses from permittees about violation follow-up, must be sent by all RWQCBs to EPA.
- Compliance review of Discharge Monitoring Reports (DMRs) is often not timely.
- Quarterly Non-Compliance Reports (QNCRs) need improvement in quality and content.
- Field presence/compliance assessment at NPDES major/minor facilities is not adequate.
- A greater inspection presence in the storm water program for both industrial and construction sites needs to be established by all RWQCBs.
- Pretreatment program expertise needs to be increased, industrial user regulation by the State is needed, and industrial user compliance problems must be addressed by the State.
- All RWQCB penalty actions need to comply with State penalty policies.

EPA's review conducted at the L. A. Board identified both specific NPDES program strengths and areas for improvement, as discussed below, applicable to their implementation of the NPDES program.

PERMITS

Strengths

In Fiscal Year (FY) 1994/1995, the L. A. Board had a NPDES permit backlog (individual permits including storm water) with nearly 70 percent of their permits requiring reissuance. In 1995, the L. A. Board implemented a watershed permitting approach, whereby priorities for permit issuance are being established consistent with emphasis on priority watersheds. At the end of FY 1997/1998, the L. A. Board was reissuing all permits in accordance with its workplan schedule for permit issuance, with only a few minor permits remaining backlogged. This permit backlog reduction is a significant accomplishment. In addition, the L. A. Board is coordinating the setting of water quality standards with NPDES permitting using a priority watershed approach, which results in better permits. The L. A. Board is establishing water quality based effluent limitations for toxic chemicals in NPDES permits based on "reasonable potential," when a pollutant causes, or has the reasonable potential to cause or contribute to an exceedance of narrative or numeric water quality standards. Also, where "reasonable potential" is established and numeric water quality objectives for toxic chemicals are lacking, the L. A. Board is using the Basin Plan narrative toxicity objective in conjunction with numeric criteria for toxic chemicals to establish water quality based effluent limitations which, in most cases, ensures protection of beneficial uses.

Required Changes

Though the L. A. Board is implementing an NPDES permitting program which is effective overall, the following changes must be made in order to fully comply with all requirements.

State-wide Issues

The current lack of State-wide water quality standards for toxic pollutants, and the absence of a plan of implementation for establishing water quality based effluent limits for toxics and whole effluent toxicity, results in NPDES permit issuance problems at all the RWQCBs, including the L. A. Board. EPA promulgation of the California Toxics Rule (CTR) and the State's adoption of the Inland Surface Waters and Enclosed Bays and Estuaries Plan's Implementation Policy are expected to address this issue for most constituents. In the interim, to ensure permits are issued as required, all the RWQCBs should refer to EPA's *Technical Support Document for Water Quality-based Toxics Control* (*Technical Support Document, or TSD*), and to fact sheets and permits that will be provided as examples by the SWRCB.

During the period prior to adoption of the CTR and the State's Implementation Policy, all RWQCBs should develop a permitting process to ensure consistent establishment of water quality based effluent limits using Basin Plan objectives and other protective numeric criteria. In addition, during the period prior to adoption and implementation of Total Maximum Daily Loads (TMDLs) for 303(d) listed waters, all RWQCBs should develop a permitting process which ensures consistent establishment of water quality based effluent limits for discharges to 303(d) listed waters without TMDLs, where discharges are found to contain pollutants causing or contributing to non-attainment of water quality standards.

Adoption of NPDES permits by the RWQCBs containing compliance schedules for water quality based effluent limitations is not allowable unless an authorizing provision is contained in applicable water quality control plans, an issue applicable to all RWQCBs except Oakland and Sacramento which have the necessary authorizing provisions. Several of the L. A. Board's tentative permits that were reviewed contained unauthorized compliance schedules for water quality based effluent limitations. These concerns, however, have been fully addressed, and Time Schedule Orders (TSOs) for these facilities were issued by the L. A. Board to meet this requirement.

All RWQCBs including the L. A. Board need to ensure that permit fact sheets/statements of basis clearly establish that permits are consistent with applicable statutes, regulations, and policy (e.g., reasonable potential, antibacksliding, establishing mixing zones, determining dilution credits, etc.). Along with summary explanations, fact sheets/statements of basis need to provide additional explanation detailing the basis for requiring water quality based effluent limitations, including reasonable potential procedures and the method used to implement water quality objectives/criteria as effluent limits.

Appropriate receiving water limitations language, for which acceptable model language has been developed by EPA, the SWRCB, and the California Storm Water Quality Task Force, needs to be included in all forthcoming municipal storm water permits from the RWQCBs, including the L. A. Board. EPA notes the June 17, 1999, adoption by the SWRCB of a policy requiring all RWQCBs to include this model language in permits.

Issues Specific to the L. A. Board

The L. A. Board must establish metals effluent limits in the "total recoverable" form rather than the "dissolved" form. When recent toxic chemical effluent data indicate the "reasonable potential" to exceed the Basin Plan narrative toxicity objective protecting aquatic life beneficial uses, the L. A. Board must establish water quality based effluent limits for that toxic chemical using numeric Basin Plan objectives (or other protective numeric criteria when numeric objectives are lacking) that will protect aquatic life beneficial uses. When recent chronic Whole Effluent Toxicity (WET) data indicate the "reasonable potential" to exceed the Basin Plan narrative toxicity objective, the L. A. Board must establish water quality based effluent limitations for either chronic toxicity or for the pollutant(s) causing the toxicity.

The L. A. Board must conduct a second public notice when changes to tentative permits are "substantial," or when permit changes cannot reasonably be considered a "logical outgrowth" of public comments received during the comment period. The L. A. Board's major permit modifications must be public noticed and subject to appeal procedures. This includes changes to permit monitoring programs which result in less stringent permit conditions. Also, in accordance with case law, the L. A. Board's expired permits may not be modified. These issues may be of State-wide concern in addition to those State-wide issues discussed in Appendix A.

Two of the six permits reviewed in depth by EPA that were issued by the L. A. Board with pollutant effluent limits did not require monitoring for those pollutants; the L.A. Board must ensure that all permit effluent limits require monitoring. NPDES permits and related information need to be submitted by the L. A. Board to EPA.

COMPLIANCE

Strengths

The L. A. Board has an excellent review and tracking program to assess compliance of its 44 major and 260 minor NPDES permittees. The overall inspection and sampling coverage of NPDES permitted facilities is good, and generally meets EPA requirements. The L. A. Board's quarterly violations summary report, which includes a listing of all violations (not just NPDES) and is prepared for submittal to its Board, is useful, and the L. A. Board is commended for including this report on its internet site, an excellent way to convey compliance information to the public. The new data system (SWIM, formerly know as ERIS) that the L. A. Board developed to replace the State-wide data system (the Waste Discharger System) is outstanding,

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and is expected to be a major step forward in data management for the entire State. The L. A. Board is to be commended for its leadership in data management in support of the State-wide program. The L. A. Board's tracking, follow-up, and review process of Discharge Monitoring Reports (DMRs) is excellent, and staff is very knowledgeable of the compliance status of the permittees. EPA's review of selected field notes indicate that staff are knowledgeable about inspection techniques and the inspections are thorough.

Required Changes

State-wide Issues

The L. A. Board's inspection coverage generally meets EPA requirements. However, State-wide, compliance assessment at NPDES major and minor facilities is not adequate. State-wide issues include use of appropriate sampling methods, adequacy of field inspection notes, and depth of on-site review. Notes taken during inspections must be retained by inspectors at all the RWQCBs for at least three years. Copies of inspection reports of major permittees, as well as copies of responses from permittees about violation follow-up, must be sent by all RWQCBs to EPA.

The QNCRs submitted by the RWQCBs need improvement in quality and content. The L. A. Board must report all appropriate violations on the QNCR, including violations of non-monthly averages.

Issues Specific to the L. A. Board

The L. A. Board needs to implement a solution to the BKK Corporation technical noncompliance problem. Since the review, EPA notes that the L. A. Board rescinded BKK's permit and enrolled it under the General Industrial Storm Water Permit.

The L. A. Board needs to implement proper compliance evaluation of report submittals. At a minimum, the language in all future permits needs to be reflective of the way reports will be tracked for compliance. The L. A. Board is now implementing practices to ensure that permittees are notified of their respective "date certain" report due dates, and the ERIS/SWIM system is now being used to track report receipt.

The SWRCB needs to be notified by the L. A. Board of changes in inspection schedules if they will result in less than 100 percent inspection coverage of majors for the inspection year, to afford EPA the opportunity to conduct remaining inspections if so desired.

STORM WATER COMPLIANCE AND ENFORCEMENT

Strengths

The L. A. Board has knowledgeable and dedicated staff that are accomplishing an admirable level of work in spite of a large universe of regulated facilities and a severely limited resource base. The Ventura County permit implementation and compliance program is well implemented, with an adequate level of Board oversight; the L. A. Board nominated this permit for an EPA national award. The L. A. Board staff inspected 100 percent of active construction sites within the Ventura watershed at least once prior to the onset of the 1997-98 rainy season, and re-inspected approximately 80 percent during the rainy season. The L. A. Board is to be commended for this pre/post rainy season inspection protocol. Los Angeles Coastal Watershed Unit staff have started to perform in-depth audits of individual co-permittees under the Los Angeles County MS4 program. The L. A. Board is to be commended for developing and implementing an improved storm water inspection tracking system in September 1998.

Required Changes

State-wide Issues

A greater inspection presence in the storm water program for both industrial and construction sites needs to be established by all RWQCBs, including the L. A. Board. Activities conducted by the L. A. Board during 1997-98 in the Ventura watershed construction program are a good model for the L. A. Board's other watershed units to strive for. Within the industrial program, the L. A. Board needs to continue and more actively seek out non-filing facilities. EPA recognizes that increased efforts are underway.

Issues Specific to the L. A. Board

The L. A. Board must review and comment upon the Los Angeles County MS4 model program submittals. Without timely Board action, implementation of this MS4 permit is not possible.

PRETREATMENT

Strengths

The L. A. Board is responsible for the regulatory oversight of 11 pretreatment programs. The Board's Pretreatment Compliance Inspections (PCIs), audits, and accompanying reports appear to be complete, including appropriate findings, requirements, and recommendations. The *Self-Monitoring Program Summary Review Sheet* is a comprehensive log which is used by some staff to record pretreatment program reviews, status, and activities. This *Review Sheet* is excellent and recommended for use by all staff.

Required Changes

State-wide Issues

The SWRCB, the L. A. Board, or some combination of RWQCBs must develop the necessary program expertise in industrial wastewater treatment, the Federal categorical standards and pretreatment regulations, and industrial user permitting and oversight, in order to effectively implement the pretreatment program. State-wide, pretreatment priority and work commitments need to be addressed. The L. A. Board needs to establish procedures to ensure that audits and pretreatment compliance inspections (PCIs) are appropriately scheduled, and that EPA and the SWRCB are notified quarterly of schedule revisions and shortfalls, as required by the Clean Water Act Section 106 annual workplan. State-wide, lack of pretreatment enforcement is of concern, especially where water quality problems exist due to pretreatment noncompliance; the L. A. Board must ensure that pretreatment enforcement activities are conducted, and are timely.

Issues Specific to the L. A. Board

The L. A. Board needs to review quarterly and annual pretreatment reports, in preparation for PCIs and audits, and for submittal of Water Enforcement National Data Base (WENDB) data elements. The L. A. Board needs to ensure that all PCI and audit reports are issued and timely; that adequate and timely PCI and audit follow-up investigation is conducted; and that PCI reports, audit reports, and WENDB data elements are submitted to EPA.

The L. A. Board needs to complete the review of the Burbank local limits and formally approve the limits, as modified if necessary. In response to EPA's formal reviews of the City of Los Angeles local limits, the Board needs to approve these local limits. Also, the Board needs to complete the pretreatment program review and approval process for the Ventura Waterworks District No. 1 (Moorpark facility).

ENFORCEMENT

Strengths

Since the time this review was conducted, EPA notes a significant improvement in both the number of enforcement actions taken and the penalties assessed by the L. A. Board. This is based on the Board's intention to issue 140 ACLs and to assess over $1.5 million in fines this year.

The L. A. Board's establishment of the Water Quality Standards and Enforcement Unit in August 1997 is commended. This Unit increases and improves the Board's focus and efforts on enforcement case development. The L. A. Board generally initiates formal enforcement actions to address NPDES violations when warranted, largely in conformance with SWRCB/RWQCB policy, and imposes and collects some civil penalties. Since the time of this review, EPA notes that the L. A. Board assessed a record $2.3 million penalty against the City of Thousand Oaks for an 86 million gallon sewage spill, recovering economic benefit. The L. A. Board has adopted a "progressive enforcement approach" in which enforcement actions are generally escalated according to a discharger's response to a previous Board action. Consistent with EPA policy and the Clean Water Action Plan, the L. A. Board is emphasizing enforcement actions for violations due to sewage spills. The L. A. Board has established a sound citizen complaint tracking system, and has also established a binder that contains all enforcement actions available for public review.

Required Changes

State-wide Issues

Penalty actions at all RWQCBs need to comply with applicable State penalty policies. Economic benefit amounts must not be reduced or rescinded as an incentive toward achieving compliance or as an off-set for supplemental environmental projects.

All RWQCBs need to place more emphasis on initiating formal enforcement actions within the storm water program. In particular, industries that are subject to, but that have not yet filed for coverage under, the General Industrial Storm Water Permit should be targeted. EPA acknowledges the L. A. Board's efforts which have resulted in an annual report submittal rate of 90 percent. For the remaining non-submitting facilities, the L. A. Board has been implementing a progressive enforcement strategy that has been effective in bringing facilities into compliance.

Issues Specific to the L. A. Board

The L.A. Board should ensure that all applicable violations are included in the "Report of Violations and Enforcement Actions" so that it complies with the SWRCB Enforcement Policy that all applicable violations are brought to the attention of the Regional Boards. EPA's review determined that staff exercise discretion when determining what violations to include in this report. Board staff should ensure that they send to EPA copies of all relevant enforcement documents related to NPDES major facilities, including Notices of Violation, formal enforcement actions, civil penalty settlement correspondence, civil penalty agreements, referrals for judicial action, and case closures.

OTHER NPDES PROGRAM SUGGESTIONS

During the conduct of this review of the L. A. Board's NPDES program, EPA identified a number of suggestions for improving their administration of the program. These suggestions are based upon both EPA's experience in implementing the NPDES program and national program perspective. EPA believes these suggestions will result in a more effective program at the L. A. Board. Though not explicitly required by law, regulation, or national policy, EPA urges the L. A. Board to implement the following:

Permits

The L. A. Board should consider encouraging public agencies that develop general public education programs on reduction of discharge of toxic materials to include pesticides in their programs. This could be accomplished by specifically mentioning pesticides in both the *residential public education* and *public agency activities* sections of the MS 4 permits. This would be expected to result in lessening the adverse impact on water quality stemming from routine household use of pesticides. Also, in addition to procedures for evaluating exfiltration from the sanitary sewer, the L. A. Board is encouraged to persuade permittees to include procedures for evaluating malfunctioning septic systems in their programs, as EPA's Part 2 MS4 guidance recommends. The L. A. Board should include each of the annual reporting requirements, as listed in the regulations, in MS4 permits so that permittees will not mistakenly only respond to the specific requirements as set forth in the permit.

To protect beneficial uses: (1) NPDES permits issued by the L. A. Board should contain toxicity conditions which require sensitivity screening for acute toxicity using a vertebrate and an invertebrate test species, and (2) NPDES permits issued by the L. A. Board should contain toxicity conditions which require increased effluent monitoring for toxicity following the measurement of effluent toxicity at critical levels, as denoted by the exceedance of an effluent limit or benchmark where no effluent limit has been established. This approach is similar to existing permit conditions which specifically require increased monitoring when a monthly average effluent limit is exceeded.

To protect beneficial uses and to facilitate water quality based permitting, the L. A. Board should develop an implementation procedure for the chronic mixing zone provision contained in Chapter 4 of the Basin Plan.

Compliance

The L. A. Board should consider establishing an automated system to track its follow-up on citizen complaints and spills. EPA notes that the data system called SWIMS, when implemented, will accommodate this tracking activity.

The L. A. Board should consider having all inspectors use bound notebooks for note-taking during inspections as contemporaneous, bound notes are potentially of more value in civil and criminal enforcement proceedings.

Pretreatment

All L. A. Board pretreatment program oversight staff should use the *Self-Monitoring Program Summary Review Sheet.*

Enforcement

The L. A. Board's Watershed Units that are responsible for the day-to-day oversight of regulated facilities and the new Enforcement Unit should develop and implement procedures to further improve on-going communication. This will ensure that a facility's total compliance history is considered when developing enforcement cases, and will also ensure that any enforcement strategies are not hindered by lack of other information regarding a facility. All compliance information is relevant and needs to be considered in the development of an enforcement action.

INTRODUCTION

On June 3 through 5, 1998, the U.S. Environmental Protection Agency, Region 9 (EPA), conducted a review of the Los Angeles Regional Water Quality Control Board's (RWQCB 4) approved National Pollution Discharge Elimination System (NPDES) program. The review was conducted by EPA to assess RWQCB 4's implementation of the NPDES program, in accordance with Federal laws, regulations, and policies, as agreed upon by EPA and California, and described in the following documents:

1. NPDES Memorandum of Agreement between the U. S. Environmental Protection Agency and the California State Water Resources Control Board (September 1989), and
2. Final FY 1995/1996, FY 1996/1997, and FY 1997/1998 Section 106 Workplans.

The EPA review focused on five main NPDES activities: permitting, compliance, pretreatment, storm water, and enforcement, and generally covered the time period from 1995 to 1998. EPA conducted its review by evaluating a representative sample of RWQCB 4's NPDES program files, documents, quarterly and other reports, and by conducting interviews of RWQCB 4's NPDES program managers and staff. The EPA evaluation of RWQCB 4's NPDES program took place both at EPA's offices in San Francisco (document review) and at RWQCB 4's offices in Monterey Park. The EPA review is documented on checklists which correlate with the requirements of the above-listed documents. This report presents the results of EPA's review of RWQCB 4 regarding the approved California NPDES program.

EPA's review participants included the following Region 9 Water Division staff:

Mike Schulz, Associate Director
Robyn Stuber, Environmental Scientist, Permitting Review
Robert Wills, Environmental Engineer, Compliance and Pretreatment Program Review
Jeremy Johnstone, Environmental Engineer, Enforcement and Storm Water Review
Jenée Gavette, Environmental Protection Specialist, Pretreatment Compliance and Enforcement Review
Dyi-You Shieh, Environmental Engineer, Compliance/Enforcement Review
Eugene Bromley, Environmental Engineer, Storm Water Permitting Review
Laurie Kermish, Attorney, from Region 9's Office of Regional Counsel

A draft review report was issued in September 1998, with comments received from the SWRCB on October 30, 1998, from RWQCB 4 dated November 6, and from RWQCB 4 staff on December 1, 1998. All comments have been discussed with the SWRCB and RWQCB 4, and the results of these discussions are incorporated into this final report. We wish to extend our thanks to the staff and managers at RWQCB 4 for their hospitality and cooperation in the conduct of this NPDES review.

OVERVIEW OF THE STATE WATER RESOURCES CONTROL BOARD AND THE REGIONAL WATER QUALITY CONTROL BOARDS

The California State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards (RWQCBs) exercise the regulatory and adjudicatory powers of the State of California in the field of water resources. To implement the State's water quality program, a regional or watershed approach to water issues was created in 1949 and greatly expanded in 1969 when the Porter-Cologne Water Quality Control Act was signed into law. Through this regional approach, the State has been divided into nine major watershed areas with the establishment of a RWQCB in each area. The RWQCBs have primary authority and responsibility for implementing four major functions to protect water quality by ensuring the adoption and implementation of water quality control plans--planning, permitting, monitoring, and enforcement.

The SWRCB was created in 1967 to combine into one agency regulatory powers covering both water rights and water quality issues, thus complementing the authority of the RWQCBs. The SWRCB may issue water quality control plans in areas of State-wide significance (i.e., an Ocean Plan, a Bay Delta Plan, a Tahoe Plan) and also ensures consistency through the adoption of State-wide policies. The SWRCB also administers key elements of the Federal Clean Water Act, such as storm water general permitting and the non-point source pollution control program, and conducts oversight of the RWQCBs, including approval of water quality control plans. The SWRCB is authorized to review most actions (or inaction) by the RWQCBs, and to adopt water quality orders when appropriate.

The SWRCB and each of the RWQCBs are headed by Boards consisting of members appointed by the Governor to four-year terms. Each Board is made up of nine volunteers from diverse backgrounds (i.e., wastewater, law, public-at-large, engineering, etc.) to ensure equal representation of each RWQCB's regulated community who are appointed by the Governor to their positions as Board members. The RWQCBs and their appointed Boards each have discrete approval or issuance authorities, as set forth in the attached Table 1.

During the last half of 1997, the SWRCB and RWQCBs added 18 new positions State-wide for enforcement activities. In addition, the SWRCB created the Compliance Assurance and Enforcement (CA&E) Unit to coordinate and evaluate enforcement activities taken State-wide. Key staff were assigned and an organizational structure was identified in each of the nine RWQCBs to assure that enforcement and compliance actions are increased. The CA&E Unit had three major tasks: (1) improve management reporting of compliance assurance and enforcement activities, (2) track the use of the special enforcement staff resources, and (3) develop a strategy to direct State compliance assurance and enforcement activities in the coming years. These three tasks have been completed, and the Compliance Assurance and Enforcement Strategy was issued in June of 1998, about the same time as EPA's review was conducted. The Strategy contains many recommendations for improving compliance and enforcement activities, many of which are expected to address issues identified in this review.

BACKGROUND AND REVIEW OBJECTIVES

The State of California and EPA have entered into the Memorandum of Agreement (MOA) and annual Clean Water Act Section 106 Workplans to ensure an effective and well-coordinated program of water quality control in California. These agreements delineate the respective responsibilities of California and of EPA for the operation of a cooperative State-Federal NPDES program, including permitting, compliance, and enforcement in accordance with the Federal Water Pollution Control Act (P.L. 92-500) as amended by the Clean Water Act (CWA) of 1987 (P.L. 100-4).

These agreements recognize that the issuance of NPDES permits, conduct of inspections, and issuance of enforcement actions necessary for the protection and enhancement of waters in California are the primary responsibility of RWQCBs, and require that RWQCBs issue permits which are consistent and compatible with the CWA and its regulations and policies. The agreements recognize EPA's substantial interest and oversight role in the issuance of NPDES permits and related enforcement matters, and describe EPA's primary role in providing financial and technical assistance, including policy guidance, to RWQCBs. The agreements also require EPA's and the RWQCB 's full cooperation to promote and conduct an enforcement program capable of providing maximum effectiveness in achieving Federal and State objectives for the regulation of water quality as follows:

1. regulating all discharges subject to the NPDES and pretreatment programs, except those reserved to EPA, in conformance with Federal and State law, regulations, and policy;
2. maintaining technical expertise, administrative procedures, and management control, such that implementation of the NPDES and pretreatment programs consistently conforms to State laws, regulations, and policies;
3. implementing federal program revisions;
4. providing technical assistance to the regulated community to encourage voluntary compliance with program requirements;
5. assuring that no person or entity realizes an economic benefit from non-compliance;
6. maintaining an adequate public file at the appropriate RWQCB Office for each permittee. Such files must, at a minimum, include copies of: the permit application, issued permit, public notice and fact sheet, discharge monitoring reports, all actions, and other pertinent information and correspondence;
7. comprehensively evaluating and assessing compliance with schedules, effluent limitations, and other conditions in permits;
8. taking timely and appropriate enforcement actions in accordance with the CWA, applicable Federal regulations, and State law; and
9. implementing pretreatment program responsibilities.

The agreements also recognize that the SWRCB is responsible for supporting and overseeing the RWQCBs' management of the NPDES and pretreatment programs in California, as follows:

1. evaluating RWQCB performance in the areas of permit content, procedure, compliance, monitoring and surveillance, quality assurance of sample analyses, and program enforcement;
2. providing that the SWRCB shall act on its own as necessary to assure that the program is administered in conformance with Federal and State legislation, regulations, policy, the MOA, and the State annual 106 workplan;
3. providing technical assistance to the RWQCBs;
4. developing and implementing regulations, policies, and guidelines as needed to maintain consistency between State and Federal policy and program operations, and to maintain consistency of program implementation throughout all nine RWQCBs and over time;
5. reviewing decisions of the RWQCBs upon petition from aggrieved persons or upon its own motion;
6. assisting the RWQCBs in the implementation of federal program revisions through the development of policies and procedures;
7. performing any of the functions and responsibilities ascribed to the RWQCBs, and
8. implementing pretreatment program responsibilities.

U.S. EPA and the State of California have been cooperatively engaged in the operation of the approved California NPDES program since 1973. During this time, formal and informal reviews and various EPA oversight activities have been conducted to determine the effectiveness of RWQCB NPDES programs. Though it has been at least five years since EPA has conducted an NPDES program review of a RWQCB, EPA is ultimately responsible to the U.S. Congress and the American public. Thus, EPA needs first-hand knowledge that EPA-approved programs are effective and compliant with all applicable laws, regulations, and policies. This review was conducted to achieve this objective.

This report consists of several components. First is an overview of the RWQCB 4 NPDES program, which briefly describes RWQCB 4's organizational structure relevant to NPDES administration. The results of EPA's review are then presented for each of five areas of the NPDES program: permits, compliance, storm water, pretreatment, and enforcement. Each of these five sections discusses EPA's evaluation of RWQCB 4's NPDES activities, including which actions were reviewed by EPA, and provides EPA's conclusions (strengths and changes required by law, regulation, and/or national policy) for improving administration of RWQCB 4's approved NPDES program, including discussion of program issues of State-wide concern. The sixth section of the report includes EPA's suggestions for improving RWQCB 4's NPDES program.

NPDES PROGRAM OVERVIEW FOR RWQCB 4

The Surface Water Division (SWD), one of three divisions/program offices of RWQCB 4, is responsible for the implementation and operation of RWQCB 4's NPDES program, including permitting, compliance, and enforcement activities for all of its NPDES-permitted facilities. The SWD's Assistant Executive Officer reports to the RWQCB 4 Executive Officer (EO). At the time of the review, the SWD was divided into two sections, Watershed Regulatory and Regional Programs, as illustrated in the attached Table 2. The Watershed Regulatory section was divided into four units, including a data and information management unit and three watershed units--Los Angeles Coastal, Ventura Coastal, and Los Angeles Inland. Watershed Unit staff were individually responsible for all permitting, compliance, and informal enforcement activities related to each NPDES facility to which they are assigned. The Regional Programs Section's Standards and Enforcement Unit was responsible for all formal enforcement actions related to NPDES facilities. The attached Tables 3 and 4 lists RWQCB 4 NPDES-permitted facilities. The attached Table 5 lists the numbers of Notices of Violation (NOVs), Time Schedule Orders (TSOs), Cease and Desist Orders (CDOs), Clean-up and Abatement Orders (CAOs), Administrative Civil Liability Complaints (ACLCs), and penalty amounts proposed, assessed, and collected by RWQCB 4 for Fiscal Years 1995 through 1998.

The SWRCB has developed NPDES program cost factors to serve as the basis for determining NPDES program needs in California; these cost factors should be used in determining RWQCB 4's resource needs in administering all aspects of its NPDES program. It should be noted that California's NPDES program has been historically underfunded, resulting in insufficient resources at all the RWQCBs, including RWQCB 4. Therefore, the RWQCBs shifted priorities and redirected resources, in RWQCB 4's case, through implementation of a watershed management approach (see RWQCB 4 Staffing for the NPDES Permitting Program section of this report). In 1999, the California state legislature recognized that there were inadequate resources to support the NPDES program and provided additional resources state-wide, including RWQCB 4.

RWQCB 4's jurisdiction covers nearly 4,000 square miles, services more than 10 million people and includes approximately 390 surface water body segments, of which 40 percent are recognized as having impaired beneficial uses, including Santa Monica Bay, Los Angeles River, and Malibu Creek. In addition, 11 Publicly Owned Treatment Works (POTWs) in RWQCB 4 receive discharges from industries comprising 50 percent of the total industries in California, accounting for the vast majority of toxics control accomplished in California under the Clean Water Act. RWQCB 4 regulates 44 major and 260 minor NPDES permitted facilities, regulates 345 enrollees under six different general permits, is responsible for 2,600 industrial facilities and 600 construction sites that are subject to storm water regulations, and regulates Ventura and Los Angeles Counties with municipal storm water permits, with 11 and 86 co-permittees, respectively.

STATE-WIDE NPDES PROGRAM NEEDS

EPA's NPDES program reviews conducted to date at RWQCBs 4 (Los Angeles), 5 (Sacramento), and 9 (San Diego) have revealed issues which are applicable throughout the State of California. These issues, as agreed upon by the SWRCB, all nine RWQCBs, and EPA during meetings held in January and February 1999 in Sacramento, are listed below, and discussed in more detail in Appendix A of this report. EPA is working with the SWRCB and the RWQCBs to identify and implement solutions to these State-wide NPDES program needs. These issues are:

- The current lack of State-wide water quality standards for toxic pollutants, and the absence of a plan of implementation for establishing water quality based effluent limits for toxics and whole effluent toxicity, results in NPDES permit issuance problems at the RWQCBs.
- Adoption of NPDES permits containing compliance schedules for water quality based effluent limitations is not allowable, unless an authorizing provision is contained in the applicable water quality control plan.
- Permit fact sheets/statements of basis need to clearly establish that permits are consistent with applicable statutes, regulations, and policy (e.g., reasonable potential, antibacksliding, establishing mixing zones, determining dilution credits, etc.).
- Appropriate receiving water limitations language, for which acceptable model language was recently developed by EPA, the SWRCB, and the California Storm Water Quality Task Force, needs to be included in all forthcoming municipal storm water permits.
- Copies of inspection reports of major permittees, as well as copies of responses from permittees about violation follow-up, must be sent by all RWQCBs to EPA, in accordance with the Memorandum of Agreement (MOA) between EPA and State of California.
- Compliance review of Discharge Monitoring Reports (DMRs) is often not timely, especially for minors.
- The Quarterly Non-Compliance Reports (QNCRs) submitted by the RWQCBs need improvement in quality and content.
- Field presence/compliance assessment at NPDES major and minor facilities is not adequate. Issues include use of appropriate sampling methods, adequacy of field inspection notes, and depth of on-site review.
- A greater inspection presence in the storm water program for both industrial and construction sites needs to be established by all RWQCBs; this program element is significantly under-funded State-wide.
- Pretreatment program expertise, in general, needs to be strengthened State-wide. Industrial user regulation by the State is needed. Industrial user compliance problems, especially when the pretreatment authority is for whatever reason unable to exert authority over the industrial user, must be addressed by the State.

- All RWQCB penalty actions need to comply with EPA and State policies which call for recovery of economic benefit resulting from noncompliance.

PERMITS

RWQCB 4's scope of responsibility for NPDES permit issuance encompasses the following:

• Individual Permits:	44 majors[1] 260 minors
• General Permits (non-storm water):	six categories (345 enrollees)
• Municipal Storm Water Permits:	Ventura County (11 co-permittees) Los Angeles County (86 co-permittees)
• Industrial/commercial storm water Notices of Intent (NOIs):	2,600 industrial/600 construction

EPA Evaluation Procedures

EPA's NPDES permit review consisted of four parts:

1. An in-depth review of a subset of RWQCB 4-issued permits--City of Los Angeles, Donald C. Tillman Water Reclamation Plant (WRP) (tentative permit); City of Simi Valley Water Quality Control Facility (WQCF); Las Virgenes Municipal Water District's Tapia Water Reclamation Facility (WRF); Chevron U.S.A., Inc.'s El Segundo Refinery; and the Los Angeles County Municipal Separate Storm Sewer System (MS4) permit--and a spot check of other individual permits to verify that permits are written in accordance with applicable law, regulations, and policy.
2. A review of the Memorandum of Agreement (MOA) to ensure that requirements are followed and that the MOA accurately reflects the needs of California's approved NPDES program.
3. An on-site review of RWQCB 4's permit files to ensure that administrative records are complete and contain required information.
4. A general review of overall program effectiveness in terms of permit backlog, staffing, training, etc.

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1 Major municipal discharges have a design flow greater than one million gallons per day (mgd) or an EPA/State-approved industrial pretreatment program. Major industrial discharges are determined based on specific ratings criteria that have been developed by EPA and the State. Minor discharges are all remaining discharges.

The NPDES ~~permits selected for in-depth review~~ or that were ~~spot checked~~ were for facilities located in Ventura or Los Angeles Counties. These two counties contain some of the largest concentrations of population and commercial activity in the world. The permits selected for in-depth review were chosen because the facilities are significant major dischargers representing different discharge categories. Also, the permits selected for in-depth review or that were spot-checked reflect water quality-based permitting practices subsequent to the 1994 invalidation of California's Inland Surface Water Quality Control Plan and Enclosed Bays and Estuaries Water Quality Control Plan, and the initiation of RWQCB 4's watershed permitting approach. Tillman WRP and several spot-checked permits were tentative permits under consideration for adoption by the RWQCB 4's Board during its June 1998 meeting. Therefore, any EPA comments on these tentative permits would have been timely for permit reissuance. Subsequent to the exit briefing, EPA objected to provisions of three tentative permits, the Donald C. Tillman WRP; the City of Los Angeles/Los Angeles-Glendale Water Reclamation Plant; and the City of Burbank Public Works Department/Burbank Water Reclamation Plant and Steam Power Plant. In response to EPA's objections, the RWQCB's Board adopted these permits with all required revisions, fully addressing EPA's concerns.

The purpose of the on-site permit file review was to view the administrative records for Tillman WRP, Simi Valley WQCF, Tapia WRF, and El Segundo Refinery. The NPDES permit files that EPA reviewed were current, orderly, and readily available for review.

RWQCB 4 Staffing for the NPDES Permitting Program

While in previous years RWQCB 4 has had an appreciable backlog of expired permits, under the watershed permitting approach (and Watershed Management Initiative, or WMI), permit issuance has been prioritized using a rotating watershed approach. RWQCB 4 has established 11 watershed management areas which are scheduled for permitting activities on a seven-year cycle. This cycle began in 1995, with the Ventura River and Calleguas Creek Watersheds, and will be completed in 2002, with the Los Angeles/Long Beach Harbors and Dominguez Channel Watersheds. The focus of permitting activities by RWQCB 4 during FY 1997/1998 and FY 1998/1999 is the Los Angeles River Watershed.

In the Watershed Regulatory Section (WRS), 12 staff and four supervisors are responsible for all surface water core regulatory activities in 11 watershed management areas, including NPDES permit reissuance. WRS priority activities for FY 1998/1999 include:

- permit reissuance and processing new individual permit applications;
- conducting inspections, tracking violations, and recommending enforcement (as appropriate);
- working with stakeholder groups in "off-year" watersheds on development and implementation of watershed management plans and monitoring programs;

- working with municipal storm water permittees on implementation of MS4 permits; and
- outreach to industrial/construction general storm water permit non-filers, etc.

While most WRS staff are experienced at writing NPDES permits, EPA encourages WRS staff to attend relevant training courses to update and broaden their expertise as training funds become available. At the request of RWQCB 4, Region 9 will be pleased to conduct a one-day whole effluent toxicity (WET) training course at the RWQCB 4 offices during FY 1999.

NPDES Permits--EPA Conclusions

Watershed Management Initiative (WMI) Schedule for Permit Issuance

In FY 1994/1995, RWQCB 4 had a NPDES permit backlog (individual permits including storm water) with nearly 70 percent of their permits requiring reissuance. In 1995, RWQCB 4 implemented its watershed permitting approach in accordance with the WMI, whereby priorities for permit issuance have been established consistent with emphasis on priority watersheds. At the completion of FY 1997/1998, RWQCB 4 is reissuing all permits in accordance with their WMI schedule for permit issuance, with only a few minor permits remaining backlogged. This is a significant accomplishment.

Storm Water Permitting

The Los Angeles County storm water permit (MS4) was reissued in July 1996. EPA was heavily involved in developing the draft permit and endorsed its reissuance. This review utilizes storm water permitting guidance available in 1996, which EPA used at that time to evaluate the reissued permit. The most important component of an MS4 permit is the storm water management program (SWMP). This permit specifies highly detailed and well thought-out requirements for the SWMP. RWQCB 4 is commended for its efforts in the development of these requirements, and for its extensive outreach to interested parties in the development of the SWMP and other permit requirements.

EPA suggests that RWQCB 4 include each of the requirements for an annual report as specified at 40 CFR 122.42(c) in its MS4 permits. Although the Los Angles County MS4 permit requires compliance with 40 CFR 122.42(c), the list of annual reporting components which is included in the permit omits any reference to budget information. A permittee may mistakenly only respond to the specific requirements as set forth in the permit. The suggested change would reduce the chance for such an omission.

EPA suggests that RWQCB 4 consider encouraging public agencies that develop general public education programs on reduction of discharge of toxic materials to include pesticides in their programs - this would be expected to result in lessening the adverse impact on water quality stemming from routine household use of pesticides. Part 2.V.C.1.b.i.aa of the Los Angeles

County MS4 permit omits mention of pesticides in its outline of the residential public education program. EPA recommends that pesticides be specifically mentioned as they are in Part 2.IV.C.4.a for public agency activities.

Also, in addition to procedures for evaluating exfiltration from the sanitary sewer, RWQCB 4 should persuade permittees to include procedures for evaluating malfunctioning septic systems in their programs. EPA's Part 2 MS4 guidance manual recommends that failing septic systems be investigated as a potential source of pollutants in storm water runoff. The Santa Monica Bay EPI study also cited failing septic systems as potential sources of the pathogens which have generated concerns in Santa Monica Bay recreational waters.

In addition, the reissued Los Angeles County MS4 permit provides that the County is to propose "model" programs which, upon approval by the Executive Officer or RWQCB 4's Board, are then to be adopted by the co-permittees. In light of the current problems hindering implementation of the terms of the reissued permit (see discussion on pages 28-30 of this report, Storm Water Compliance Activities), neither EPA nor RWQCB 4 should endorse this type of permit in the future. Any permits which rely on action by the regulatory agency before requirements are triggered may experience similar implementation problems due to the uncertainties of future resources and changing priorities.

Finally, EPA has objected to "precedential" receiving water limits which were adopted by the SWRCB in January 1998, and incorporated into recent MS4 permits (the RWQCB 2 Vallejo and the RWQCB 9 Riverside County MS4 permits). The "precedential" language requires that storm water management plans be designed, implemented, and, if necessary, upgraded to prevent only those exceedances which "cause or substantially (in more than a de minimus amount) contribute to a continuing or recurring exceedance of any applicable water quality standard." EPA believes that receiving water limitations must address all exceedances of water quality standards--not just those that are substantial, continuing, or recurring. The Los Angeles County MS4 permit contains its own unique receiving water limits language which provides that implementation of Best Management Practices (BMPs) required by the permit constitute compliance with receiving water limits. EPA accepted this language when the permit was reissued and has not reconsidered its acceptability since that time. However, the revised receiving water limitation language, which EPA developed with the SWRCB and the California Storm Water Quality Task Force, needs to be included in all forthcoming MS4 permits issued in the State, including those in RWQCB 4.

Application of Secondary Treatment Standards

In response to CWA requirements, EPA has established performance standards for secondary treatment at 40 CFR 133.102 which describe national minimum levels of effluent quality required for five-day Biochemical Oxygen Demand (BOD_5) and Suspended Solids (SS) (both effluent concentration and percent removal from influent) as well as pH. All publicly owned treatment works with permits reviewed or spot checked by EPA contained appropriate secondary treatment standards, including some which were more stringent than the Federal minimums in order to fully protect beneficial uses. In some of these permits, while EPA found that secondary treatment standards for effluent pH were not contained in the permit's "Discharge Limitations" section, they were found in the "Standard Provisions, General Monitoring, and Reporting Requirements" section ("Attachment N" to these permits).

Application of Effluent Limitations Guidelines

National effluent limitations guidelines set forth effluent limits for industrial categories (i.e., refineries, foundries, etc.). The guidelines, as developed by EPA, represent a reasonable level of wastewater treatment which is within the economic means of specific categories of industrial facilities. The industrial permit reviewed by EPA (El Segundo Refinery) included all effluent limits required by applicable effluent limitations guidelines. WRS staff are commended on their implementation of the guidelines given the complex circumstances surrounding the discharge of process and non-process wastewaters by this facility (described in the fact sheet and permit findings).

Implementation of Water Quality Standards

EPA recognizes that a number of the RWQCB 4 water quality standard permitting problems that are discussed below are partially attributable to the lack of State-wide water quality standards for toxic pollutants. EPA's promulgation of the California Toxics Rule (CTR) and the State's adoption of the Inland Surface Waters and Enclosed Bays and Estuaries Plan's Implementation Policy are expected to address this issue for most constituents. In the interim, to ensure permits are issued as required, all RWQCBs should refer to EPA's *Technical Support Document* and to fact sheets and permits that will be provided as examples by the SWRCB, as discussed in Appendix A, State-wide issues.

The regulations at 40 CFR 122.44(d) require that numeric water quality based effluent limitations be established for discharged pollutants which cause, have the reasonable potential to cause, or contribute to an exceedance of narrative or numeric water quality standards. In the permits reviewed in-depth or spot checked, fact sheets/permit findings indicate that "reasonable potential" served as the basis for many of the water quality based effluent limitations. Fact sheets/statements of basis need to clearly detail: (1) the procedure by which reasonable potential was determined for the discharge (e.g., the statistical approach from EPA's *Technical Support Document for Water Quality-based Toxics Control (Technical Support Document*; TSD) for water quality-based toxics control, percent of objective approach, detected in effluent approach, etc.); (2) which effluent pollutants were evaluated for reasonable potential; and (3) other important characteristics of effluent pollutant data sets evaluated for reasonable potential (e.g., operational time period which data represent, size of data set, etc.). In addition, EPA recommends that the WRS use a consistent approach for determining reasonable potential.

In some of the ~~permits reviewed in depth,~~ EPA found ~~that some~~ water quality based effluent limitations were not based on appropriate numeric criteria, for example: (1) for protection of an "aquatic life" beneficial use, effluent limits were established based on less stringent Maximum Contaminant (MCL) objectives, rather than on more stringent protective aquatic life criteria; and (2) while daily maximum limits were established based on available <u>acute</u> aquatic life criteria, no monthly average limits were established based on available <u>chronic</u> aquatic life criteria. EPA also found that the averaging period for a given numeric objective/criterion was not consistently applied to permits. For example, the averaging period for the same objective should not be "daily maximum" in one permit and "monthly average" in another permit. EPA suggests that the WRS develop procedures to ensure consistent implementation of objectives/criteria with respect to beneficial use protection, reasonable potential determinations and effluent limit averaging period (see also EPA's *Technical Support Document*, Chapter 3, Effluent Characterization, and Chapter 5, Permit Requirements).

In all inland surface water discharge permits reviewed in depth or spot checked, the metals effluent limits were not properly developed. The "form" required for most metals effluent limits in these permits was the "dissolved" form rather than the "total recoverable" form, as defined in 40 CFR 136. Expressing water quality objectives/criteria for metals in the dissolved form poses the need to "translate" between dissolved and total recoverable metal forms for the purpose of NPDES permits, so that total recoverable effluent limits for metals can be established as required by 40 CFR 122.45(c). This translation is necessary because chemical conditions in ambient waters frequently differ substantially from those in effluents, and there is no assurance that effluent particulate metal will not dissolve after discharge.

A "translator" is the ratio of dissolved to total recoverable metal concentrations as an effluent mixes with the receiving water, and is used to estimate the concentration of total recoverable metal in an effluent (i.e., the wasteload allocation based on a TMDL or estimated using a water quality objective/criterion) that equates to a dissolved instream concentration equal to the dissolved objective/criterion[2]. This "total recoverable" wasteload allocation represents the maximum release that will still allow attainment of the "dissolved" objective/criterion. Total recoverable metal effluent limits are established based on this wasteload allocation. Where site-specific "translators" have not been developed, EPA recommends using criteria conversion factors as default translators. EPA notes that Water Effect Ratios (WERs) should be used to

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$$WLA_t = \frac{[C_t(Q_u+Q_e)-Q_uC_u]}{Q_e}, \text{ where}$$

WLA_t	=	total recoverable wasteload allocation
C	=	concentration
C_t	=	total recoverable instream concentration equal to the dissolved criterion (i.e., "dissolved" criterion + translator)
Q	=	flow
u	=	upstream
e	=	effluent

develop site-specific objectives/criteria, not "dissolved" effluent limits, as allowed in RWQCB 4 permit conditions. Also, in some permits, EPA found that hardness values for the "effluent" rather than the "ambient water body" were used to determine applicable water quality criteria for some metals. EPA recommends that ambient hardness values be used to determine applicable water quality criteria for metals.

Implementation of Whole Effluent Toxicity

EPA recognizes that a number of the whole effluent toxicity (WET) permitting problems discussed below are partially attributable to the lack of a State-wide implementation policy for toxicity. Progress in addressing these issues is expected once the State adopts its Implementation Policy for toxics standards for inland surface waters, enclosed bays, and estuaries of California.

EPA recommends that permits require sensitivity screening using a vertebrate and an invertebrate for acute toxicity test species, as recommended in the *Technical Support Document.* Most permits reviewed in depth or spot checked required both acute and chronic WET monitoring, and most inland surface water discharge permits required chronic toxicity monitoring in the receiving water. While these permits required sensitivity screening using a vertebrate, invertebrate, and alga for chronic toxicity test species, they did not require sensitivity screening using a vertebrate and an invertebrate for acute toxicity test species. In addition, permits should require that all WET and receiving water testing be conducted using the most current acute and chronic toxicity test methods manuals approved under 40 CFR 136.

In all inland surface water discharge permits reviewed or spot checked, EPA found that chronic toxicity limits (using the Basin Plan's narrative objective for toxicity) are applied to the "receiving water" rather than the "effluent." Subsequent to the EPA review exit briefing, further analyses indicated that for at least one of these facilities where there had been chronic toxicity problems with the effluent (Tillman WRP; see Enforcement Case Studies section of this report), the permit was reissued with receiving water limits for chronic toxicity rather than effluent limits. EPA wishes to emphasize that receiving water limits for chronic toxicity may be used to complement, but cannot substitute for water quality-based effluent limits for chronic toxicity when required by "reasonable potential" regulations at 40 CFR 122.44(d)[3]. Where effluent data for chronic toxicity demonstrate the "reasonable potential" to exceed the Basin Plan's narrative objective for toxicity, regulations at 40 CFR 122.44(d) require water quality based effluent limits for chronic toxicity or for the pollutant(s) causing the toxicity. Where receiving water limits for chronic toxicity are warranted, EPA recommends that the permit clearly establish the distance downstream of the effluent discharge within which chronic toxicity may occur, consistent with Basin Plan chronic toxicity mixing zone provisions (<250 feet).

3 While this statement is made in the context of our review of implementation of whole effluent toxicity in permits, it also applies to any pollutant discharged under the NPDES.

Several ~~permits reviewed in depth contained~~ "Toxicity Identification Evaluation (TIE) trigger" conditions following exceedances of 1 TUc in the receiving water; EPA supports using the magnitude of 1 TUc as a benchmark for triggering investigation into the causes of toxicity and as the basis for establishing water quality-based limits for chronic toxicity when reasonable potential is demonstrated.

All permits reviewed in depth contained "TIE trigger" conditions based on the observance of "consistent toxicity," or toxicity observed over "n" consecutive months; however, these permits did not require accelerated effluent monitoring for toxicity following the exceedance of an effluent limit or benchmark where no effluent limit has been established. Where accelerated effluent monitoring is not required following such an exceedance, EPA is concerned that critical levels of effluent toxicity may continue for an unacceptably long period of time before any action to reduce effluent toxicity is required by the permit. This is of special concern where effluent monitoring requirements for toxicity are infrequent in relation to the frequency of exceedances that trigger action by the permittee to reduce or identify the cause(s) of toxicity. Region 9's recommendations for accelerated effluent monitoring following the measurement of effluent toxicity at critical levels may be found in the *Regions 9 and 10 Guidance for Implementing Whole Effluent Toxicity Testing Programs* (Denton and Nerves, 1996).

Finally, understanding that ammonia, in conjunction with other toxicants, may be responsible for toxicity at critical levels, EPA recommends that standard permit language specifying the conditions under which ammonia can be removed during a toxicity test be updated. When the suspected toxicant is ammonia, recommended procedures for identifying and evaluating the cause(s) of toxicity are outlined in pages 5-7 through 5-9 of *Regions 9 and 10 Guidance for Implementing Whole Effluent Toxicity Testing Programs.*

Other Permitting and Documentation Requirements

In two of the six permits reviewed in depth (Simi Valley WQCF and Tapia WRF), effluent or receiving water monitoring requirements for some pollutants with effluent limits or receiving water limits (e.g., chronic toxicity) were omitted from the monitoring and reporting program. This should not be allowed. Despite these two cases, EPA believes that only on occasion do these types of omissions occur and that it is routine procedure for RWQCB 4 to include monitoring requirements for all pollutants with effluent limits and for ambient toxicity when a permit contains a toxicity "receiving water limit" or "receiving water objective".

The fact sheet (or statement of basis) and supporting documentation serve as the primary basis for defending a permit in an administrative appeal and, ultimately, in the courts. Regulations at 40 CFR 124.8 require that fact sheets contain the following information:

- the type and ~~quantity of pollutants treated and discharged;~~
- a summary of the basis for the tentative permit conditions including reference to applicable statutory or regulatory provisions and appropriate supporting references to the administrative record; and
- any calculations or other necessary explanations of the derivation of specific effluent limits and conditions.

The fact sheets prepared by the WRS provide summary explanations for permit requirements, and special attention is given to the source document for water quality based effluent limitations. Additional explanation detailing the basis for requiring water quality based effluent limitations needs to be provided in the fact sheet, including reasonable potential procedures and the methodology used to implement water quality objectives/criteria as effluent limits.

For some permits reviewed in depth, fact sheets/permit findings did not indicate whether antibacksliding requirements at Section 402(o) of the CWA (see also 40 CFR 122.44(l)) and Section 303(d) of the CWA have been met. Permit fact sheets/statements of basis need to clearly document whether antibacksliding requirements are met.

In general, fact sheets/permit findings for the reviewed and spot checked permits did not appear to establish whether the permit is consistent with State and federal antidegradation policies. The fact sheet/statement of basis needs to document whether the permitted discharge is consistent with State and federal antidegradation policies.

As discussed above, the need for greater specificity in fact sheets is a State-wide issue. To ensure permits are issued as required, all RWQCBs should refer to EPA's *Technical Support Document* and to fact sheets and permits that will be provided as examples by the SWRCB, as discussed in Appendix A, State-wide issues.

Standard Permit Conditions

Standard permit conditions in 40 CFR 122.41 and 122.42 delineate the legal, administrative, and procedural requirements for all NPDES permits. Standard conditions may be incorporated into the permit verbatim, or by specific reference to the regulations. The use of standard conditions helps ensure uniformity and consistency of all NPDES permits issued by authorized States or EPA. NPDES permits adopted by RWQCB 4 contain these standard permit conditions in the "Standard Provisions, General Monitoring, and Reporting Requirements" section (NPDES permit "Attachment N"). EPA reviewed "Attachment N" dated April 21, 1997, and concluded that it should be updated with respect to violation penalties, sludge conditions, and reporting requirements. EPA also noted that at least two different versions of "Attachment N" (i.e., April 21, 1997 and May 14, 1997) are being used by the WRS. Because attachments may change ~~over time; EPA requests that signed major permits~~ sent by RWQCB 4 to EPA include all attachments, including "Attachment N."

Memorandum of Agreement (MOA)

The MOA requirements are generally followed by RWQCB 4. While tentative permits seem to be provided to EPA for review within time frames specified under the MOA, all permit attachments and fact sheets/statements of basis do not accompany these submittals. EPA requests that the practice of sending to EPA all permit attachments and fact sheets for major permits be reinstated.

EPA has noted that during the public comment period, as RWQCB 4 enters into negotiations with the permittee and other interested parties, substantial changes may be made to the noticed tentative permit prior to adoption by the RWQCB's Board. In accordance with 40 CFR 124.10 and case law which establishes the standard for re-initiating public notice, a second public notice may be required when RWQCB 4 changes to tentative permits are "substantial" or when the changes can not reasonably be considered a "logical outgrowth" of the public comments received during the public comment period. While this can be a fact-specific judgment call, re-noticing may avoid procedural challenges and bring out any lingering substantive concerns. This issue may be of State-wide concern, in addition to those State-wide issues discussed in Appendix A.

Permit Modification Procedures

In its review, EPA noted that permit modifications, especially modifications to monitoring and reporting programs which result in less stringent permit conditions, are frequently made by the Executive Officer. Many of these modifications are major modifications as defined by regulations at 40 CFR 122.62, and must be properly public noticed and subject to appeal procedures (see also the MOA). During the in-depth review of major permits, EPA found that RWQCB 4 improperly modified one of the permits subsequent to its expiration date (Tillman, Order No. 91-102 issued 9/9/91, as modified in 1998). Improper modifications undermine permit enforceability, therefore, EPA requires that all permit modifications be conducted in accordance with applicable regulations. This issue may be of State-wide concern, in addition to those State-wide issues discussed in Appendix A.

Compliance Schedules

As established by 40 CFR 122.47 and applicable case law, NPDES permits cannot contain compliance schedules for achieving water quality based effluent limitations unless an authorizing provision is included in a State's water quality standards. The primary water quality standards document in the Los Angeles Region is the Basin Plan. The Basin Plan contains an authorizing compliance schedule provision for ammonia objectives, but not for other effluent pollutants routinely regulated in NPDES permits. Several permits reviewed in depth or spot checked by EPA contained unauthorized compliance schedules for water quality based effluent limitations without an authorizing provision in the applicable water quality control plan. EPA requires that when an authorizing compliance schedule provision is not included in the applicable water quality control plan, the permit must be issued with a companion enforcement order containing appropriate compliance schedule conditions. This was one of the bases for EPA's subsequent objections to the reissuance of permits for Tillman WRP, Glendale WRP, and Burbank WRP and SPP. EPA's concerns were fully addressed by RWQCB 4, and Time Schedule Orders (TSOs) for these facilities have been issued. This issue is of State-wide concern, as discussed in Appendix A.

EPA CONCLUSIONS SUMMARY--PERMITS

Strengths

1. In FY 1994/1995, RWQCB 4 had a NPDES permit backlog (individual permits including storm water) with nearly 70 percent of their permits requiring reissuance. At the completion of FY 1997/1998, RWQCB 4 was reissuing all permits in accordance with its workplan schedule for permit issuance, with only a few minor permits remaining backlogged. This is a significant accomplishment.
2. RWQCB 4 is coordinating the setting of water quality standards with NPDES permitting using a rotating priority watershed approach.
3. RWQCB 4 is establishing water quality based effluent limitations for toxic chemicals in NPDES permits when the RWQCB finds that a discharge causes, has the reasonable potential to cause, or contribute to an exceedance of narrative or numeric water quality objectives (i.e., has "reasonable potential").
4. Where reasonable potential is established and numeric water quality objectives for toxic chemicals are lacking, RWQCB 4 is using the Basin Plan narrative toxicity objective in conjunction with protective numeric criteria for toxic chemicals (e.g., NTR criteria, Gold Book criteria, etc.) to establish water quality based effluent limitations which in most cases ensure protection of beneficial uses. Lack of State-wide water quality standards for toxic pollutants is a State-wide issue, discussed below.
5. RWQCB 4's NPDES permit files were orderly, current, and readily available for review.

Required Changes--State-wide Issues

1. The current lack of State-wide water quality standards for toxic pollutants, and the absence of a plan of implementation for establishing water quality based effluent limits for toxics and whole effluent toxicity, results in NPDES permit issuance problems at all the RWQCBs, including RWQCB 4. EPA Promulgation of the California Toxics Rule (CTR) and the State's adoption of the Inland Surface Waters and Enclosed Bays and Estuaries Plan's Implementation Policy are expected to address this issue for most

constituents. In ~~the interim, to ensure permits~~ are issued as ~~required,~~ all RWQCBs should refer to EPA's *Technical Support Document* and to fact sheets and permits that will be provided as examples by the SWRCB. During the period prior to adoption and implementation of the CTR and the toxic standards for inland surface waters, enclosed bays, and estuaries, all RWQCBs should develop a permitting process to ensure consistent establishment of water quality based effluent limits using Basin Plan objectives and other protective numeric criteria. In addition, during the period prior to adoption and implementation of Total Maximum Daily Loads (TMDLs) for 303(d) listed waters, all RWQCBs should develop a permitting process which ensures consistent establishment of water quality based effluent limits for discharges to 303(d) listed waters without TMDLs where discharges are found to contain pollutants causing or contributing to non-attainment.

2. Adoption of NPDES permits by the RWQCBs containing compliance schedules for water quality based effluent limitations is not allowable (in accordance with 40 CFR 122.47 and applicable case law [i.e., Star-Kist Caribe, Inc., NPDES Appeal No. 88-5]) unless an authorizing provision is contained in the applicable water quality control plan (e.g., Basin Plan, Ocean Plan, etc.) EPA requires that when an authorizing compliance schedule provision is not included in the applicable water quality control plan, the permit must be issued with a companion enforcement order containing appropriate compliance schedule conditions. RWQCB 4's Basin Plan contains an authorizing compliance schedule provision for ammonia objectives, but not for other effluent pollutants routinely regulated in NPDES permits. Several RWQCB 4 tentative permits reviewed in depth or spot checked by EPA contained unauthorized compliance schedules for water quality based effluent limitations without an authorizing provision in the applicable water quality control plan. EPA's concerns were fully addressed and Time Schedule Orders (TSOs) for these facilities were issued by RWQCB 4 to meet this requirement.
3. All RWQCBs including RWQCB 4 need to ensure that permit fact sheets/statements of basis clearly establish that permits are consistent with applicable statutes, regulations, and policy (e.g., reasonable potential, antibacksliding, establishing mixing zones, determining dilution credits, etc.). Along with summary explanations, RWQCB 4's fact sheets need to provide additional explanation detailing the basis for requiring water quality based effluent limitations, including reasonable potential procedures and the methodology used to implement water quality objectives/criteria as effluent limits.
4. Appropriate receiving water limitations language, for which acceptable model language was developed by EPA, SWRCB, and the California Storm Water Quality Task Force, needs to be included in all forthcoming municipal storm water permits from all the RWQCBs, including RWQCB 4.

Required Changes--RWQCB 4

1. In accordance with 40 CFR 122.45(c), RWQCB 4 must establish metals effluent limits in the "total recoverable" form rather than the "dissolved" form.

2. In accordance with 40 CFR 122.44(d), where recent toxic chemical effluent data indicate the "reasonable potential" to exceed the Basin Plan narrative toxicity objective protecting aquatic life beneficial uses, RWQCB 4 must establish water quality based effluent limits for that toxic chemical using numeric Basin Plan objectives (or other protective numeric criteria when numeric objectives are lacking) that will protect aquatic life beneficial uses. For example, a MCL objective should not be used to protect aquatic life beneficial uses where aquatic life criteria are available and more stringent than the MCL.
3. In accordance with 40 CFR 122.44(d), when recent chronic WET data indicate the "reasonable potential" to exceed the Basin Plan narrative toxicity objective, RWQCB 4 must establish water quality based effluent limitations for either chronic toxicity or for the pollutant(s) causing the toxicity.
4. In accordance with 40 CFR 124.10 and case law which establishes the standard for re-initiating public notice, RWQCB 4 must conduct a second public notice when RWQCB 4 changes to tentative permits are "substantial" or when permit changes can not reasonably be considered a "logical outgrowth" of the public comments received during the comment period. This issue may be of State-wide concern, in addition to those State-wide issues discussed in Appendix A.
5. In accordance with 40 CFR 122.62, RWQCB 4's major permit modifications must be public noticed and subject to appeal procedures. This includes changes to permit monitoring programs which result in less stringent permit conditions. EPA notes that this issue may be of State-wide concern, in addition to those State-wide issues discussed in Appendix A.
6. In accordance with applicable case law, RWQCB 4's expired permits may not be modified (Tillman). EPA notes that this issue may be of State-wide concern, in addition to those State-wide issues discussed in Appendix A.
7. In accordance with 40 CFR 122.44(i), permits issued by RWQCB 4 with pollutant effluent limits must require monitoring for those pollutants.
8. NPDES permits and related information need to be submitted by RWQCB 4 to EPA in accordance with the MOA.

COMPLIANCE

EPA Evaluation Procedures

Activities conducted at EPA prior to the June 1998 RWQCB 4 office visit included the review of data (obtained quarterly from the State's Waste Discharger System (WDS) data system) in EPA's Permits Compliance System (PCS) data system, review of the quarterly non-compliance reports (QNCRs) submitted by RWQCB 4 from FY 1995 through 2nd quarter FY 1998, and review of the self-monitoring reports (SMRs) for the same period.

Field activities at the RWQCB 4 office included interviews with the unit chiefs (also referred to as "seniors") in the Watershed Regulatory Section (WRS) and 11 other staff of the WRS, review of files maintained by the staff, and review of staff inspection notebooks. Subsequent to the field review, supplemental information was gathered from telephone conversations with one of the above and two additional staff members.

WRS staff are responsible for all activities from permitting through compliance and informal (and occasionally formal) enforcement. Therefore, it was not possible to estimate the resources utilized in individual program activities such as inspections or SMR review.

Compliance Tracking--Procedures

RWQCB 4 has developed and is piloting a new data system, the Environmental Reporting Information System (ERIS, now known as SWIM), to replace the existing State-wide WDS. ERIS/SWIM has expanded capability as compared to WDS in terms of programs it can handle, ease of use, and ready expansion of data fields. ERIS/SWIM is also designed to receive electronic data submission from dischargers and automatically compare submitted data to requirements, thus eventually relieving staff from doing manual compliance determinations.

SMRs and other reports required by NPDES permits are received and date-stamped at a central location. The receipt date is entered into ERIS/SWIM and the report is routed to the appropriate senior; the senior then routes it to the staff responsible for the facility. The staff reviews the reports and, exercising discretion, prepares a Level 1 letter (signed by a senior) if the report is inadequate. The staff will also generate a Level 1 letter in the case of non-receipt of a due report; it is expected that ERIS/SWIM will generate non-receipt letters in the future after due dates are coded. See the Enforcement Procedures section of this report for discussion of "Levels".

Monitoring files are kept at the individual staff person's office. The staff reviews the SMRs using the actual permit or a summary sheet as a compliance reference, and enters information about the review (date, violations, etc.) onto a SMR summary review sheet (orange sheet kept on top of the SMRs in the monitoring file). For violations which warrant action other than a telephone call, a Level 1 or Level 2 letter (EO signature level, similar to a Notice of Violation) is prepared and routed up to a senior for review and transmittal to the facility, or a recommendation for Level 3 action (formal enforcement, which includes clean-up and abatement orders (CAOs), cease and desist orders (CDOs), administrative civil liability complaints (ACLCs), and civil and criminal litigation) is routed up to a senior for review/transmittal to the Standards and Enforcement Unit for action. On occasion, depending upon workload, WRS staff will prepare the Level 3 action.

All outgoing correspondence, regardless of signature level, is accompanied by a green mail checklist sheet which serves as the route slip/concurrence sheet for the document and is routed to/through the unit and section chiefs. The mail checklist is stored in a central location for approximately three months after the document is signed. If no problems occur with the document, the mail checklist is recycled.

Telephone conversations with permittees are recorded on a Record of Communication form and are filed in the facility correspondence file. This includes "dings" for minor violations when the staff person decides that a Level 1 letter is not warranted. Phone complaints received from the public are normally handled by staff responsible for the facility and the complaints are written up on a Spill/Complaint Report form. Follow-up is documented on the form which is then filed in the correspondence file. If the complaint is about a storm water problem which normally would be handled by a municipal separate storm sewer system (MS4) program, the complaint is forwarded to the MS4 agency for follow-up. Currently, RWQCB 4 is entering records of spills and complaints into its violation and enforcement tracking system and are included in the EO's report to RWQCB 4's Board. However, the current system does not accommodate automated tracking to ensure that follow-up is accomplished. EPA notes that the State-Wide Information Management System (SWIMS), when implemented, can accommodate automated tracking of follow-up

Monthly, WRS staff members give information to the unit chiefs on SMRs received and reviewed, with highlights of problems noted. The unit chief includes this information in a monthly report to the WRS section chief. Quarterly, WRS staff also prepares a form regarding all violations noted (all programs, not just NPDES), actions taken, and other information. The completed forms are given to the permit coordinator who is responsible for a number of tracking systems and reports for violations, spills, enforcement actions, and public information requests. The permit coordinator consolidates the violations information into a quarterly violations summary report which is sent to the EO as an attachment to the quarterly report. This report is made available to the public on the RWQCB 4 web site (http://www.swrcb.ca.gov/~rwqcb4).

Quarterly, WRS staff prepares the Quarterly Non-Compliance Report (QNCR) for each of their assigned facilities, as necessary. The permit coordinator compiles each individual QNCR into one report and sends it to EPA. Questions from EPA regarding content are referred to the appropriate staff person.

Compliance Tracking--Conclusions

The monitoring files reviewed by EPA were complete, well organized, and the summary review sheets were completed promptly. The WRS staff interviewed by EPA had a good knowledge of the compliance status of the facilities for which they were responsible. There is little chance that non-reporting can occur without action or that noncompliance will be unobserved. There are some problems, however, which need correction in the reporting of noncompliance.

Some of the staff are not entering certain violations on the forms which comprise RWQCB 4's quarterly violations summary report, the QNCR, or both. In some cases, staff may be using discretion in deciding that the violations are not important enough to report. This is counter to the intent of the report. Discretion can be factored in at the actions part of the report, but all violations should be reported. In one case, BKK Corporation, staff was making compliance determinations based on an interpretation of the permit rather than the permit itself. The metals limits in the 1991 permit did not state what form (total, total recoverable, dissolved) the limits took. Without such delimitation, the plain meaning is total metals. It is not proper to factor in discretion when determining compliance. RWQCB 4 needs to implement a solution to the BKK Corporation technical noncompliance problem. Since the review, EPA notes that RWQCB 4 rescinded BKK's permit and enrolled it under the General Industrial Storm Water Permit.

In another case, Ventura RCSD-Santa Paula, no information was provided on the QNCR for this facility even though it was in significant noncompliance (SNC) with BOD limits for the October 1997 through March 1998 period. The staff person said that it was not included because the information regarding noncompliance had been forwarded to the Standards and Enforcement Unit for action. The facility still should have been reported as SNC on the QNCR.

A potential problem observed was the way in which reports from the permittees are being tracked. The date that a report is physically received at the RWQCB 4 office is the official logged date for compliance purposes. However, a review of RWQCB 4 permits indicates that most, if not all, reporting requirements are phrased as "transmitted" or "submitted" without definitions being provided for these terms. The plain meaning of these terms is "sent." Thus, rather than track by receipt date, the WRS should be tracking against "sent" or postmarked date. This is hard to do, as few reports are sent certified mail and postmarks are often illegible or missing. However, enforcement could be compromised by using the wrong triggering date. RWQCB 4 has implemented procedures to ensure that permittees are notified of their respective "date certain" report due dates. The ERIS/SWIM system is now being used to track report due dates and receipt.

The WRS has experienced some difficulties in the preparation of the QNCR, especially since 1996, when EPA added non-monthly averages to the coverage. Neither the permit coordinator responsible for the QNCR nor staff have had training on preparation of the QNCR and none were familiar with the 1996 coverage expansion. Adequate preparation of the QNCR (quality and content) is of State-wide concern, as discussed in Appendix A, State-wide issues.

Inspections--Procedures

Each WRS inspector provides the WDS coordinator with a schedule of inspections to be accomplished during the upcoming inspection year (July 1 through June 30). The scheduled dates are entered into WDS and serve as a reference for future accomplishment reports.

Inspections are generally conducted without notice or with a one-day notice to all facilities, except for Department of Defense facilities (which require additional pre-notice) and power plants (which need enough notice to arrange for an environmental representative to be at the facility). Almost all of the annual inspections of major facilities are sampling inspections.

The inspector sets up the automatic sampler for the effluent sample on the first day of the inspection, conducts the inspection, and retrieves the 24-hour composite sample on the second day. A sample of the influent, when needed, is obtained by splitting a sample taken by the permittee. Samples are delivered, using chain-of-custody procedures, to the State laboratory in Los Angeles for analysis. The State lab provides the sample bottles (with preservatives, if necessary, already in the containers) and cleans the automatic samplers after use.

Inspection findings are recorded either in a bound notebook or on loose-leaf paper during the inspection. The inspectors check the standard items during the inspection, including facility site review, operations and maintenance, records, and reporting and compliance schedules. Laboratory analytical procedures are not evaluated as part of the inspection as the permits require the use of State-certified labs for self monitoring and analysis. Compliance with EPA sludge regulations is also not normally evaluated, with the exception of the Tapia wastewater treatment plant where sludge problems have been observed.

Once back at the office, the inspector completes the Facilities Inspection Report (SWRCB Form 001). The report usually does not contain any narrative description of the findings of the inspection unless non-compliance was observed; an exception to this may be if it was the inspector's first visit to the facility. The inspector may wait for the sampling results to come back from the State lab (usually one month) or may indicate "pending" on Form 001. A copy of Form 001 is then sent to RWQCB 4's WDS coordinator for data entry. After data input, the WDS coordinator indicates by a check mark on Form 001 that the data has been entered and keeps the form in a file. When the lab results are received, information about compliance or non-compliance is written on the form and the form is filed by the inspector in the facility inspection file. The lab results are also filed in the inspection file. It is left to staff discretion whether or not this information is submitted to the WDS Coordinator for entry into a "comment" field of the WDS system. The notes from the inspection may or may not be retained, depending upon the inspector and whether notes were taken on bound or loose-leaf paper.

When non-compliance is noted, either during the inspection or as a result of sample analysis, a narrative report is added to Form 001 and the report is sent to the permittee by cover letter (usually Level 1; see the Enforcement Procedures section of this report for discussion of Levels) requiring that the permittee explain the reasons for noncompliance and the actions taken to prevent recurrence. Depending upon the response, the inspector may recommend escalated action.

The APM, in Chapter 4, states that inspections conducted to fulfill EPA requirements will be documented using both Form 001 and EPA Form 3560-3, and that for majors the latter EPA Form will be sent to EPA. The inspectors do not complete the EPA Inspection Report Form 3560-3 for any inspections as EPA told the State that Forms 001 and 3560-3 contain basically the same information, so completion of the latter is not necessary. Copies of inspection reports have not been sent to EPA since 1992 when inspection data started being entered into WDS. The APM also states that copies of inspection reports will be sent to the facilities inspected, whereas RWQCB 4 only sends a report to facilities if violations are noted during the inspection. As of the time of this review, RWQCB 4 had not sent copies of inspection reports to the SWRCB for approximately two years.

Quarterly, the WDS coordinator prepares a report for each inspector which compares the inspection schedule in WDS with accomplishments. Copies of the quarterly reports are sent to the seniors and the section chief. This serves as a reminder to staff regarding remaining workload and also as a reminder to submit Forms 001 for data entry.

Inspections–EPA Conclusions

RWQCB 4 is doing a good job in conducting NPDES inspections. During inspection years (IYs) 1995 through 1997, 126 of 132 scheduled inspections of major facilities were conducted, for a 95 percent completion rate. This is very close to the regulatory requirement of 100 percent coverage [40 CFR 123.26(e)(5)]. Of these 126 inspections, 80 percent were sampling inspections which significantly exceeds the minimum requirement. One inspection was missed during IY 1995, none were missed during IY 1996, and five were missed during IY 1997. Of the latter IY, four were missed because of increased emphasis on permitting in that particular watershed, and the other facility was inspected the first month in the following inspection year. However, even though it was known that the inspections would not be conducted, no information regarding commitment changes was provided to the SWRCB and, therefore, to EPA. This eliminated EPA's opportunity to increase the coverage to 100 percent if it chose to do so, by conducting the inspections with EPA staff or contractors.

With regard to minor facilities, RWQCB 4 inspected over 97 percent of the facilities during the five-year period IY 1993 through IY 1997, which meets the EPA policy requirement of inspecting minor facilities at least once during the five year life of each permit.

Although detailed inspection reports are not routinely prepared, a review of selected field notes indicates that staff are knowledgeable about inspection techniques and the inspections are thorough. On-the-job inspector training is supplemented by formal training, such as training by sampler manufacturers, when available. Having ready access to a State lab for sample containers and cleaned samplers is a considerable asset in lessening the workload involved in sampling inspections.

Inspection reports of major facilities are not being sent to EPA as required by the MOA. For EPA to maintain its oversight role, general knowledge is needed of on-going violations and of the State and permittee actions regarding those violations. Thus, receiving copies of inspection reports which note violations is important. Also important is receiving copies of report transmittal letters which detail the action needed by the permittee as well as copies of the responses from the permittees. For inspections where no violations were noted, there is no additional information about the inspection other than what is contained in Form 001 which is entered into WDS. As this WDS data is subsequently transferred to PCS where it is available to EPA, EPA considers the inspection report to have been "sent" to EPA, and the requirement of the MOA is satisfied. This issue is of State-wide concern, as discussed in Appendix A, State-wide issues.

EPA has no requirement that reports for inspections with no violations observed should be sent to the permittee. While all EPA guidance indicates that inspection reports are normally sent to the permittees, RWQCB 4 may choose to do otherwise. The primary purpose served by sending such a report, other than courtesy, is to provide the permittee with an official record that an inspection was conducted and that no violations were found. Balanced against this would be the time involved for the additional replies and whether sufficient information may have been provided to the permittee by the inspector during the closeout interview. Regardless, inspectors should be careful to complete the portion of Form 001 which indicates which compliance areas were observed/evaluated during the inspection, and note which areas were not evaluated. This minimizes the possibility of a permittee claiming, should violations be found later, that the inspector had observed and determined facility compliance with all compliance areas.

Inspectors' use of loose-leaf paper rather than bound notebooks to record field observations is of some concern, but more troubling is that some inspectors do not keep field notes of inspections conducted where no violations are found. 40 CFR 123.26 requires that "Investigatory inspections shall be conducted, samples shall be taken and other information shall be gathered in a manner that will produce evidence admissible in an enforcement proceeding or in court". Reasonable implementation of this regulation calls for records retention for at least three years. The field notes will support findings in an inspection report as well as oral testimony because these records are the actual record of the inspection and contemporaneous recordings of observations. The notes also serve as the primary evidence in any action that may be taken. For example, a permittee may request inspector's notes of inspection findings to defend itself against an enforcement action. This issue is of State-wide concern, as discussed in Appendix A, State-wide issues. Common practice for inspectors is to keep their notebooks for their entire career. Using bound notebooks with numbered pages, with care taken so that all pages are accounted for (including, where appropriate, marking pages or portions of pages "deliberately left blank"), is the "gold standard" of note taking for field inspectors, and is strongly encouraged.

EPA CONCLUSIONS SUMMARY--COMPLIANCE

Strengths

1. RWQCB 4 has an excellent review and tracking program to assess compliance of its 44 major and 260 minor NPDES permittees. Inspection coverage of both major and minor permits is good and generally meets EPA requirements. Inspections of majors almost always includes sampling which exceeds EPA's requirements. The system developed for scheduling and reporting inspections provides a good tool for tracking accomplishments/work to be done.
2. The tracking, follow-up, and review process of SMRs is excellent, and staff is very knowledgeable of the compliance status of the permittees. The files are complete and easy to access, even though being kept at individual work stations. RWQCB 4's quarterly violation summary report is an excellent means for keeping management up-to-date on compliance, and making it available on the Internet is an excellent way to convey compliance information to the public.
3. The new ERIS/SWIM data system will be a great step forward in data management for the State of California. RWQCB 4 is to be commended for its leadership in data management in support of the State-wide program.
4. EPA's review of selected field notes indicate that staff are knowledgeable about inspection techniques and the inspections are thorough.

Required Changes--State-wide Issues

1. RWQCB 4's inspection coverage is generally adequate. However, State-wide, field presence/compliance assessment at NPDES major and minor facilities is not adequate. Issues include use of appropriate sampling methods, adequacy of field inspection notes, and depth of on-site review. Notes taken during inspections must be retained by inspectors at all the RWQCBs for at least three years, as required by 40 CFR 123.26.
2. Copies of inspection reports of major permittees, as well as copies of responses from permittees about violation follow-up, must be sent by all RWQCBs to EPA, in accordance with the Memorandum of Agreement (MOA) between EPA and the State.
3. The QNCRs submitted by the RWQCBs need improvement in quality and content. RWQCB 4 must report all appropriate violations on the QNCR, including violations of non-monthly averages, in accordance with 40 CFR 123.45 and EPA guidance.

Required Changes--RWQCB 4

1. RWQCB 4 needs to implement a solution to the BKK Corporation technical noncompliance problem, per 40 CFR 122.45(c) and 40 CFR 123.45. Since the review, EPA notes that RWQCB 4 rescinded BKK's permit and enrolled it under the General Industrial Storm Water Permit.

2. RWQCB 4 needs to implement proper compliance evaluation of report submittals, as required by 40 CFR 123.45(a)(2)(ii)(D). At a minimum, the language in all future permits needs to be reflective of the way reports will be tracked for compliance. RWQCB 4 is now implementing practices to ensure that permittees are notified of their respective "date certain" report due dates, and the ERIS/SWIM system is now being used to track report receipt.
3. The SWRCB needs to be notified by RWQCB 4 of changes in inspection schedules if they will result in less than 100 percent inspection coverage of majors for the inspection year (July 1 through June 30), in accordance with the MOA, to afford EPA the opportunity to conduct remaining inspections if so desired.

STORM WATER COMPLIANCE AND ENFORCEMENT

EPA Storm Water Evaluation Procedures

EPA's storm water compliance review consisted of two parts: (1) interviews and discussions with RWQCB 4 staff and management to discuss activities, priorities, resources issues, and other challenges, and (2) a review of selected files at RWQCB 4's offices. In particular, the Los Angeles County and Ventura County MS4 program files were spot checked for purposes of completeness, and for RWQCB 4 action on permittee submittals.

Storm Water Staffing

RWQCB 4 staff are responsible for tracking dischargers' compliance with the following storm water permits: two municipal storm water program permits covering the Counties of Los Angeles (with 86 co-permittees, including Los Angeles County) and Ventura (with 11 co-permittees, including Ventura County), both issued by RWQCB 4, and two General Permits, issued by the SWRCB, one each regulating storm water discharges from industrial and construction sites. Regarding these latter two permits, there are approximately 2,600 and 600 facilities/sites, respectively, that are subject to these two permits within RWQCB 4's jurisdiction.

As of the time of this review, RWQCB 4 received five person years from the SWRCB to implement the storm water program, including oversight of municipal, industrial, and construction permit compliance. Storm water compliance resources are distributed within each of the WRS's watershed units, as well as in the Standards and Enforcement Unit. At the time of this review, 1.5 person years were allocated within the Los Angeles Coastal Unit for oversight of the Los Angeles County MS4 program alone. This allocation includes an estimated 0.75 person years expended in support of on-going litigation with the City of Long Beach, which filed suit against RWQCB 4 in connection with issuance of the Los Angeles County MS4 permit. RWQCB 4 estimates that they require significantly more resources to properly implement their responsibilities in regard to the storm water program, and have submitted requests to the

SWRCB for the additional resources. Storm water staffing levels is a State-wide concern, as discussed in Appendix A, State-wide issues.

Storm Water Compliance Activities

WRS compliance activities in the municipal storm water program include review, comment, and approval, as appropriate, of submittals made pursuant to permit requirements. WRS staff also spend a significant portion of their time involved in periodic outreach and management meetings with co-permittees and other regulated entities (industrial facilities). In 1997-98, the WRS committed to evaluate 10 co-permittees program submittals for compliance with the Los Angeles MS4 permit conditions[4]. However, there was a significant lack of overall progress in implementing the terms and conditions of this storm water permit (as re-issued in July 1996) because the WRS had not reviewed and approved the model program components submitted by Los Angeles County, the lead permittee. The MS4 permit was structured such that a number of storm water management program components (e.g., illicit connections/illegal discharges, industrial/commercial best management practices (BMPs), etc.) are to be proposed by the County as "model" programs. Only after Executive Officer/Board approval of individual model programs are the other co-permittee cities required to adopt the model program within their own jurisdiction. As of the time of the EPA review, five major model programs submitted by the County had not yet been reviewed and/or approved by the WRS, thus hindering overall progress towards achieving permit objectives.

Compliance activities in the industrial storm water program include annual report tracking, review, and referral for enforcement (generally informal) for annual report non-submittal. Staff also responds to telephone and written inquiries from the public, and inspects sites to verify Notices of Termination and Notices on Non-Applicability, to investigate possible non-filers or to determine permit compliance status of permittee facilities. According to RWQCB 4's records, during State FY 1996/1997 (the last complete year that such records were available), WRS staff accomplished, among other things, review of 671 annual reports, issuance of 676 letters for non-submittal of annual reports, inspection of 50 industrial sites, processing of 154 Notices of Termination, and response to 1,113 phone inquiries.

Compliance activities in the construction storm water program largely consist of conducting inspections of construction sites and engaging in occasional outreach activities. For State FY 1997/1998, the Ventura Coastal Watershed Unit established and accomplished the goal of conducting pre-rainy season inspections at each active site within the watershed (approximately 40). Staff also performed follow-up inspections during the rainy season at approximately 80 percent of the active sites.

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4 Co-permittees are required to comply with the requirements of the last (1990) permit until such time as individual elements under the re-issued (1996) permit go into effect.

Storm Water Compliance--EPA Conclusions

RWQCB 4 storm water program staff are both very knowledgeable and dedicated. They accomplish a great deal in spite of a resource base that is both severely underbudgeted and diverted from compliance activities due to the litigation brought by the City of Long Beach. Oversight of the Los Angeles County MS4 program has been adversely affected by this diversion of staff. Oversight of the Ventura County MS4 program appears to be adequate. Staff working in the Ventura Coastal Unit admirably conducted a significant number of inspections of construction sites prior to and during the past rainy season.

Going into the review, EPA was particularly concerned about the lack of compliance oversight of the Los Angeles County MS4 program. Overall progress under the terms and conditions of the storm water permit had been severely hindered due to the inability of RWQCB 4 to review/approve model program components submitted by the County as the lead permittee. Since the NPDES permit is structured such that compliance with permit requirements is dependant upon this RWQCB 4 action, EPA believed that it was important that RWQCB 4 find the means to provide a prompt and thorough review of model program components as submitted. Since the time of the review, EPA was able to assist by providing contractor resources to RWQCB 4 to help in the review of some of the outstanding model program component submittals. Also, to its credit, RWQCB 4 staff have conducted audits of certain individual co-permittee city storm water management programs.

Within the industrial and construction program areas, RWQCB 4 needs to establish a greater field presence, both to provide an appropriate level of compliance oversight of permitted facilities and sites, and to identify entities that are operating without having filed for appropriate permit coverage. This latter point is important both as an equity issue and also as a possible source of future budgetary resources for RWQCB 4's storm water staff, as a portion of permit filing fees are returned to the RWQCB from the SWRCB in the form of storm water program person years. EPA remains concerned about the lack of resources for implementation of the storm water program State-wide, as discussed in Appendix A, State-wide issues.

Finally, RWQCB 4's storm water files are generally both voluminous and very well organized. At the time of this review, the inspections tracking system was limited to gross reporting of statistics, such as the total number of inspections of industrial facilities in a given time period. However, RWQCB 4 has since developed a tracking system to account for individual inspections and dates which was activated on September 1, 1998.

See also the conclusions summaries for permitting and enforcement for additional information on the RWQCB 4 storm water program.

EPA CONCLUSIONS SUMMARY--STORM WATER

Strengths

1. RWQCB 4 is fortunate to have such knowledgeable and dedicated staff working in its storm water program. Staff is accomplishing an admirable level of work given its severely limited resource base.
2. The Ventura County municipal program is well implemented, with an adequate level of oversight by RWQCB 4 staff; RWQCB 4 nominated this permit for an EPA national award.
3. RWQCB 4 staff inspected 100 percent of active construction sites within the Ventura watershed at least once prior to the onset of the 1997-98 rainy season, and re-inspected approximately 80 percent during the rainy season. RWQCB 4 is to be commended for this pre/post rainy season inspection protocol.
4. Los Angeles Coastal watershed unit staff have started to perform in-depth audits of individual co-permittees under the Los Angeles County MS4 program.
5. During the review, the need was identified for a better inspection tracking system, to account for individual inspections and dates rather than just total number of inspections. RWQCB 4 is to be commended for developing and implementing such a tracking system in September 1998.
6. The storm water program's files are voluminous, but well organized.

Required Changes--State-wide Issues

1. A greater inspection presence in the storm water program for both industrial and construction sites needs to be established by all RWQCBs, including RWQCB 4. Activities conducted by RWQCB 4 during 1997-98 in the Ventura watershed construction program are a good model for the other RWQCB 4 watershed units to strive for.
2. Within the industrial program, RWQCB 4 needs to continue and more actively seek out non-filing facilities. EPA recognizes that increased efforts are underway.

Required Changes--RWQCB 4

1. RWQCB 4 must review and comment on the Los Angeles County MS4 permit model program submittals. Without timely RWQCB 4 action, implementation of this MS4 permit is not possible.

PRETREATMENT

EPA Pretreatment Evaluation Procedures

The review conducted at EPA of FY 1995 through FY 1998 records included Discharge Monitoring Reports (DMRs) from all RWQCB 4 approved pretreatment programs. Field activities at RWQCB 4 included review of selected records, including RWQCB 4 and SWRCB quarterly activity reports, RWQCB 4's Watershed Management Initiative (WMI) information, Pretreatment Compliance Inspection Reports (PCIs) and audits, pretreatment-related records for nine of the 11 pretreatment programs as indicated in the attached Table 4, and an interview with the Watershed Regulatory Supervisor.

Pretreatment Staffing

RWQCB 4 is responsible for the regulatory oversight of 11 approved pretreatment programs as listed in the attached Table 4. Pretreatment program oversight is assigned to six WRS staff members according to the watershed and associated permittees for which they are responsible. Each staff member is responsible for overall oversight of one to three pretreatment programs. RWQCB 4's WMI chapter identifies pretreatment inspections and audits as a Category I core activity.

In RWQCB 4, and throughout California, nearly all industrial wastewaters discharge into POTWs under the regulation of pretreatment programs. The 11 pretreatment programs in RWQCB 4 regulate over 50 percent of all significant industrial users (IUs) in California, including mostly large and old facilities, most of which must comply with complicated Federal standards. These programs account for a significant component of the toxics control accomplished in California under the Clean Water Act.

The complexity of the pretreatment program and its importance to RWQCB 4 requires in-depth experience and expertise. Implementation and oversight of the pretreatment program requires a working knowledge of the Federal pretreatment implementation regulations as well as the nearly 30 categories of Federally-regulated industries. For each regulated industry, an understanding is required of Federal rules, development documents which support the rules, industrial processes and methods, and technologies for wastewater treatment and handling. The SWRCB, RWQCB 4, or some combination of RWQCBs must develop the necessary pretreatment program expertise described above, as well as in industrial user permitting and oversight, in order to fulfill the requirements of the APM and to effectively implement the pretreatment program. This issue is of State-wide concern, as discussed in Appendix A.

Pretreatment Compliance Tracking

Quarterly and annual pretreatment reports submitted by the permittees are not consistently tracked (receipt) or reviewed by RWQCB 4. Of the nine pretreatment programs reviewed by EPA, only two pretreatment programs' annual and quarterly reports were tracked and reviewed, as indicated by the inclusion of a *Self-Monitoring Program Summary Review Sheet* in the files.

RWQCB 4's report tracking and review process requires change in order to comply with the SWRCB's Pretreatment Program Administrative Procedures Manual (APM). The APM calls for review of quarterly and annual reports, especially for submittal of Water Enforcement National Data Base (WENDB) data elements (see discussion below) and in preparation for PCIs and audits. Consistent tracking and review will ensure report receipt as required by the NPDES permit, as well as indicate Industrial User (IU) compliance status and adequate/inadequate program response and implementation. The *Self-Monitoring Program Summary Review Sheet* is a comprehensive log which is used to record program reviews, status, and activities, and is recommended for use by all RWQCB 4 pretreatment program oversight staff.

Pretreatment PCIs and Audits

The schedule for conducting PCIs and audits is included each year in California's annual CWA Section 106 grant workplan. The WMI documents set forth the following standard for pretreatment audits and inspections: all pretreatment facilities will be audited once during a 5-year period, and for years when an audit is not conducted, a PCI will be conducted. This is compatible with EPA guidance. During FY 1994/1995, four PCIs/audits were scheduled and conducted, but only two reports were issued; during FY 1995/1996, eight PCIs/audits were scheduled, but only two were conducted and had reports issued; during FY 1996/1997, eight PCIs/audits were scheduled, but only three were conducted and had reports issued. RWQCB 4 did not formally revise its PCI/audit schedule, which is required on a quarterly basis by the CWA Section 106 workplan, so that the SWRCB could notify EPA when PCI/audit commitments were not going to be met.

EPA reviewed five PCI/audit reports. This review indicated that the PCI/audits were thorough, including findings from the last PCI/audit, and review and evaluation of legal authority, local limits, IU characterization, control mechanism, compliance monitoring, enforcement program, and program resources. EPA's file review indicated that in only three cases were PCI/audit checklists used to conduct the inspections. While checklist use is not required by the APM, regular use will ensure ongoing consistency and thoroughness in the manner in which PCI/audits are conducted.

PCI/audit reports are complete, including findings, recommendations, and requirements. Of the seven reports issued by RWQCB 4, PCI reports were issued approximately three months after each PCI was conducted; audit reports were issued approximately four months after each audit was conducted, with the exception of one which was issued three years after the audit. This delay was attributed to RWQCB 4's backlogged permit reissuance activities. The APM and 106 workplan require that PCI reports be completed within 60 days from the inspection, and that audit reports be completed within 90 days from the audit. Three reports were not issued for two audits and one PCI conducted by RWQCB 4 during FY 1994/1995. However, they were reported to EPA as conducted/complete. According to EPA policy, a PCI or audit is not considered "complete" or "conducted" unless a report is issued.

The PCI/audit reports were transmitted to the pretreatment program permittees by letters signed by the watershed unit chiefs. In most cases, a 45-day response from the permittee was requested. There was some follow-up to some reports in the form of correspondence, submittals, and further RWQCB 4 review and evaluation, but this was not the case for all reports. It is also noted that RWQCB 4 has not taken any pretreatment-related enforcement actions (formal or informal) during the three-year review period, even though PCI/audit reports included findings along with "requirements" which the pretreatment permittee needed to implement in order to be in full compliance with pretreatment regulations and requirements. The APM requires that in the event of non-compliance by a discharger, the RWQCB should issued a Notice of Violation (NOV, an informal action) and conduct follow-up investigations.

Copies of PCI reports, audit reports, and completed WENDB forms (for entry into PCS) for PCIs, audits, and annual report reviews are not consistently submitted to EPA in accordance with the 106 workplan.

RWQCB 4 maintains formal files for approximately half of its approved pretreatment program permittees. Of these, most were in good order and current, but in some cases PCI and audit reports were missing and had to be located. Some files included the *Self-Monitoring Program Summary Review Sheet* as described above. RWQCB 4 must establish and maintain complete and current public files for each NPDES permittee's approved pretreatment program.

Pretreatment PCIs and Audits--EPA Conclusions

PCI and Audit Scheduling

RWQCB 4 does not formally revise its PCI/audit schedule on a quarterly basis, as required by the CWA Section 106 workplan, so that the SWRCB can notify EPA when PCI/audit commitments cannot be met. RWQCB 4 needs to establish procedures to ensure that audits and PCIs are scheduled in accordance with WMI principles and that the EPA/SWRCB is notified quarterly of schedule revisions and shortfalls.

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PCIs, Audits, Reports, and Follow-up

PCIs, audits, and their reports appear to be complete and include findings, requirements, and recommendations. Most PCI and audit reports are issued three to four months after the inspection, instead of the required two and three month interval. Three reports were not issued for two audits and one PCI conducted by RWQCB 4 during FY 1994/1995, though they were reported to EPA as conducted/complete. PCI and audit reports are transmitted by letter. RWQCB 4 needs to ensure that all PCI and audit reports are issued and timely, that adequate and timely PCI and audit follow-up investigation and enforcement is conducted, and that PCI reports, audit reports, and WENDB data elements are submitted to EPA. Lack of pretreatment enforcement is of State-wide concern, as discussed in Appendix A, State-wide issues.

Pretreatment Files

RWQCB 4 maintains formal files for approximately half of its permittees with approved pretreatment programs for which it has oversight responsibility. Of these, most were in good order and current, though RWQCB 4 needs to establish and maintain complete and current public files for all of its approved pretreatment programs, either in the permittee's facility file or in a separate pretreatment file. The *Self-Monitoring Program Summary Review Sheet* should be completed and included in all pretreatment files.

Pretreatment Program Approvals and Modifications

Program approvals and modifications generally have a lower priority than other RWQCB 4 NPDES activities, and thus have lagged in recent years. No formal approvals/modifications, including approvals of local limits, had been done during the three-year time period covered by this review. Thus, there was a backlog of actions needed (approval of local limits for the City of Los Angeles, and Burbank programs, and approval of a full-level program for Ventura Waterworks District No.1--Moorpark).

PRETREATMENT CONCLUSIONS SUMMARY

Strengths

1. PCIs, audits, and their reports are complete, including appropriate findings, requirements, and recommendations.
2. The *Self-Monitoring Program Summary Review Sheet* is a comprehensive log which is used by some staff to record program reviews, status, and activities. This *Review Sheet* is excellent and recommended for use by all staff.

Required Changes--State-wide Issues

1. The SWRCB, RWQCB 4, or some combination of RWQCBs must develop the necessary program expertise in industrial wastewater treatment, the Federal categorical standards and pretreatment regulations, and industrial user permitting and oversight, in order to fulfill the requirements of the APM and to effectively implement the pretreatment program.
2. State-wide, pretreatment priority and work commitments need to be addressed. RWQCB 4 needs to establish procedures to ensure that audits and PCIs are scheduled in accordance with WMI principles, and that EPA and the SWRCB are notified quarterly of schedule revisions and shortfalls, as required by the annual 106 workplan.
3. Lack of pretreatment enforcement State-wide is of concern, especially where water quality problems exist due to pretreatment noncompliance. RWQCB 4 must ensure that pretreatment enforcement activities are conducted, as described above, and are timely.

Required Changes--RWQCB 4

1. RWQCB 4 needs to review quarterly and annual pretreatment reports, in preparation for PCIs and audits, and for submittal of WENDB data elements as required by the MOA.
2. RWQCB 4 needs to ensure that all PCI and audit reports are issued and timely; that adequate and timely PCI and audit follow-up investigation is conducted;.and that PCI reports, audit reports, and WENDB data elements are submitted to EPA, in accordance with the MOA and the APM.
3. RWQCB 4 needs to complete the review of the Burbank local limits and formally approve the limits, as modified if necessary. In response to EPA's now completed formal reviews of the City of Los Angeles local limits, RWQCB 4 needs to approve these local limits. Also, RWQCB 4 needs to complete the pretreatment program review and approval process for the Ventura Waterworks District No. 1 (Moorpark facility).
4. RWQCB 4 needs to ensure that all records for all of its approved pretreatment programs are filed as required by the MOA.

ENFORCEMENT

EPA Evaluation Procedures

EPA's NPDES enforcement review consisted of three parts:

1. A review of the Memorandum of Agreement (MOA), applicable portions of the SWRCB's Administrative Procedures Manual [Water Quality Enforcement Policy (Resolution No. 96-030, as amended by Resolution 97-085) and "Guidance to Implement the Water Quality Enforcement Policy"], the Regional Board's Enforcement Strategy

(Order No. 97-005) and implementing guidance, and applicable portions of recent CWA Section 106 Workplans.
2. A review of case files on a subset of recent enforcement actions to verify that appropriate procedures are being adhered to.
3. A review of a selection of other NPDES permitted facility files based upon a screening of discharger self monitoring reports (SMRs) to determine how the WRS responds to violations.

Enforcement Procedures

RWQCB 4's enforcement process to ensure discharger compliance is provided in the SWRCB's Administrative Procedures Manual (APM), Water Quality, Chapter 6, which consists of the SWRCB's Water Quality Enforcement Policy (Resolution No. 96-030, as amended by Resolution No. 97-085) and "Guidance to Implement the Water Quality Enforcement Policy," dated April 1996 and amended September 1997. In March 1997, RWQCB 4 adopted Order No. 97-005, which formally adopted the SWRCB enforcement policy as its own.

According to the SWRCB's "Guidance to Implement the Water Quality Enforcement Policy," enforcement cases may be initiated from any of the following means: (1) review of SMRs, (2) compliance inspections, (3) direct facility reporting, (4) complaints, (5) file review, and/or (6) interagency notifications.

The Water Quality Enforcement Policy sets forth specific types of violations that are to be considered for possible enforcement action by the RWQCBs:

1. major NPDES facilities in Significant Non-Compliance (SNC) with Technical Review Criteria (TRC) per 40 CFR 123.45;
2. major NPDES facilities in SNC of monthly average effluent limitations in any four months in a six month period per 40 CFR 123.45;
3. any incidence of acute toxicity which violates Waste Discharge Requirements (WDRs), Basin Plans, or other provisions of law;
4. violations of narrative toxicity standards contained in WDRs or Basin Plans due to chronic toxicity;
5. violations of prohibitions contained in WDRs, Basin Plans, or enforcement orders;
6. spills (unauthorized discharges);
7. failure to submit reports;
8. violations of compliance schedule milestones;
9. failure of a POTW to implement its approved pretreatment program, and/or
10. failure to comply with terms and conditions of a storm water permit.

In taking an enforcement action, the SWRCB's Guidance to Implement the Water Quality Enforcement Policy specifies that the following types of actions are available:

1. Informal Enforcement
   - Telephone contact/follow-up letter
   - Notice of Non-Compliance Letter
2. Time Schedule Orders (TSO)
3. Notices to Comply
4. Cease and Desist Order (CDO)
5. Cleanup & Abatement Orders (CAO)
6. Modification or Rescission of WDR
7. Administrative Civil Liability (ACL)
8. Referrals for Judicial Action
   - Attorney General
   - District Attorney

In establishing its own enforcement strategy to implement the requirements of Resolution 96-030, RWQCB 4 has developed what it refers to as a "progressive enforcement policy" in which enforcement actions are generally escalated according to a discharger's response to a previous RWQCB 4 action. RWQCB 4 reserves its ability to bypass lower threshold actions if the nature of a particular set of violations so warrants. Under its progressive enforcement policy, RWQCB 4 has identified the following levels of enforcement:

Level 1:	warning letters (Notices of Non-Compliance letters), issued by the section/unit chief;
Level 2:	formal Notice of Violation, issued by the EO;
Level 3:	administrative enforcement actions, issued by the EO (CAOs) or pursuant to Board Order;
Level 4:	referrals for judicial enforcement made pursuant to Board Order

Enforcement matters had been handled within each of the respective programmatic or watershed units. However, in August 1997, the Executive Officer (EO) established a new Standards and Enforcement Unit (SEU) within the Surface Water Division, which, among other things, is responsible for the development and pursuit of all of the formal enforcement actions that are recommended to the EO or to RWQCB 4's Board for issuance. Originally a team of two plus a supervisor, the SEU had six staff at the time of this review, including a supervisor and one staff person who is dedicated to matters relating to the industrial storm water program. "Informal" enforcement--the drafting of violation letters and Notices of Violation--is still largely left to the individual WRS project officer for a given facility.

Enforcement Action Case Studies

Enforcement case files of six major NPDES permitted facilities were reviewed by EPA, in accordance with the NPDES program review checklists developed for this review and the APM. The files were selected from among the 18 actions forwarded to EPA in May 1998, and were selected so as to review one each of several different types of formal actions. EPA also reviewed facility files for three NPDES major facilities, for which enforcement had not been taken but which appeared to merit consideration due to the nature of violations reported in SMRs. The results are summarized below.

Order 95-020, Administrative Civil Liability Complaint (ACLC), Village Properties Co.

RWQCB 4 issued an ACLC on April 21, 1995, for violations of the California General Construction Activities Storm Water NPDES Permit (NPDES Permit No. CAS000002). Specifically, the ACLC alleged failure to develop and implement a Storm Water Pollution Prevention Plan (SWPPP), failure to develop and implement a monitoring program, and discharge in a manner which caused, or threatened to cause, a condition of pollution, contamination, or nuisance on at least 19 days. The ACLC cited a total maximum civil liability of $17,824,000, and recommended that RWQCB 4's Board impose an administrative civil liability in the amount of $226,200, with $26,200 ($15,000 penalty plus $11,200 staff costs) to be made due and payable, and the remaining $200,000 to be suspended, conditioned upon the discharger's compliance with the terms and conditions of the General Permit. The ACLC estimated an economic benefit of non-compliance (cost savings) in excess of $105,000, although the recommended cash penalty of $15,000 would not recover it. Village Properties (Baldwin Co.) filed for bankruptcy protection sometime after issuance of the ACLC. In subsequent discussions, RWQCB 4 agreed to settle for $35,000. There was nothing in the files dated later than February 1996 which indicated whether or not the penalty was paid. Discussions with RWQCB 4 and SWRCB staff indicated that a decision was made to not pursue the penalty through the bankruptcy process.

Order No. 95-115, Cease and Desist Order, Ojai Valley Sanitary District

RWQCB 4's Board adopted this CDO on August 21, 1995. The purpose of the Order was to extend the final date for compliance with effluent limits from July 1, 1996, to January 1, 1998. The discharger had been under a CDO establishing a final compliance date since May 21, 1990 (Order No. 90-063). The original July 1, 1996, date was the result of a previous CDO (Order No. 90-063, amended in 1992 to extend the original compliance date from July 1993 to July 1996). Order No. 95-115 also required compliance with interim milestone dates. A review of the file indicated that all interim milestone dates were complied with as reported by the discharger, and that final compliance was achieved with dedication of a new treatment facility in October 1997. When RWQCB 4 adopted the renewal order (Order No. 96-04) for Ojai Valley, that Order had a provision rescinding the CDO Order No. 90-063 which had been amended by Orders No. 92-093 and No. 95-115.

Order No. 97-136, Time Schedule Order (TSO), Las Virgenes Municipal Water District (MWD), Tapia Water Reclamation Facility (WRF)

This TSO was issued at the time of the reissuance of the facility's NPDES Permit (No. CA0056014) on November 3, 1997, because the facility was unable to immediately comply with new effluent limits established for nitrate (as N) or dichlorobromomethane. The TSO set interim effluent limits for these constituents, and also established a time schedule that required the discharger to investigate measures to reduce concentrations of these two constituents in its effluent. The TSO also set a final compliance date of October 10, 2002, for compliance with the permitted effluent limit for nitrate. However, there was no final date for compliance with the effluent limit established for dichlorobromomethane, instead stating that the interim limit "is in effect until such time as the Discharger has completed the study required in this Order and has implemented the necessary measures to reduce the pollutant in the discharge, and the Executive Order (sic) has determined that the constituent limit is achievable." Las Virgenes MWD has complied with milestone dates that had passed as of the time of the EPA review. WRS committed to the discharger that it would review the December 1997 workplans by the end of January 1998; there was no record in the file that the WRS review had been done.

Order No. 98-016, Cleanup and Abatement Order (CAO), City of Thousand Oaks, Unit W Sewer Interceptor

RWQCB 4's EO issued this CAO on February 9, 1998, to address a February 3, 1998 washout of the City's Unit W sewer interceptor during a storm event and the resulting discharge of raw sewage into the South Fork of Arroyo Conejo. The Order required an assessment of the extent of contamination resulting from the spill; implementation of a cleanup and abatement program; submittal of a written report on the February 3, 1998 event; submittal of a long term corrective action plan; and monthly status reports. According to the EO's Report of April 13, 1998 (prepared for the RWQCB's Board meeting), the discharger had complied with all of the requirements of the CAO to that date. RWQCB 4 also issued an ACLC seeking payment of penalties for the February 3, 1998 event. (EPA is aware of the results of the Board hearing on this ACLC, which occurred after this review was completed.)

City of Los Angeles, Tillman Water Reclamation Plant (WRP)

This facility's file was selected for review based upon a review of Discharge Monitoring Reports (DMRs) at EPA's office that indicated a recent history of violations of the chronic toxicity limit. The facility violated the limit for chronic toxicity during the following months: January through March, May through July, September, and November 1997; and January and March 1998. A review of this facility's files at RWQCB 4's offices revealed that the facility had acknowledged each monthly violation in submitting applicable DMRs. Further, the facility completed a toxicity identification evaluation and toxicity reduction evaluation (TIE/TRE) in February 1998, identifying "seasonal diazanon" as the likely causative agent. A review of staff reports dated 1998 to RWQCB 4's Board did not indicate that the Board had been kept informed of the continuing toxicity violations, but that is perhaps attributable to a clause in the facility's permit stating that if the discharger is implementing a TIE it shall not be considered in violation of the chronic toxicity effluent limit. The discharger requested an alternate, narrative effluent limit. The permit was re-issued in June 1998, and the chronic toxicity effluent limit was replaced with chronic toxicity "receiving water limits" for chronic toxicity, rather than effluent limits (see discussion in this report at NPDES Permitting, Other Permitting and Documentation Requirements). A review of the files also indicated several (approximately five instances during 1995 through 1997) violations of the effluent limit established for residual chlorine. There was no record that violations were reported by staff to RWQCB 4's Board in accordance with required procedures (the SWRCB's Water Quality Enforcement Policy (Resolution No. 96-030, as amended by Resolution No. 97-085). However, the WRS area engineer assigned to this facility was aware of the violations and stated that the facility was presently undergoing a rehabilitation of its chlorination/dechlorination control system, which is due to be completed in 1999.

Shell Oil Los Angeles Refinery/Carson Plant

This facility's file was also selected for review based upon a review of DMRs at EPA's office that indicated a recent history of violations of the chronic toxicity limit. In July 1997, the facility completed a Phase I TIE Report to address previously recurring toxicity in the bioassay test organism *Selanastrum*. The report identified the ionic nature of the discharge as the root cause of the observed toxicity, and recommended a change in test species to the Fathead minnow. However, the discharger reported violations of the toxicity limit in December 1997 and from January through April 1998 even with the change in test species. Additionally, the facility also reported violations of effluent limits for the following parameters: zinc (February 1998), silver (April 1998), and xylene and toluene (March 1998). There was no record that the violations were reported by staff to RWQCB 4's Board (only the toxicity violations were required to be reported per policy). The WRS staff assigned to this facility were familiar with the violations, and stated that the facility had ceased operating as a petroleum refinery, had changed to use as a bulk distribution plant, and thus now only discharged storm water, no longer having any process wastewater. The facility had, therefore, requested that its NPDES permit be terminated, and that it be placed under coverage of the California General Industrial Activities Storm Water NPDES Permit.

Texaco Refining/Marketing Inc. Los Angeles Plant

This facility's file was selected for review based upon a review of DMRs at EPA's office that indicated a recent history of violations of several effluent limits in 1997 and 1998. The facility had also been identified in a report by a local environmental group[5] as having had a significant number of spills (this assertion was not independently verified in the course of the EPA program review). A review of the facility file indicated that RWQCB 4 had in the past sent a number of informal and formal notices of violation (Levels 1 and 2) for the above-referenced effluent limit violations. Discussions with RWQCB 4 staff indicated that an enforcement action was being developed against this facility for the above-noted effluent limit violations, demonstrating a good example of RWQCB 4's progressive enforcement approach. However, the SEU indicated that they were not considering the facility's spills history in their assessment, and were unaware of the extent of this history, stating that this information had not been provided to

5 Omission Accomplished: The Lack of a Regional Water Board Enforcement Program, 1992-1997, Heal the Bay, January 1998.

them. Additionally, during the EPA site review, a draft renewal NPDES permit was mailed by the WRS without the knowledge of the SEU.

Enforcement--EPA Conclusions

EPA's review found that RWQCB 4 enforcement activities largely meet the requirements of the approved NPDES program. RWQCB 4 has adopted a "progressive enforcement approach" in implementing the SWRCB's Enforcement Policy, although not always followed in the past, in particular regarding the issuance of Level 1 and 2 non-compliance notices. At the time of this review, RWQCB 4 had taken a few formal enforcement actions in the past, and had collected some civil penalties. In August 1997, the EO created the Standards and Enforcement Unit, primarily responsible for initiating and undertaking formal enforcement actions. The number of formal actions has increased significantly since the creation of this unit. Since the time this review was conducted, EPA notes a significant improvement in both the number of enforcement actions taken and the penalties assessed by RWQCB 4, i.e., RWQCB 4 expects to issue 140 ACLs and assess over $1.5 million in fines this year. A summary of formal enforcement actions may be found in the attached Table 5. Also, enforcement files were generally complete and well organized, although most enforcement-related documentation is not being forwarded to EPA, as required by the MOA.

EPA's review found that the following RWQCB 4 enforcement activities require change to comply with applicable regulations and national policy.

Civil Penalties and Economic Benefit

During the review, EPA found that, while RWQCB 4 imposes and collects some penalties, it rarely included an assessment of, nor attempted to recover, the economic benefit of non-compliance in its penalty actions. The need for State enforcement actions to comply with State penalty policies including recovery of economic benefit through penalties is of State-wide concern, as discussed in Appendix A.

However, EPA notes that, since the time of the review, RWQCB 4 assessed a record $2.3 million penalty, which did recover economic benefit, against the City of Thousand Oaks for an 86 million gallon sewage spill. During 1999, RWQCB 4 has also initiated several ACL actions with complaints which appear to include assessment of the economic benefit of non-compliance. RWQCB 4 staff have also attended EPA's training class in BEN, the Agency's computer model for estimating economic benefit, thus providing them with the ability to determine, calculate, justify, and recover economic benefit in a consistent, fair, and equitable manner in accordance with the SWRCB's and RWQCB 4's enforcement and penalty policies and EPA national policy requirements.

EPA also noted during the review that RWQCB 4 has a history of supporting the use of supplemental environmental projects (SEPs) as a major part of its penalty actions. EPA also supports the use of SEPs, to the extent that they are consistent with EPA's "Interim Revised Supplemental Environmental Projects Policy," dated May 3, 1995. In general, EPA's policy states that SEPs may be used as a supplement to a cash penalty, which in turn "should recover, at a minimum, the economic benefit of non-compliance, plus 10 percent of the gravity component, or 25 percent of the gravity component only, whichever is greater" (Revised SEP Policy, Section E.1., page 11).

Also, although ACLCs adequately document the discharger's liability and the justification for the proposed penalty assessment, case files themselves do not appear to contain record of final payment of the ACLC penalty by the violator. This information must be retrieved from a SWRCB database. It would be advisable for the case officer to track the discharger's compliance with requirements to pay the penalty and, where appropriate, compliance with other requirements established as a condition of suspending a portion of the ACLC. These tracking activities should be documented in the files.

Violations Reporting

The SWRCB enforcement policy requires that specific types of violations be reported by RWQCB 4 to its Board. RWQCB 4 accomplishes this requirement with a quarterly "Report of Violations and Enforcement Actions." However, as noted in the case file reviews above, not all of the applicable violations are being brought to the attention of the Board as required. This may be attributable to the fact that the forwarding of violations to the compiler of the quarterly report has largely been left to individual staff's discretion. It is anticipated that this problem will be corrected with the implementation of the new automated database that is under development by RWQCB 4 (ERIS/SWIM), discussed in the Compliance Section of this report, from which the quarterly reports will be compiled in the future.

Final Compliance Dates

In the matter of the Las Virgenes Tapia WRP, one of the six case files reviewed by EPA, the adopted TSO did not contain a final compliance date for the effluent limit set for dichlorobromomethane. RWQCB 4 must ensure that all TSOs, CAOs, and CDOs require compliance with the applicable NPDES permit, establish a final compliance date, and set appropriate interim effluent limits and schedule milestones.

EPA CONCLUSIONS SUMMARY–ENFORCEMENT

Strengths

1. RWQCB 4's creation of and resource commitment to the new Standards and Enforcement Unit is commended, as is the significant improvement in both the number of enforcement actions taken and the penalties assessed by RWQCB 4 this year.
2. RWQCB 4 generally initiates formal enforcement actions (TSOs, CAOs, CDOs) to address NPDES violations when warranted, largely in conformance with SWRCB and RWQCB 4 policy.
3. RWQCB 4 imposes and collects some civil penalties through issuance of ACLCs. Since the time of this review, EPA notes that RWQCB 4 assessed a record $2.3 million penalty, which recovered economic benefit, against the City of Thousand Oaks for an 86 million gallon sewage spill.
4. RWQCB 4 has adopted a "progressive enforcement approach."
5. RWQCB 4 is currently emphasizing enforcement actions for violations due to raw sewage spills. This is consistent with EPA policy and the Federal government's Clean Water Action Plan.
6. RWQCB 4 has established a sound citizen complaint tracking system.
7. RWQCB 4 has established a binder that contains all enforcement actions available for public review.

Required Changes--State-wide Issues

1. Penalty actions at all RWQCBs need to comply with applicable State penalty policies, including recovery of economic benefit resulting from noncompliance. Economic benefit amounts must not be reduced or rescinded as an incentive toward achieving compliance or as an off-set for supplemental environmental projects.
2. All RWQCBs including RWQCB 4 need to place more emphasis on initiating formal enforcement actions in the storm water program. In particular, industries that are subject to, but that have not yet filed for coverage under, the General Industrial Storm Water Permit should be targeted. EPA acknowledges RWQCB 4's efforts which have resulted in an annual report submittal rate of 90 percent. For the remaining non-submitting facilities, RWQCB 4 has been implementing a progressive enforcement strategy that has been effective in bringing facilities into compliance. (See also the Storm Water section of this report.)

Required Changes--RWQCB 4

1. In one instance, an adopted Time Schedule Order did not contain a final compliance date. All formal enforcement actions taken by RWQCB 4 must require compliance by a date certain, and contain appropriate interim effluent limits and schedule milestone dates.
2. RWQCB 4 should ensure that all applicable violations are included in the "Report of Violations and Enforcement Actions" so that it complies with the SWRCB Enforcement Policy that all applicable violations are brought to the attention of the RWQCB 4's Board.
3. RWQCB 4 staff should ensure that they send to EPA copies of all relevant enforcement documents related to NPDES majors, including NOVs, formal actions (TSOs, CAOs, CDOs, and ACLCs), civil penalty settlement correspondence, civil penalty agreements, referrals for judicial action, and case closures.

OTHER NPDES PROGRAM SUGGESTIONS

During the conduct of this review of RWQCB 4's NPDES program, EPA identified a number of suggestions for improving RWQCB 4's administration of the program. These suggestions are based upon both EPA's experience in implementing the NPDES program and national program perspective. EPA believes these suggestions will result in a more effective program at RWQCB 4. Though not explicitly required by law, regulation, or national policy, EPA urges RWQCB 4 to implement the following:

Permits

1. RWQCB 4 should consider encouraging public agencies that develop general public education programs on reduction of discharge of toxic materials to include pesticides in their programs (i.e., pesticides should be specifically mentioned in Section V of the MS4 permit, in addition to Section IV). This would be expected to result in lessening the adverse impact on water quality stemming from routine household use of pesticides. (See page 9.)
2. In addition to procedures for evaluating exfiltration from the sanitary sewer, RWQCB 4 is encouraged to persuade permittees to include procedures for evaluating malfunctioning septic systems in their programs. (See page 10.)
3. The L. A. Board should include each of the annual reporting requirements, as listed in 40 CFR 122.42(c), in MS4 permits so that permittees will not mistakenly only respond to the specific requirements as set forth in the permit. (See page 10.)
4. The WRS should develop procedures to ensure consistent implementation of objectives/criteria with respect to beneficial use protection, reasonable potential determinations and effluent limit averaging period (see also EPA's *Technical Support*

Document, Chapter 3, Effluent Characterization, and Chapter 5, Permit Requirements). (See page 11.)

5. To protect beneficial uses, NPDES permits issued by RWQCB 4 should contain toxicity conditions which require sensitivity screening for acute toxicity using a vertebrate and an invertebrate test species. (See pages 11-12.)
6. To protect beneficial uses, NPDES permits issued by RWQCB 4 should contain toxicity conditions which require accelerated effluent monitoring for toxicity following the measurement of effluent toxicity at critical levels, as denoted by the exceedance of an effluent limit or benchmark where no effluent limit has been established. This approach is similar to existing permit conditions which specifically require accelerated monitoring when a monthly average effluent limit is exceeded. (See pages 14.)
7. To protect beneficial uses and to facilitate water quality based permitting, RWQCB 4 should develop an implementation procedure for the chronic mixing zone provision contained in Chapter 4 of the Basin Plan. (See page 13.)

Compliance

1. RWQCB 4 should consider establishing an automated system to track its follow-up on citizen complaints and spills. EPA notes that SWIMS, when implemented, will accommodate this tracking activity. (See page 21.)
2. RWQCB 4 should consider having all inspectors use bound notebooks for note-taking during inspections as contemporaneous, bound notes are of more value in civil and criminal enforcement proceedings. (See pages 23, 25.)

Pretreatment

1. All RWQCB 4 pretreatment program oversight staff should use the *Self-Monitoring Program Summary Review Sheet*. (See pages 32, 33.)

Enforcement

1. The Watershed Units that are responsible for the day-to-day oversight of regulated facilities and the new Enforcement Unit should develop and implement procedures to further improve on-going communication. This will ensure that a facility's total compliance history is considered when developing enforcement cases, and will also ensure that any enforcement issuance strategies are not hindered by lack of other information regarding a facility. As discussed above, in the context of the pending case against Texaco, all compliance information is relevant and needs to be considered in the development of an enforcement action. (See page 40-41.)

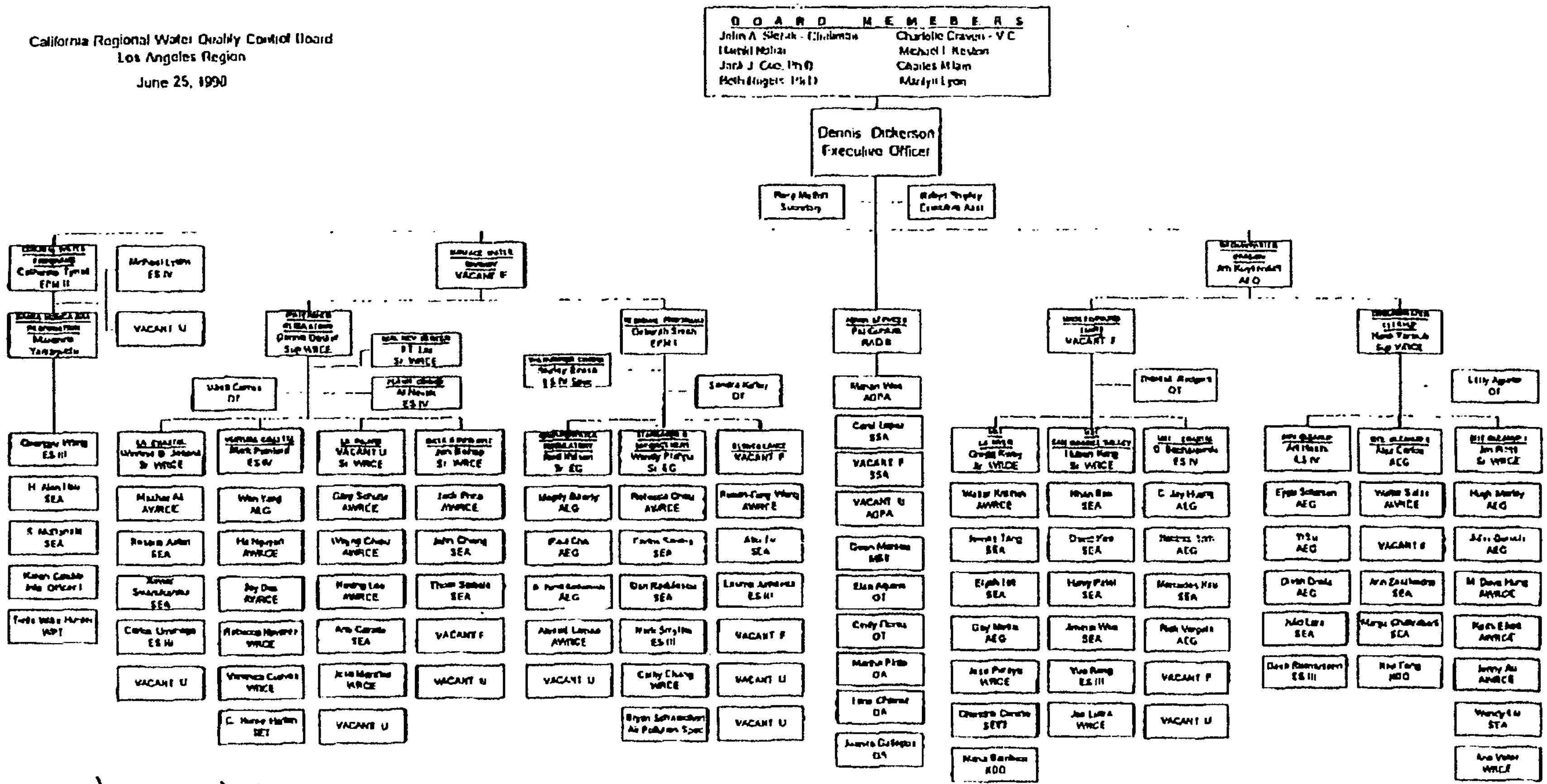
Attachment–Table 1
CALIFORNIA RWQCB AND BOARD AUTHORITIES

RWQCB	APPOINTED 9-MEMBER BOARDS
Preparation of NPDES related permits for Board adoption, modification, or rescission	Adoption, modification, or rescission of NPDES related permits
Issuance of Notice of Violations (NOVs), Notice to Comply (NOC) and Cleanup and Abatement Orders (CAOs)	Adoption, modification, or rescission of TSOs, CDOs and referrals to the Attorney General or District Attorney
Preparation of Time Schedule Orders (TSOs), Cease and Desist Orders (CDOs) and recommendations for referrals to the Attorney General or District Attorney for Board approval, modification, or rescission	
Issuance of Administrative Civil Liability (ACL) Complaint (sets forth violations and proposed penalty amount) for Board adoption, modification, or rescission	Adoption, modification, or rescission of ACL Complaints (sets forth settlement amount or measures)
Development of regional plans or policies (i.e., basin plans or operating procedures, etc.) for Board adoption, modification, or rescission	Adoption, modification, or rescission of regional plans or policies (i.e., basin plans or operating procedures, etc.) for ratification by the SWRCB

Attachment—Table 2

California Regional Water Quality Control Board
Los Angeles Region

June 25, 1990



Dennis A. Dickerson
Executive Officer

R0018083

Attachment—Table 3 RWQCB 4 NPDES PERMITTED FACILITIES								
		Major			Storm Water		Minor	
Permittee	Permit No.	Ind	Muni	Fed	MS4	Gen	all[1]	Gen
Arco Petroleum Products Co.	CA0000680	✓						
Avalon, City of	CA0054372		✓					
BKK Corporation	CA0059536	✓						
Boeing North American, Inc.	CA0001309	✓						
Burbank, City of Public Works	CA0055531		✓					
Camarillo Sanitary District	CA0053597		✓					
Chevron U.S.A. Inc.	CA0000337	✓						
El Segundo Power, L.L.C.	CA0001147	✓						
Heinz Pet Products Div.	CA0001333	✓						
Las Virgenes MWD	CA0056014		✓					
Long Beach Generation LLC	CA0001171	✓						
Long Beach Naval Complex	CA0003786			✓				
LA City DWP (Harbor Gen.)	CA0000361		✓					
LA City DWP (Haybes Gen.)	CA0000353		✓					
LA City DWP (Scatterg'd Gen.)	CA0000370		✓					
LA City DPW (Hyperion)	CA0109991		✓					
LA City DPW (LA-Glendale)	CA0053953		✓					
LA City DPW (Terminal Island)	CA0053859		✓					
LA City DPW (Tillman)	CA0056227		✓					
LA County SD (JWPCP Carson)	CA0053813		✓					
LA County SD (Long Beach)	CA0054119		✓					
LA County SD (Los Coyotes)	CA0054011		✓					
LA County SD (Pomona)	CA0053619		✓					
LA County SD (San Jose Creek)	CA0053911		✓					
LA County SD (Saugus)	CA0054311		✓					
LA County SD (Valencia)	CA0054216		✓					
LA County SD (Whittier)	CA0053716		✓					
Mobil Oil Corp.	CA0055387	✓						
Ocean Vista Power Generation	CA0001180	✓						
Ojai Valley San Dist	CA0053961		✓					
Oxnard Wastewater Div. Plant	CA0054097		✓					

Attachment–Table 3

RWQCB 4 NPDES PERMITTED FACILITIES

Permittee	Permit No.	Major			Storm Water		Minor	
		Ind	Muni	Fed	MS4	Gen	all[1]	Gen
Powerine Oil Co.	CA0057177	✓						
SoCal Edison (Alamitos)	CA0001139	✓						
SoCal Edison (Dominguez	CA0052949	✓						
SoCal Edison (Ormond Beach)	CA0001198	✓						
SoCal Edison (Redondo)	CA0001201	✓						
San Buenaventura, City of	CA0053651		✓					
Shell Oil Products Co.	CA0000809	✓						
Simi Valley, City of	CA0055221		✓					
Texaco Refining & Marketing	CA0003778	✓						
Thousand Oaks, City of DPW	CA0005629		✓					
Tosco Corp. (Carson Plant)	CA0063185	✓						
Tosco Corp. (Wilm. Plant)	CA0000035	✓						
Ventura Regional SD	CA0054224		✓					
Construction SW (200 NOIs)	CAS000002					✓		
Industrial SW (2,600 NOIs)	CAS000001					✓		
LA County (84 Cities)	CAS614140				✓			
Ventura County (10 cities)	CAS063339				✓			
Groundwater (GW) from Dewatering [2]	CAG994001							✓
Treated GW from Dewatering [2]	CAG994002							✓
Treated GW From Clean Up Of Petroleum Fuel Pollution [2]	CAG834001							✓
VOC Contaminated GW [2]	CAG914001							✓
Hydrostatic Test Water [2]	CAG674001							✓
Cooling Water [2]	CAG254000							✓
Total Permittees		18	25	1	2	2	260	6

[1])industrial and municipal minor permittees not listed individually
[2])six general permit categories with 345 enrollees

Attachment—Table 4
RWQCB 4 APPROVED PRETREATMENT PROGRAMS & ACTIVITIES

Program	Reviewed by EPA	Pretreatment Compliance Inspections & Audits					
		FY	PCI/Audit	Target	Actual	Report	WENDB
Burbank	✓	94/95	Audit	1/1/95	1/25/95	Yes	No
		95/96	PCI	3/1/96			
		97/98	PCI	5/1/98			
Camarillo	✓	95/96	Audit	3/1/96	3/26/96	Yes	No
Las Virgenes	✓	94/95	PCI	1/1/95	5/16/95	No	No
		96/97	Audit	6/1/97			
Los Angeles City	✓	94/95	PCI	9/1/94	10/18/94	Yes	Yes
		95/96	PCI	3/1/96			
Los Angeles County		94/95	PCI	1/1/95	6/8/95	No	No
Ojai	✓	95/96	PCI	2/1/96			
		96/97	PCI	12/1/96	4/3/97	Yes	No
Oxnard	✓	96/97	Audit	6/1/96			
		96/97	PCI	9/1/96			
San Buenaventura	✓	94/95	Audit	4/1/95	5/18/95	No	No
		95/96	PCI	5/1/96			
		96/97	PCI	8/1/96			
Simi Valley		95/96	PCI	3/1/96			
		96/97	PCI	8/1/96	10/4/96	Yes	No
Thousand Oaks	✓	95/96	PCI	3/1/96			
		96/97	PCI	11/1/96	4/9/97	Yes	Yes
Ventura	✓	95/96	Audit	1/1/96	2/23/96	Yes	Yes

Attachment–Table 5 INVENTORY OF RWQCB 4 MAJOR NPDES ACTIONS BY YEAR								
					ACLCs			
Year	NOVs[1]	TSOs	CAOs	CDOs	No. Issued	$ Proposed by RWQCB	$ Assessed by Board	$ Collected
1995	NR[2]	0	7	1	1	$211,200	$ 11,200	0
1996	NR	0	4	2	4	$196,805	$195,805	$ 51,250
1997	360[3]	2	10	1	1	$20,000	$ 20,000	$ 15,000
1998 (as of 6/1)	568[4,7]	4	16	2	21[5]	$3,471,740[6]	3,524,140	$230,520
Total				-		$ 2,482,780[6]		

Figures on this Table may vary slightly due to conversion of tracking systems (WDS to ERIS to SWIMS). Also, collected penalty amounts do not include amounts that have/are funding supplemental environmental projects.

<u>Notes Key</u>

1) "NOVs" include informal letters, for all RWQCB programs, not just NPDES majors
2) "NR" indicates not reviewed.
3) 1997 NOV data for 7-12/97 only
4) 1998 NOV data thru 3/31 only
5) 4 of these ACLCs relate to violations of storm water permit requirements
6) $2,300,000 of this amount is attributable to a single assessment against the City of Thousand Oaks
7) This amount includes the hundreds of letters sent to industrial facilities as part of a statewide initiative to identify non-filers that are potentially subject to storm water permit requirements.

APR 0 5 1999

Mr. John Norton, Chief
Compliance Assurance and Enforcement Unit
California State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

Dear Mr. Norton:

As we discussed during our February 11, 1999, meeting with representatives from the Regional Water Quality Control Boards (RWQCBs) and the State Water Resources Control Board (SWRCB), enclosed is the list of issues in the NPDES program which all agreed are applicable throughout the State of California. These issues were identified during our NPDES reviews conducted last year at RWQCBs 4, 5, and 9. Each issue statement on the enclosed includes the actions we all agreed were needed to resolve each issue. Please distribute the enclosed list to the appropriate individuals at the SWRCB and RWQCBs.

I want to thank you for facilitating our meeting of February 11 - it greatly contributed to our being able to reach agreement on these issues and the actions needed to address them. If there are any questions on the enclosed information, please do not hesitate to contact me at (415) 744-1817 or Ms. Jenée Gavette at (415) 744-1942.

Sincerely,

Original signed by:

Mike Schulz
Associate Director
Water Division

Enclosure

EPA's NPDES program reviews conducted to date at Regional Water Quality Control Boards (RWQCBs) 4, 5, and 9 have revealed issues which are applicable throughout the State of California. These State-wide issues, discussed and ~~agreed upon by the~~ RWQCBs, State Water Resources Control Board (SWRCB), and EPA during meetings held in January and February of 1999, are listed below, along with the agreed-upon actions that address each one.

- The current lack of State-wide water quality standards for toxic pollutants, and the absence of a plan of implementation for establishing water quality based effluent limits for toxics and whole effluent toxicity, result in NPDES permit issuance problems at the RWQCBs.
  - Identified as an on-going problem, it was agreed that promulgation of the California Toxics Rule (CTR) and the State's adoption of the Inland Surface Waters and Enclosed Bays and Estuaries Plan's Implementation Policy would address this issue for most constituents.
  - In the interim, before the CTR becomes final and the State Implementation Policy is adopted, RWQCBs should refer to EPA's national guidance, *Technical Support Document for Water Quality-Based Toxics Control (EPA/505/2-90-001, March 1991).* This guidance is also summarized in *Guidance for NPDES Permit Issuance (EPA, Region 9, February 1994).* RWQCBs should also refer to the fact sheets and permits that the SWRCB will provide on the Internet (see discussion below).
  - EPA's national Permit Writers Training Course, to be given in San Francisco the week of March 22, 1999, will provide detailed instructions on the development of water quality based effluent limits in NPDES permits, giving permit writers at the RWQCBs some guidance on how to write permits addressing these issues, until the CTR and the State's Implementation Policy are completed.

- Adoption of NPDES permits containing compliance schedules for water quality based effluent limitations is not allowable, unless an authorizing provision is contained in the applicable water quality control plan.
  - Sheila Vassey, SWRCB Counsel, will address this issue by writing a memorandum to be sent to the RWQCBs and EPA.

- Permit fact sheets/statements of basis need to clearly establish that permits are consistent with applicable statutes, regulations, and policy (e.g., reasonable potential, antibacksliding, establishing mixing zones, determining dilution credits, etc.).
  - Good examples of fact sheets that defend permitting decisions will be provided in EPA's national Permit Writers Course, to be given in San Francisco beginning on March 22, 1999. EPA has requested that an additional course be given in California later this calendar year.

- These examples, along with the permits they defend, will be provided on the Internet by the SWRCB for reference by the RWQCBs.
- This issue will be referred to California's NPDES Roundtable for further discussion, and EPA will participate.
- The recommended method for reasonable potential analysis is provided in EPA's national guidance, *Technical Support Document for Water Quality-Based Toxics Control (EPA/505/2-90-001, March 1991)*. This guidance is also summarized in *Guidance for NPDES Permit Issuance (EPA, Region 9, February 1994)*. Both documents are available to the RWQCBs and SWRCB.

- Appropriate receiving water limitations language, for which acceptable model language was recently developed by EPA, the State Water Resources Control Board (SWRCB), and the California Storm Water Quality Task Force, needs to be included in all forthcoming municipal storm water permits.

  - EPA, the SWRCB, and the RWQCBs all agree to use this new language in all future municipal storm water permits.
  - As EPA issues MS4 permits, EPA will send copies to the SWRCB for distribution to all RWQCBs.

- Copies of inspection reports of major permittees, as well as copies of responses from permittees about violation follow-up, must be sent by all RWQCBs to EPA, in accordance with the Memorandum of Agreement (MOA) between EPA and State of California.

  - This issue will be discussed and resolved at California's NPDES Roundtable meeting on March 23, 1999. Bob Wills from EPA will participate.

- Compliance review of Discharge Monitoring Reports (DMRs) is often not timely, especially for minors.

  - This issue will be referred to California's NPDES Roundtable for resolution; the SWRCB will develop procedures by May 1999 for use by all RWQCBs.

- The Quarterly Non-Compliance Reports (QNCRs) submitted by the RWQCBs need improvement in quality and content.

  - Jose Angel of the State and Bob Wills of EPA will provide procedures and training for the RWQCBs this calendar year.

- Field presence/compliance assessment at NPDES major and minor facilities is not adequate. *Issues include use of appropriate sampling methods, adequacy of field inspection notes, and depth of on-site review.*

    - The SWRCB's Compliance Assurance and Enforcement Unit is developing procedures to address this issue, targeted for completion in June 1999, with State-wide implementation thereafter. EPA will assist the SWRCB in this effort.

- A greater inspection presence in the storm water program for both industrial and construction sites needs to be established by all RWQCBs; this program element is significantly under funded State-wide.

    - The identification of non-filers is a high priority and should be emphasized.
    - Expected level of inspection presence needs to be defined, as well as procedures for targeting inspections (geographic or otherwise). The State Urban Runoff Task Force will address this issue. The "floor" of a credible state-wide storm water compliance program needs to be defined. EPA compliance staff will assist in this effort.
    - EPA will work with the State to decide what activities will be funded in the coming year, e.g., identification of non-filers, development of the "floor" for a credible inspection program, and a given number of storm water inspections (SWRCB notes that $100,000 = 100 inspections).

- Pretreatment program expertise, in general, needs to be strengthened State-wide. Industrial user regulation by the State is needed. Industrial user compliance problems, especially when the pretreatment authority is for whatever reason unable to exert authority over the industrial user, must be addressed by the State.

    - Instances where EPA has identified water quality problems due to pretreatment noncompliance need to be addressed promptly by the State.
    - Pretreatment priority an work commitments need to be addressed in next year's Clean Water Act Section 106 workplan.
    - Sheila Vassey, SWRCB Counsel, will write a memorandum regarding the State's industrial user enforcement authority, to be furnished to EPA, the SWRCB, and the RWQCBs.
    - Development and availability of State-wide pretreatment expertise will be addressed by the State's NPDES roundtable, i.e., how and where to provide this expertise (at the RWQCBs or SWRCB).
    - SWRCB will identify significant unregulated industrial users.

- All RWQCB penalty actions need to recover economic benefit resulting from noncompliance, ~~in accordance with EPA policy, the MOA, the State's Administrative~~ Procedures Manual (APM), and the State Enforcement Policy.

    - The State economist has evaluated BEN (EPA's model for determining economic benefit) and determined that it's a useful tool to determine economic benefit.
    - RWQCBs will attend BEN training, to be scheduled this calendar year by EPA.
    - The State Compliance and Enforcement Roundtable is developing both penalty assessment and settlement procedures. EPA will participate in these Roundtable discussions.

federal register

Wednesday
December 8, 1999

Part II

Environmental Protection Agency

40 CFR Parts 9, 122, 123, and 124
National Pollutant Discharge Elimination System—Regulations for Revision of the Water Pollution Control Program Addressing Storm Water Discharges; Final Rule

R0018093

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 9, 122, 123, and 124

[FRL—6470-8]

RIN 2040-AC82

National Pollutant Discharge Elimination System—Regulations for Revision of the Water Pollution Control Program Addressing Storm Water Discharges

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: Today's regulations (Phase II) expand the existing National Pollutant Discharge Elimination System (NPDES) storm water program (Phase I) to address storm water discharges from small municipal separate storm sewer systems (MS4s) (those serving less than 100,000 persons) and construction sites that disturb one to five acres. Although these sources are automatically designated by today's rule, the rule allows for the exclusion of certain sources from the national program based on a demonstration of the lack of impact on water quality, as well as the inclusion of others based on a higher likelihood of localized adverse impact on water quality. Today's regulations also exclude from the NPDES program storm water discharges from industrial facilities that have "no exposure" of industrial activities or materials to storm water. Finally, today's rule extends from August 7, 2001 until March 10, 2003 the deadline by which certain industrial facilities owned by small MS4s must obtain coverage under an NPDES permit. This rule establishes a cost-effective, flexible approach for reducing environmental harm by storm water discharges from many point sources of storm water that are currently unregulated.

EPA believes that the implementation of the six minimum measures identified for small MS4s should significantly reduce pollutants in urban storm water compared to existing levels in a cost-effective manner. Similarly, EPA believes that implementation of Best Management Practices (BMP) controls at small construction sites will also result in a significant reduction in pollutant discharges and an improvement in surface water quality. EPA believes this rule will result in monetized financial, recreational and health benefits, as well as benefits that EPA has been unable to monetize. Expected benefits include reduced scouring and erosion of streambeds, improved aesthetic quality of waters, reduced eutrophication of aquatic systems, benefit to wildlife and endangered and threatened species, tourism benefits, biodiversity benefits and reduced costs for siting reservoirs. In addition, the costs of industrial storm water controls will decrease due to the exclusion of storm water discharges from facilities where there is "no exposure" of storm water to industrial activities and materials.

DATES: This regulation is effective on February 7, 2000. The incorporation by reference of the rainfall erosivity factor publication listed in the rule is approved by the Director of the Federal Register as of February 7, 2000. For judicial review purposes, this final rule is promulgated as of 1:00 p.m. Eastern Standard Time, on December 22, 1999 as provided in 40 CFR 23.2.

ADDRESSES: The complete administrative record for the final rule and the ICR have been established under docket numbers W–97–12 (rule) and W–97–15 (ICR), and includes supporting documentation as well as printed, paper versions of electronic comments. Copies of information in the record are available upon request. A reasonable fee may be charged for copying. The record is available for inspection and copying from 9 a.m. to 4 p.m., Monday through Friday, excluding legal holidays, at the Water Docket, EPA, East Tower Basement, 401 M Street, SW, Washington, DC. For access to docket materials, please call 202/260–3027 to schedule an appointment.

FOR FURTHER INFORMATION CONTACT: George Utting, Office of Wastewater Management, Environmental Protection Agency, Mail Code 4203, 401 M Street, SW, Washington, DC 20460; (202) 260–5816; sw2@epa.gov.

SUPPLEMENTARY INFORMATION: Entities potentially regulated by this action include:

Category	Examples of regulated entities
Federal, State, Tribal, and Local Governments.	Operators of small separate storm sewer systems, industrial facilities that discharge storm water associated with industrial activity or construction activity disturbing 1 to 5 acres.
Industry	Operators of industrial facilities that discharge storm water associated with industrial activity.
Construction Activity.	Operators of construction activity disturbing 1 to 5 acres.

This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to be regulated by this action. This table lists the types of entities that EPA is now aware could potentially be regulated by this action. Other types of entities not listed in the table could also be regulated. To determine whether your facility or company is regulated by this action, you should carefully examine the applicability criteria in §§ 122.26(b), 122.31, 122.32, and 123.35 of the final rule. If you have questions regarding the applicability of this action to a particular entity, consult the person listed in the preceding **FOR FURTHER INFORMATION CONTACT** section.

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I. Background

A. Proposed Rule and Pre-Proposal Outreach

On January 9, 1998 (63 FR 1536), EPA proposed to expand the National Pollutant Discharge Elimination System (NPDES) storm water program to include storm water discharges from municipal separate storm sewer systems (MS4s) and construction sites that were smaller than those previously included in the program. The proposal also addressed industrial sources that have "no exposure" of industrial activities and materials to storm water. Today, EPA is promulgating a final rule to implement most of the proposed revisions with minor changes based on public comments received on the proposal. Today's final rule also extends the deadline by which certain industrial facilities operated by municipalities of less than 100,000 population must be covered by a NPDES permit; the deadline is changed from August 7, 2001 until March 10, 2003.

In 1972, Congress amended the Federal Water Pollution Control Act (commonly referred to as the Clean Water Act (CWA)) to prohibit the discharge of any pollutant to waters of the United States from a point source unless the discharge is authorized by an NPDES permit. The NPDES program is a program designed to track point sources and require the implementation of the controls necessary to minimize the discharge of pollutants. Initial efforts to improve water quality under the NPDES program primarily focused on reducing pollutants in industrial process wastewater and municipal sewage. These discharge sources were easily identified as responsible for poor, often drastically degraded, water quality conditions.

As pollution control measures for industrial process wastewater and municipal sewage were implemented and refined, it became increasingly evident that more diffuse sources of water pollution were also significant causes of water quality impairment. Specifically, storm water runoff draining large surface areas, such as agricultural and urban land, was found to be a major cause of water quality impairment, including the nonattainment of designated beneficial uses.

In 1987, Congress amended the CWA to require implementation, in two phases, of a comprehensive national program for addressing storm water discharges. The first phase of the program, commonly referred to as "Phase I," was promulgated on November 16, 1990 (55 FR 47990). Phase I requires NPDES permits for storm water discharge from a large number of priority sources including municipal separate storm sewer systems ("MS4s") generally serving populations of 100,000 or more and several categories of industrial activity, including construction sites that disturb five or more acres of land.

Today's rule, which is the second phase of the storm water program, expands the existing program to include discharges of storm water from smaller municipalities in urbanized areas and from construction sites that disturb between one and five acres of land. Today's rule allows certain sources to be excluded from the national program based on a demonstrable lack of impact on water quality. The rule also allows other sources not automatically regulated on a national basis to be designated for inclusion based on increased likelihood for localized adverse impact on water quality.

Today's rule also conditionally excludes storm water discharges from industrial facilities that have "no exposure" of industrial activities or materials to storm water. Today's rule and the effort that led to its development are commonly referred to as "Phase II." On August 7, 1995, EPA promulgated a final rule that required facilities to be regulated under Phase II to apply for a NPDES permit by August 7, 2001, unless the NPDES permitting authority designates them as requiring a permit by an earlier date. (60 FR 40230). That rule is referred to as "the Interim Phase II Rule." Today's rule replaces the Interim Phase II rule.

EPA performed extensive outreach and worked with a variety of stakeholders prior to proposing today's rule. On September 9, 1992, EPA published a notice requesting information and public comment on how to prepare regulations under CWA section 402(p)(6) (see 57 FR 41344). The notice identified three sets of issues associated with developing new NPDES storm water regulations: (1) How should EPA identify unregulated sources of storm water to protect water quality, (2) what types of control strategies should EPA develop for these sources, and (3) what are appropriate deadlines for implementing new requirements. The notice recognized that potential sources for coverage under the section 402(p)(6) regulations would fall into two main categories: municipal separate storm sewer systems and individual (commercial and residential) sources. EPA received more than 130 comments on the September 9, 1992, notice. For further discussion of the comments received, see *Storm Water Discharges Potentially Addressed by Phase II of the National Pollutant Discharge Elimination System: Report to Congress* (EPA, 1995a), pp. 1–21 to 1–22, and Appendix J (which provides a detailed summary of the comments received as they relate to the specific issues raised in the notice).

In early 1993, the Rensselaerville Institute and EPA held public and expert meetings to assist in developing and analyzing options for identifying unregulated sources and possible controls. The report on the 1993 meetings identified two options that were favored by the various groups that participated. One option was a program that allowed States to select sources to be controlled in a manner consistent with criteria developed by EPA. A second option was a tiered approach under which EPA would select high priority sources for control by NPDES permits and States would select other sources for control under a State water quality program other than the NPDES program. For additional details see the "Report on the EPA Storm Water Management Program (Rensselaerville Study)," Appendix I of *Storm Water Discharges Potentially Addressed by Phase II of the National Pollutant Discharge Elimination System: Report to Congress* (EPA, 1995a).

EPA also conducted outreach with representatives of small entities in conjunction with the convening of a Small Business Advocacy Review Panel under the Small Business Regulatory Enforcement Fairness Act (SBREFA). This process is discussed in section IV.E of today's preamble. For additional background see the discussion in the preamble to the proposal for today's rule.

To assist EPA by providing advice and recommendations regarding the urban municipal wet weather water pollution control program, EPA established the Urban Wet Weather Flows Federal Advisory Committee (hereinafter, "FACA Committee") under the Federal Advisory Committee Act (FACA). The Office of Management and Budget approved the charter for the FACA Committee on March 10, 1995. The FACA Committee provided a forum for identifying and addressing issues associated with water quality impacts from storm water sources.

The FACA Committee established two subcommittees: the Storm Water Phase II FACA Subcommittee and the Sanitary Sewer Overflows (SSOs) FACA Subcommittee. Consistent with the requirements of FACA, the membership of both the FACA Committee and the subcommittees was balanced among EPA's various outside stakeholder interests, including representatives from municipalities, States, Indian Tribes, EPA, industrial and commercial sectors, agriculture, and environmental and public interest groups.

The Storm Water Phase II FACA Subcommittee ("Subcommittee") met fourteen times between September 1995 and June 1998. The 32 Subcommittee members discussed possible regulatory frameworks at these meetings as well as during numerous other meetings and conference calls. Members of the FACA Committee provided views regarding the development of the "no exposure" provision and other provisions in drafts of the Phase II rule. EPA provided Subcommittee members with four successive drafts of the proposed rule and preamble, outlines of the rule, summaries of the written comments received on each draft, and documents identifying the changes made to each draft. In the course of providing input to the Committee, individual Subcommittee members provided significant input and advice that EPA considered in the context of public comments received. Ultimately, the Subcommittee did not provide a written report back to the FACA Committee, and the FACA Committee did not provide written advice and recommendations to EPA. The Agency, therefore, did not rely on group recommendations in developing today's rule, but does consider the process to have resulted in important public outreach.

B. Water Quality Concerns/Environmental Impact Studies and Assessments

Storm water runoff from lands modified by human activities can harm surface water resources and, in turn, cause or contribute to an exceedance of water quality standards by changing natural hydrologic patterns, accelerating stream flows, destroying aquatic habitat, and elevating pollutant concentrations and loadings. Such runoff may contain or mobilize high levels of contaminants, such as sediment, suspended solids, nutrients (phosphorous and nitrogen), heavy metals and other toxic pollutants, pathogens, toxins, oxygen-demanding substances (organic material), and floatables (U.S. EPA. 1992. *Environmental Impacts of Storm Water Discharges: A National Profile.* EPA 841–R–92–001. Office of Water. Washington, DC). After a rain, storm water runoff carries these pollutants into nearby streams, rivers, lakes, estuaries, wetlands, and oceans. The highest concentrations of these contaminants often are contained in "first flush" discharges, which occur during the first major storm after an extended dry period (Schueler, T.R. 1994. "First Flush of Stormwater Pollutants Investigated in Texas." Note 28. *Watershed Protection Techniques* 1(2)). Individually and combined, these pollutants impair water quality, threatening designated beneficial uses and causing habitat alteration or destruction.

Uncontrolled storm water discharges from areas of urban development and construction activity negatively impact receiving waters by changing the physical, biological, and chemical composition of the water, resulting in an unhealthy environment for aquatic organisms, wildlife, and humans. The following sections discuss the studies and data that address and support this finding.

Although water quality problems also can occur from agricultural storm water discharges and return flows from irrigated agriculture, this area of concern is statutorily exempted from regulation as a point source under the Clean Water Act and is not discussed here. (See CWA section 502(14)). Other storm water sources not specifically identified in the regulations may be of concern in certain areas and can be addressed on a case-by-case (or category-by-category) basis through the NPDES designation authority preserved by CWA section 402(p)(2)(6), as well as today's rule.

1. Urban Development

Urbanization alters the natural infiltration capability of the land and generates a host of pollutants that are associated with the activities of dense populations, thus causing an increase in storm water runoff volumes and pollutant loadings in storm water discharged to receiving waterbodies (U.S. EPA, 1992). Urban development increases the amount of impervious surface in a watershed as farmland, forests, and meadowlands with natural infiltration characteristics are converted into buildings with rooftops, driveways, sidewalks, roads, and parking lots with virtually no ability to absorb storm water. Storm water and snow-melt runoff wash over these impervious areas, picking up pollutants along the way while gaining speed and volume because of their inability to disperse and filter into the ground. What results are storm water flows that are higher in volume, pollutants, and temperature than the flows in less impervious areas, which have more natural vegetation and soil to filter the runoff (U.S. EPA, 1997. *Urbanization and Streams: Studies of Hydrologic Impacts*. EPA 841–R–97-009. Office of Water. Washington, DC).

Studies reveal that the level of imperviousness in an area strongly correlates with the quality of the nearby receiving waters. For example, a study in the Puget Sound lowland ecoregion found that when the level of basin development exceeded 5 percent of the total impervious area, the biological integrity and physical habitat conditions that are necessary to support natural biological diversity and complexity declined precipitously (May, C.W., E.B. Welch, R.R. Horner, J.R. Karr, and B.W. May. 1997. *Quality Indices for Urbanization Effects in Puget Sound Lowland Streams*, Technical Report No. 154. University of Washington Water Resources Series). Research conducted in numerous geographical areas, concentrating on various variables and employing widely different methods, has revealed a similar conclusion: stream degradation occurs at relatively low levels of imperviousness, such as 10 to 20 percent (even as low as 5 to 10 percent according to the findings of the Washington study referenced above) (Schueler, T.R. 1994. "The Importance of Imperviousness." *Watershed Protection Techniques* 1(3); May, C., R.R. Horner, J.R. Karr, B.W. Mar, and E.B. Welch. 1997. "Effects Of Urbanization On Small Streams In The Puget Sound Lowland Ecoregion." *Watershed Protection Techniques* 2(4); Yoder, C.O., R.J. Miltner, and D. White. 1999. "Assessing the Status of Aquatic Life Designated Uses in Urban and Suburban Watersheds." In *Proceedings: National Conference on Retrofits Opportunities in Urban Environments*. EPA 625–R–99–002, Washington, DC; Yoder, C.O and R.J. Miltner. 1999. "Assessing Biological Quality and Limitations to Biological Potential in Urban and Suburban Watersheds in Ohio." In *Comprehensive Stormwater & Aquatic Ecosystem Management Conference Papers*, Auckland, New Zealand). Furthermore, research has indicated that few, if any, urban streams can support diverse benthic communities at imperviousness levels of 25 percent or more. An area of medium density single family homes can be anywhere from 25 percent to nearly 60 percent impervious, depending on the design of the streets and parking (Schueler, 1994).

In addition to impervious areas, urban development creates new pollution sources as population density increases and brings with it proportionately higher levels of car emissions, car maintenance wastes, pet waste, litter, pesticides, and household hazardous wastes, which may be washed into receiving waters by storm water or dumped directly into storm drains designed to discharge to receiving waters. More people in less space results in a greater concentration of pollutants that can be mobilized by, or disposed into, storm water discharges from municipal separate storm sewer systems. A modeling system developed for the Chesapeake Bay indicated that contamination of the Bay and its tributaries from runoff is comparable to, if not greater than, contamination from industrial and sewage sources (Cohn-Lee, R. and D. Cameron. 1992. "Urban Stormwater Runoff Contamination of the Chesapeake Bay: Sources and Mitigation." *The Environmental Professional*, Vol. 14).

a. Large-Scale Studies and Assessments

In support of today's regulatory designation of MS4s in urbanized areas, the Agency relied on broad-based assessments of urban storm water runoff and related water quality impacts, as well as more site-specific studies. The first national assessment of urban runoff characteristics was completed for the *Nationwide Urban Runoff Program (NURP)* study (U.S. EPA. 1983. *Results of the Nationwide Urban Runoff Program, Volume 1—Final Report*. Office of Water. Washington, D.C.). The NURP study is the largest nationwide evaluation of storm water discharges, which includes adverse impacts and sources, undertaken to date.

EPA conducted the NURP study to facilitate understanding of the nature of urban runoff from residential, commercial, and industrial areas. One objective of the study was to characterize the water quality of discharges from separate storm sewer systems that drain residential, commercial, and light industrial (industrial parks) sites. Storm water samples from 81 residential and commercial properties in 22 urban/suburban areas nationwide were collected and analyzed during the 5-year period between 1978 and 1983. The majority of samples collected in the study were analyzed for eight conventional pollutants and three heavy metals.

Data collected under the NURP study indicated that discharges from separate storm sewer systems draining runoff from residential, commercial, and light industrial areas carried more than 10 times the annual loadings of total suspended solids (TSS) than discharges from municipal sewage treatment plants that provide secondary treatment. The NURP study also indicated that runoff from residential and commercial areas carried somewhat higher annual loadings of chemical oxygen demand (COD), total lead, and total copper than effluent from secondary treatment plants. Study findings showed that fecal coliform counts in urban runoff typically range from tens to hundreds of thousands per hundred milliliters of runoff during warm weather conditions, with the median for all sites being around 21,000/100 ml. This is generally consistent with studies that found that fecal coliform mean values range from 1,600 coliform fecal units (CFU)/100 ml to 250,000 cfu/100 ml (Makepeace, D.K., D.W. Smith, and S.J. Stanley. 1995. "Urban Storm Water Quality: Summary of Contaminant Data." *Critical Reviews in Environmental Science and Technology* 25(2):93-139). Makepeace, et al., summarized ranges of contaminants from storm water, including physical contaminants such as total solids (76—36,200 mg/L) and copper (up to 1.41 mg/L); organic chemicals; organic compounds, such as oil and grease (up to 110 mg/L); and microorganisms.

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Monitoring data summarized in the NURP study provided important information about urban runoff from residential, commercial, and light industrial areas. The study concluded that the quality of urban runoff can be affected adversely by several sources of pollution that were not directly evaluated in the study, including illicit discharges, construction site runoff, and illegal dumping. Data from the NURP study were analyzed further in the U.S. Geological Survey (USGS) Urban Storm Water Data Base for 22 Metropolitan Areas Throughout the United States study (Driver, N.E., M.H. Mustard, R.B. Rhinesmith, and R.F. Middleburg. 1985. *U.S. Geological Survey Urban Storm Water Data Base for 22 Metropolitan Areas Throughout the United States.* Report No. 85–337 USGS. Lakewood, CO). The USGS report summarized additional monitoring data compiled during the mid-1980s, covering 717 storm events at 99 sites in 22 metropolitan areas and documented problems associated with metals and sediment concentrations in urban storm water runoff. More recent reports have confirmed the pollutant concentration data collected in the NURP study (Marsalek, J. 1990. "Evaluation of Pollutant Loads from Urban Nonpoint Sources." *Wat. Sci. Tech.* 22(10/11):23–30; Makepeace, et al., 1995).

Commenters argued that the NURP study does not support EPA's contention that urban activities significantly jeopardize attainment of water quality standards. One commenter argued that the NURP study and the 1985 USGS study are seriously out of date. Because they were issued 10 years or more before the implementation of the current storm water permit program, the data in those reports do not reflect conditions that exist after implementation of permits issued by authorized States and EPA for storm water from construction sites, large municipalities, and industrial activities.

In response, EPA notes that it is not relying solely on the NURP study to describe current water quality impairment. Rather, EPA is citing NURP as a source of data on typical pollutant concentrations in urban runoff. Recent studies have not found significantly different pollutant concentrations in urban runoff when compared to the original NURP data (see Makepeace, et al., 1995; Marsalek, 1990; and Pitt, et al., 1995).

America's Clean Water—the States' Nonpoint Source Assessment (Association of State and Interstate Water Pollution Control Administrators (ASIWPCA). 1985. *America's Clean Water—The States' Nonpoint Source Assessment.* Prepared in cooperation with the U.S. EPA, Office of Water, Washington, DC), a comprehensive study of diffuse pollution sources conducted under the sponsorship of the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) and EPA revealed that 38 States reported urban runoff as a major cause of designated beneficial use impairment and 21 States reported storm water runoff from construction sites as a major cause of beneficial use impairment. In addition, the 1996 305(b) Report (U.S. EPA. 1998. *The National Water Quality Inventory, 1996 Report to Congress.* EPA 841–R–97–008. Office of Water. Washington, DC), provides a national assessment of water quality based on biennial reports submitted by the States as required under CWA section 305(b) of the CWA. In the CWA 305(b) reports, States, Tribes, and Territories assess their individual water quality control programs by examining the attainment or nonattainment of the designated uses assigned to their rivers, lakes, estuaries, wetlands, and ocean shores. A designated use is the legally applicable use specified in a water quality standard for a watershed, waterbody, or segment of a waterbody. The designated use is the desirable use that the water quality should support. Examples of designated uses include drinking water supply, primary contact recreation (swimming), and aquatic life support. Each CWA 305(b) report indicates the assessed fraction of a State's waters that are fully supporting, partially supporting, or not supporting designated beneficial uses.

In their reports, States, Tribes, and Territories first identified and then assigned the sources of water quality impairment for each impaired waterbody using the following categories: industrial, municipal sewage, combined sewer overflows, urban runoff/storm sewers, agricultural, silvicultural, construction, resource extraction, land disposal, hydrologic modification, and habitat modification. The 1996 Inventory, based on a compilation of 60 individual 305(b) reports submitted by States, Tribes, and Territories, assessed the following percentages of total waters nationwide: 19 percent of river and stream miles; 40 percent of lake, pond, and reservoir acres; 72 percent of estuary square miles; and 6 percent of ocean shoreline waters. The 1996 Inventory indicated that approximately 40 percent of the Nation's assessed rivers, lakes, and estuaries are impaired. Waterbodies deemed as "impaired" are either partially supporting designated uses or not supporting designated uses.

The 1996 Inventory also found urban runoff/discharges from storm sewers to be a major source of water quality impairment nationwide. Urban runoff/storm sewers were found to be a source of pollution in 13 percent of impaired rivers; 21 percent of impaired lakes, ponds, and reservoirs; and 45 percent of impaired estuaries (second only to industrial discharges). In addition, urban runoff was found to be the leading cause of ocean impairment for those ocean miles surveyed.

In addition, a recent USGS study of urban watersheds across the United States has revealed a link between urban development and contamination of local waterbodies. The study found the highest levels of organic contaminants, known as polycyclic aromatic hydrocarbons (PAHs) (products of combustion of wood, grass, and fossil fuels), in the reservoirs of urbanized watersheds (U.S. Geological Survey (USGS). 1998. *Research Reveals Link Between Development and Contamination in Urban Watersheds.* USGS news release. USGS National Water-Quality Assessment Program).

Urban storm water also can contribute significant amounts of toxicants to receiving waters. Pitt, et. al. (1993), found heavy metal concentrations in the majority of samples analyzed. Industrial or commercial areas were likely to be the most significant pollutant source areas (Pitt, R., R. Field, M. Lalor, M. Brown 1993. "Urban stormwater toxic pollutants: assessment, sources, and treatability" *Water Environment Research*, 67(3):260–75).

b. Local and Watershed-Based Studies

In addition to the large-scale nationwide studies and assessments, a number of local and watershed-based studies from across the country have documented the detrimental effects of urban storm water runoff on water quality. A study of urban streams in Milwaukee County, Wisconsin, found local streams to be highly degraded due primarily to urban runoff, while three studies in the Atlanta, Georgia, region were characterized as being "the first documentation in the Southeast of the strong negative relationship between urbanization and stream quality that has been observed in other ecoregions" (Masterson, J. and R. Bannerman. 1994. "Impacts of Storm Water Runoff on Urban Streams in Milwaukee County, Wisconsin." Paper presented at National Symposium on Water Quality: American Water Resources Association; Schueler, T.R. 1997. "Fish Dynamics in Urban Streams Near Atlanta, Georgia."

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Technical Note 94. *Watershed Protection Techniques* 2(4)). Several other studies, including those performed in Arizona (Maricopa County), California (San Jose's Coyote Creek), Massachusetts (Green River), Virginia (Tuckahoe Creek), and Washington (Puget Sound lowland ecoregion), all had the same finding: runoff from urban areas greatly impair stream ecology and the health of aquatic life; the more heavily developed the area, the more detrimental the effects (Lopes, T. and K. Fossum. 1995. "Selected Chemical Characteristics and Acute Toxicity of Urban Stormwater, Streamflow, and Bed Material, Maricopa County, Arizona." *Water Resources Investigations Report* 95-4074. USGS; Pitt, R. 1995. "Effects of Urban Runoff on Aquatic Biota." In *Handbook of Ecotoxicology;* Pratt, J. and R. Coler. 1979. "Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Inhabiting the Green River, Massachusetts." Completion Report Project No. A-094. Water Resources Research Center. University of Massachusetts at Amherst.; Schueler, T.R. 1997. "Historical Change in a Warmwater Fish Community in an Urbanizing Watershed." Technical Note 93. *Watershed Protection Techniques* 2(4); May, C., R. Horner, J. Karr, B. Mar, nd E. Welch. 1997. "Effects Of Jrbanization On Small Streams In The Puget Sound Lowland Ecoregion." *Watershed Protection Techniques* 2(4)).

Pitt and others also described the receiving water effects on aquatic organisms associated with urban runoff (Pitt, R.E. 1995. "Biological Effects of Urban Runoff Discharges" In *Stormwater Runoff and Receiving Systems: Impact, Monitoring, and Assessment*, ed. E.E Herricks, Lewis Publishers; Crunkilton, R., J. Kleist, D. Bierman, J. Ramcheck, and W. DeVita. 1999. "Importance of Toxicity as a Factor Controlling the Distribution of Aquatic Organisms in an Urban Stream." In *Comprehensive Stormwater & Aquatic Ecosystem Management Conference Papers*. Auckland, New Zealand).

In Wisconsin, runoff samples were collected from streets, parking lots, roofs, driveways, and lawns. Source areas were broken up into residential, commercial, and industrial. Geometric mean concentration data for residential areas included total solids of about 500-800 mg/L from streets and 600 mg/L from lawns. Fecal coliform data from residential areas ranged from 34,000 to ,000 cfu/100 mL for streets and ıveways. Contaminant concentration data from commercial and industrial source areas were lower for total solids and fecal coliform, but higher for total zinc (Bannerman, R.T., D.W. Owens, R.B. Dods, and N.J. Hornewer. 1993. "Sources of Pollutants in Wisconsin Stormwater." *Wat. Sci. Tech.* 28(3-5):241-59).

Bannerman, et al. also found that streets contribute higher loads of pollutants to urban storm water than any other residential development source. Two small urban residential watersheds were evaluated to determine that lawns and streets are the largest sources of total and dissolved phosphorus in the basins (Waschbusch, R.J., W.R. Selbig, and R.T. Bannerman. 1999. "Sources of Phosphorus in Stormwater and Street Dirt from Two Urban Residential Basins In Madison, Wisconsin, 1994-95." *Water Resources Investigations Report* 99-4021. U.S. Geological Survey). A number of other studies have indicated that urban roadways often contain significant quantities of metal elements and solids (Sansalone, J.J. and S.G. Buchberger. 1997. "Partitioning and First Flush of Metals in Urban Roadway Storm Water." *ASCE Journal of Environmental Engineering* 123(2); Sansalone, J.J., J.M. Koran, J.A. Smithson, and S.G. Buchberger. 1998. "Physical Characteristics of Urban Roadway Solids Transported During Rain Events" *ASCE Journal of Environmental Engineering* 124(5); Klein, L.A., M. Lang, N. Nash, and S.L. Kirschner. 1974. "Sources of Metals in New York City Wastewater" *J. Water Pollution Control Federation* 46(12):2653-62; Barrett, M.E, R.D. Zuber, E.R. Collins, J.F. Malina, R.J. Charbeneau, and G.H Ward., 1993. "A Review and Evaluation of Literature Pertaining to the Quantity and Control of Pollution from Highway Runoff and Construction." Research Report 1943-1. Center for Transportation Research, University of Texas, Austin).

c. Beach Closings/Advisories

Urban wet weather flows have been recognized as the primary sources of estuarine pollution in coastal communities. Urban storm water runoff, sanitary sewer overflows, and combined sewer overflows have become the largest causes of beach closings in the United States in the past three years. Storm water discharges from urban areas not only pose a threat to the ecological environment, they also can substantially affect human health. A survey of coastal and Great Lakes communities reports that in 1998, more than 1,500 beach closings and advisories were associated with storm water runoff (Natural Resources Defense Council. 1999. "A Guide to Water Quality at Vacation Beaches" New York, NY). Other reports also document public health, shellfish bed, and habitat impacts from storm water runoff, including more than 823 beach closings/advisories issued in 1995 and more than 407 beach closing/advisories issued in 1996 due to urban runoff (Natural Resources Defense Council. 1996. *Testing the Waters Volume VI: Who Knows What You're Getting Into.* New York, NY; NRDC. 1997. *Testing the Waters Volume VII: How Does Your Vacation Beach Rate.* New York, NY; Morton, T. 1997. *Draining to the Ocean: The Effects of Stormwater Pollution on Coastal Waters.* American Oceans Campaign, Santa Monica, CA). The Epidemiological Study of Possible Adverse Health Effects of Swimming in Santa Monica Bay (Haile, R.W., et. al. 1996. "An Epidemiological Study of Possible Adverse Health Effects of Swimming in Santa Monica Bay." *Final Report prepared for the Santa Monica Bay Restoration Project*) concluded that there is a 57 percent higher rate of illness in swimmers who swim adjacent to storm drains than in swimmers who swim more than 400 yards away from storm drains. This and other studies document a relationship between gastrointestinal illness in swimmers and water quality, the latter of which can be heavily compromised by polluted storm water discharges.

2. Non-Storm Water Discharges Through Municipal Storm Sewers

Studies have shown that discharges from MS4s often include wastes and wastewater from non-storm water sources. Federal regulations (§ 122.26(b)(2)) define an illicit discharge as "* * * any discharge to an MS4 that is not composed entirely of storm water * * *," with some exceptions. These discharges are "illicit" because municipal storm sewer systems are not designed to accept, process, or discharge such wastes. Sources of illicit discharges include, but are not limited to: sanitary wastewater; effluent from septic tanks; car wash, laundry, and other industrial wastewaters; improper disposal of auto and household toxics, such as used motor oil and pesticides; and spills from roadway and other accidents.

Illicit discharges enter the system through either direct connections (e.g., wastewater piping either mistakenly or deliberately connected to the storm drains) or indirect connections (e.g., infiltration into the MS4 from cracked sanitary systems, spills collected by drain outlets, and paint or used oil dumped directly into a drain). The result is untreated discharges that contribute high levels of pollutants, including heavy metals, toxics, oil and grease, solvents, nutrients, viruses and bacteria into receiving waterbodies. The NURP study, discussed earlier, found that pollutant levels from illicit discharges were high enough to significantly degrade receiving water quality and threaten aquatic, wildlife, and human health. The study noted particular problems with illicit discharges of sanitary wastes, which can be directly linked to high bacterial counts in receiving waters and can be dangerous to public health.

Because illicit discharges to MS4s can create severe widespread contamination and water quality problems, several municipalities and urban counties performed studies to identify and eliminate such discharges. In Michigan, the Ann Arbor and Ypsilanti water quality projects inspected 660 businesses, homes, and other buildings and identified 14 percent of the buildings as having improper storm sewer drain connections. The program assessment revealed that, on average, 60 percent of automobile-related businesses, including service stations, automobile dealerships, car washes, body shops, and light industrial facilities, had illicit connections to storm sewer drains. The program assessment also showed that a majority of the illicit discharges to the storm sewer system resulted from improper plumbing and connections, which had been approved by the municipality when installed (Washtenaw County Statutory Drainage Board. 1987. Huron River Pollution Abatement Program).

In addition, an inspection of urban storm water outfalls draining into Inner Grays, Washington, indicated that 32 percent of these outfalls had dry weather flows. Of these flows, 21 percent were determined to have pollutant levels higher than the pollutant levels expected in typical urban storm water runoff characterized in the NURP study (U.S. EPA. 1993. *Investigation of Inappropriate Pollutant Entries Into Storm Drainage Systems—A User's Guide*. EPA 600/R–92/238. Office of Research and Development. Washington, DC). That same document reports a study in Toronto, Canada, that found that 59 percent of outfalls from the MS4 had dry-weather flows. Chemical tests revealed that 14 percent of these dry-weather flows were determined to be grossly polluted.

Inflows from aging sanitary sewer collection systems are one of the most serious illicit discharge-related problems. Sanitary sewer systems frequently develop leaks and cracks, resulting in discharges of pollutants to receiving waters through separate storm sewers. These pollutants include sanitary waste and materials from sewer main construction (e.g., asbestos cement, brick, cast iron, vitrified clay). Municipalities have long recognized the reverse problem of storm water infiltration into sanitary sewer collection systems; this type of infiltration often disrupts the operation of the municipal sewage treatment plant.

The improper disposal of materials is another illicit discharge-related problem that can result in contaminated discharges from separate storm sewer systems in two ways. First, materials may be disposed of directly in a catch basin or other storm water conveyance. Second, materials disposed of on the ground may either drain directly to a storm sewer or be washed into a storm sewer during a storm event. Improper disposal of materials to street catch basins and other storm sewer inlets often occurs when people mistakenly believe that disposal to such areas is an environmentally sound practice. Part of the confusion may occur because some areas are served by combined sewer systems, which are part of the sanitary sewer collection system, and people assume that materials discharged to a catch basin will reach a municipal sewage treatment plant. Materials that are commonly disposed of improperly include used motor oil; household toxic materials; radiator fluids; and litter, such as disposable cups, cans, and fast-food packages. EPA believes that there has been increasing success in addressing these problems through initiatives such as storm drain stenciling and recycling programs, including household hazardous waste special collection days.

Programs that reduce illicit discharges to separate storm sewers have improved water quality in several municipalities. For example, Michigan's Huron River Pollution Abatement Program found the elimination of illicit connections caused a measurable improvement in the water quality of the Washtenaw County storm sewers and the Huron River (Washtenaw County Statutory Drainage Board, 1987). In addition, an illicit detection and remediation program in Houston, Texas, has significantly improved the water quality of Buffalo Bayou. Houston estimated that illicit flows from 132 sources had a flow rate as high as 500 gal/min. Sources of the illicit discharges included broken and plugged sanitary sewer lines, illicit connections from sanitary lines to storm sewer lines, and floor drain connections (Glanton, T., M.T. Garrett, and B. Goloby. 1992. The Illicit Connection: Is It the Problem? *Wat. Env. Tech.* 4(9):63–8).

3. Construction Site Runoff

Storm water discharges generated during construction activities can cause an array of physical, chemical, and biological water quality impacts. Specifically, the biological, chemical, and physical integrity of the waters may become severely compromised. Water quality impairment results, in part, because a number of pollutants are preferentially absorbed onto mineral or organic particles found in fine sediment. The interconnected process of erosion (detachment of the soil particles), sediment transport, and delivery is the primary pathway for introducing key pollutants, such as nutrients (particularly phosphorus), metals, and organic compounds into aquatic systems (Novotny, V. and G. Chesters. 1989. "Delivery of Sediment and Pollutants from Nonpoint Sources: A Water Quality Perspective." *Journal of Soil and Water Conservation*, 44(6):568–76). Estimates indicate that 80 percent of the phosphorus and 73 percent of the Kjeldahl nitrogen in streams is associated with eroded sediment (U.S. Department of Agriculture. 1989. "The Second RCA Appraisal, Soil, Water and Related Resources on Nonfederal Land in the United States, Analysis of Condition and Trends." Cited in Fennessey, L.A.J., and A.R. Jarrett. 1994. "The Dirt in a Hole: a Review of Sedimentation Basins for Urban Areas and Construction Sites." *Journal of Soil and Water Conservation*, 49(4):317–23).

In watersheds experiencing intensive construction activity, the localized impacts of water quality may be severe because of high pollutant loads, primarily sediments. Siltation is the largest cause of impaired water quality in rivers and the third largest cause of impaired water quality in lakes (U.S. EPA, 1998). The 1996 305(b) report also found that construction site discharges were a source of pollution in: 6 percent of impaired rivers; 11 percent of impaired lakes, ponds, and reservoirs; and 11 percent of impaired estuaries. Introduction of coarse sediment (coarse sand or larger) or a large amount of fine sediment is also a concern because of the potential of filling lakes and reservoirs (along with the associated remediation costs for dredging), as well as clogging stream channels (e.g., Paterson, R.G., M.I. Luger, E.J. Burby, E.J. Kaiser, H.R. Malcolm, and A.C. Beard. 1993. "Costs and Benefits of Urban Erosion and Sediment Control: North Carolina Experience." *Environmental Management* 17(2):167–78). Large inputs of coarse sediment into stream channels initially will reduce stream depth and minimize habitat complexity by filling in pools (U.S. EPA. 1991. *Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska*. EPA 910/9–91–001. Seattle, WA). In addition, studies have shown that stream reaches affected by construction activities often extend well downstream of the construction site. For example, between 4.8 and 5.6 kilometers of stream below construction sites in the Patuxent River watershed were observed to be impacted by sediment inputs (Fox, H.L. 1974. "Effects of Urbanization on the Patuxent River, with Special Emphasis on Sediment Transport, Storage, and Migration." Ph.D. dissertation. Johns Hopkins University, Baltimore, MD. As Cited in Klein, R.D. 1979. "Urbanization and Stream Quality Impairment." *Water Resources Bulletin* 15(4): 948–63).

A primary concern at most construction sites is the erosion and transport process related to fine sediment because rain splash, rills (i.e., a channel small enough to be removed by normal agricultural practices and typically less than 1-foot deep), and sheetwash encourage the detachment and transport of this material to waterbodies (Storm Water Quality Task Force. 1993. *California Storm Water Best Management Practice Handbooks—Construction Activity*. Oakland, CA: Blue Print Service). Construction sites also can generate other pollutants associated with onsite wastes, such as sanitary wastes or concrete truck washout.

Although streams and rivers naturally carry sediment loads, erosion from construction sites and runoff from developed areas can elevate these loads to levels well above those in undisturbed watersheds. It is generally acknowledged that erosion rates from construction sites are much greater than from almost any other land use (Novotny, V. and H. Olem. 1994. *Water Quality: Prevention, Identification, and Management of Diffuse Pollution*. New York: Van Nostrand Reinhold). Results from both field studies and erosion models indicate that erosion rates from construction sites are typically an order of magnitude larger than row crops and several orders of magnitude greater than rates from well-vegetated areas, such as forests or pastures (USDA. 1970. "Controlling Erosion on Construction Sites." *Agriculture Information Bulletin*, Washington, DC; Meyer, L.D., W.H. Wischmeier, and W.H. Daniel. 1971. "Erosion, Runoff and Revegetation of Denuded Construction Sites." *Transactions of the ASAE* 14(1):138–41; Owen, O.S. 1975. *Natural Resource Conservation*. New York: MacMillan. As cited in Paterson, et al., 1993).

A recent review of the efficiency of sediment basins indicated that inflows from 12 construction sites had a mean TSS concentration of about 4,500 mg/L (Brown, W.E. 1997. "The Limits of Settling." Technical Note No. 83. *Watershed Protection Techniques* 2(3)). In Virginia, suspended sediment concentrations from housing construction sites were measured at 500–3,000 mg/L, or about 40 times larger than the concentrations from already-developed urban areas (Kuo, C.Y. 1976. "Evaluation of Sediment Yields Due to Urban Development." Bulletin No. 98. Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University, Blacksburg, VA).

Similar impacts from storm water runoff have been reported in a number of other studies. For example, Daniel, et al., monitored three residential construction sites in southeastern Wisconsin and determined that annual sediment yields were more than 19 times the yields from agricultural areas (Daniel, T.C., D. McGuire, D. Stoffel, and B. Miller. 1979. "Sediment and Nutrient Yield from Residential Construction Sites" *Journal of Environmental Quality* 8(3):304–08). Daniel, et al., identified total storm runoff, followed by peak storm runoff, as the most influential factors controlling the sediment loadings from residential construction sites. Daniel, et al., also found that suspended sediment concentrations were 15,000–20,000 mg/L in moderate events and up to 60,000 mg/L in larger events.

Wolman and Schick (Wolman, M.G. and A.P. Schick. 1967. "Effects of Construction on Fluvial Sediment, Urban and Suburban Areas of Maryland." *Water Resources Research* 3(2): 451–64) studied the impacts of development on fluvial systems in Maryland and determined that sediment yields in areas undergoing construction were 1.5 to 75 times greater than detected in natural or agricultural catchments. The authors summarize the potential impacts of construction on sediment yields by stating that "the equivalent of many decades of natural or even agricultural erosion may take place during a single year from areas cleared for construction" (Wolman and Schick, 1967).

A number of studies have examined the effects of road construction on erosion rates and sediment yields. A highway construction project in West Virginia disturbed only 4.2 percent of a 4.72-square-mile basin, but resulted in a three-fold increase in suspended sediment yields (Downs, S.C. and D.H. Appel. 1986. *Progress Report on the Effects of Highway Construction on Suspended-Sediment Discharge in the Coal River and Trace Fork, West Virginia*, 1975–81. USGS Water Resources Investigations Report 84–4275. Charlestown, WV). During the largest storm event, it was estimated that 80 percent of the sediment in the stream originated from the construction site. As is often the case, the increase in suspended sediment load could not be detected further downstream, where the drainage area was more than 50 times larger (269 square miles).

Another study evaluated the effect of 290 acres of highway construction on watersheds ranging in size from 5 to 38 square miles. Suspended sediment loads in the smallest watershed increased by 250 percent, and the estimated sediment yield from the construction area was 37 tons/acre during a 2-year period (Hainly, R.A. 1980. *The Effects of Highway Construction on Sediment Discharge into Blockhouse Creek and Stream Valley Run, Pennsylvania*. USGS Water Resources Investigations Report 80–68. Harrisburg, PA). A more recent study in Hawaii showed that highway construction increased suspended sediment loads by 56 to 76 percent in three small (1 to 4 square mile) basins (Hill, B.R. 1996. *Streamflow and Suspended-Sediment Loads Before and During Highway Construction, North Halawa, Haiku, and Kamooalii Drainage Basins, Oahu, Hawaii, 1983–91*. USGS Water Resources Investigations Report 96–4259. Honolulu, HI). A 1970 study determined that sediment yields from construction areas can be as much as 500 times the levels detected in rural areas (National Association of Counties Research Foundation. 1970. *Urban Soil Erosion and Sediment Control*. Water Pollution Control Research Series, Program #15030 DTL. Federal Water Quality Administration, U.S. Department of Interior. Washington, DC)

Yorke and Herb (Yorke, T.H., and W.J. Herb. 1978. *Effects of Urbanization on Streamflow and Sediment Transport in the Rock Creek and Anacostia River Basins, Montgomery County, Maryland, 1962–74*. USGS Professional Paper 1003, Washington, DC) evaluated nine subbasins in the Maryland portion of the Anacostia watershed for more than a decade in an effort to define the impacts of changing land use/land cover on sediment in runoff. Average annual suspended sediment yields for construction sites ranged from 7 to 100 tons/acre. Storm water discharges from construction sites that occur when the land area is disturbed (and prior to

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surface stabilization) can significantly impact designated uses. Examples of designated uses include public water supply, recreation, and propagation of fish and wildlife. The siltation process described previously can threaten all three designated uses by (1) depositing high concentrations of pollutants in public water supplies; (2) decreasing the depth of a waterbody, which can reduce the volume of a reservoir or result in limited use of a water body by boaters, swimmers, and other recreational enthusiasts; and (3) directly impairing the habitat of fish and other aquatic species, which can limit their ability to reproduce.

Excess sediment can cause a number of other problems for waterbodies. It is associated with increased turbidity and reduced light penetration in the water column, as well as more long-term effects associated with habitat destruction and increased difficulty in filtering drinking water. Numerous studies have examined the effect that excess sediment has on aquatic ecosystems. For example, sediment from road construction activity in Northern Virginia reduced aquatic insect and fish communities by up to 85 percent and 40 percent, respectively (Reed, J.R. 1997. "Stream Community Responses to Road Construction Sediments." Bulletin No. 97. Virginia Water Resources Research Center, Virginia Polytechnic Institute, Blacksburg, VA. As cited in Klein, R.D. 1990. *A Survey of Quality of Erosion and Sediment Control and Storm Water Management in the Chesapeake Bay Watershed*. Annapolis, MD: Chesapeake Bay Foundation). Other studies have shown that fine sediment (fine sand or smaller) adversely affects aquatic ecosystems by reducing light penetration, impeding sight-feeding, smothering benthic organisms, abrading gills and other sensitive structures, reducing habitat by clogging interstitial spaces within a streambed, and reducing the intergravel dissolved oxygen by reducing the permeability of the bed material (Everest, F.H., J.C. Beschta, K.V. Scrivener, J.R. Koski, J.R. Sedell, and C.J. Cederholm. 1987. "Fine Sediment and Salmonid Production: A Paradox." *Streamside Management: Forestry and Fishery Interactions*, Contract No. 57, Institute of Forest Resources, University of Washington, Seattle, WA). For example, 4.8 and 5.6 kilometers of stream below construction sites in the Patuxent River watershed in Maryland were found to have fine sediment amounts 15 times greater than normal (Fox, 1974. As cited in Klein, 1979). Benthic organisms in the streambed can be smothered by sediment deposits, causing changes in aquatic flora and fauna, such as fish species composition (Wolman and Schick, 1967). In addition, the primary cause of coral reef degradation in coastal areas is attributed to land disturbances and dredging activities due to urban development (Rogers, C.S. 1990. "Responses of Coral Reefs and Reef Organizations to Sedimentation." *Marine Ecology Progress Series*, 62:185–202).

EPA believes that the water quality impact from small construction sites is as high as or higher than the impact from larger sites on a per acre basis. The concentration of pollutants in the runoff from smaller sites is similar to the concentrations in the runoff from larger sites. The proportion of sediment that makes it from the construction site to surface waters is likely the same for larger and smaller construction sites in urban areas because the runoff from either site is usually delivered directly to the storm drain network where there is no opportunity for the sediment to be filtered out.

The expected contribution of total sediment yields from small sites depends, in part, on the extent to which erosion and sedimentation controls are being applied. Because current storm water regulations are more likely to require erosion and sedimentation controls on larger sites in urban areas, smaller construction sites that lack such programs are likely to contribute a disproportionate amount of the total sediment from construction activities (MacDonald, L.H. 1997. *Technical Justification for Regulating Construction Sites 1–5 Acres in Size*. Unpublished report submitted to U.S. EPA, Washington, DC). Smaller construction sites are less likely to have an effective plan to control erosion and sedimentation, are less likely to properly implement and maintain their plans, and are less likely to be inspected (Brown, W. and D. Caraco. 1997. *Controlling Storm Water Runoff Discharges from Small Construction Sites: A National Review*. Submitted to Office of Wastewater Management, U.S. EPA, Washington, DC., by the Center for Watershed Protection, Silver Spring, MD). The proportion of sediment that makes it from the construction site to surface waters is likely the same for larger and smaller construction sites in urban areas because the runoff from either site is usually delivered directly to the storm drain network, where there is no opportunity for the sediment to be filtered out.

To confirm its belief that sediment yields from small sites are as high as or higher than the 20 to 150 tons/acre/year measured from larger sites, EPA gave a grant to the Dane County, Wisconsin Land Conservation Department, in cooperation with the USGS, to evaluate sediment runoff from two small construction sites. The first was a 0.34 acre residential lot and the second was a 1.72 acre commercial office development. Runoff from the sites was channeled to a single discharge point for monitoring. Each site was monitored before, during, and after construction.

The Dane County study found that total solids concentrations from these small sites are similar to total solids concentrations from larger construction sites. Results show that for both of the study sites, total solids and suspended solids concentrations were significantly higher during construction than either before or after construction. For example, preconstruction total solids concentrations averaged 642 mg/L during the period when ryegrass was established, active construction total solids concentrations averaged 2,788 mg/L, and post-construction total solids concentrations averaged 132 mg/L (on a pollutant load basis, this equaled 7.4 lbs preconstruction, 35 lbs during construction, and 0.6 lbs post-construction for total solids). While this site was not properly stabilized before construction, after construction was complete and the site was stabilized, post-construction concentrations were more than 20 times less than during construction. The results were even more dramatic for the commercial site. The commercial site had one preconstruction event, which resulted in total solids concentrations of 138 mg/L, while active construction averaged more than 15,000 mg/L and post-construction averaged only 200 mg/L (on a pollutant load basis, this equaled 0.3 lbs preconstruction, 490 lbs during construction, and 13.4 lbs post-construction for total solids). The active construction period resulted in more than 75 times more sediment than either before or after construction (Owens, D.W., P. Jopke, D.W. Hall, J. Balousek and A. Roa. 1999. "Soil Erosion from Small Construction Sites." Draft USGS Fact Sheet. USGS and Dane County Land Conservation Department, WI). The total solids concentrations from these small sites in Wisconsin are similar to total solids concentrations from larger construction sites. For example, a study evaluating the effects of highway construction in West Virginia found that a small storm produced a sediment concentration of 7,520 mg/L (Downs and Appel, 1986).

One important aspect of small construction sites is the number of small sites relative to larger construction sites

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and total land area within the watershed. Brown and Caraco surveyed 219 local jurisdictions to assess erosion and sediment control (ESC) programs. Seventy respondents provided data on the number of ESC permits for construction sites smaller than 5 acres. In 27 cases (38 percent of the respondents), more than three-quarters of the permits were for sites smaller than 5 acres; in another 18 cases (26 percent), more than half of the permits were for sites smaller than 5 acres.

In addition, data on the total acreage disturbed by smaller construction sites have been collected recently in two States (MacDonald, 1997). The most recent and complete data set is the listing of the disturbed area for each of the 3,831 construction sites permitted in North Carolina for 1994–1995 and 1995–1996. Nearly 61 percent of the sites that were 1 acre or larger were between 1.0 and 4.9 acres in size. This proportion was consistent between years. Data showed that this range of sites accounted for 18 percent of the total area disturbed by construction. The values showed very little variation between the 2 years of data. The total disturbed area for all sites over this 2-year period was nearly 33,000 acres, or about 0.1 percent of the total area of North Carolina.

EPA estimates that construction sites disturbing greater than 5 acres disturb 2.1-million acres of land (78.1 percent of the total) while sites disturbing between 1 and 5 acres of land disturb 0.5-million acres of land (19.4 percent). The remaining sites on less than 1 acres of land disturb 0.07-million acres of land (only 2.5 percent of the total). Given the high erosion rates associated with most construction sites, small construction sites can be a significant source of water quality impairment, particularly in small watersheds that are undergoing rapid development. Exempting sites under 1 acre will exclude only about 2.5 percent of acreage from program coverage, but will exclude a far higher number of sites, approximately 25 percent.

Several studies have determined that the most effective construction runoff control programs rely on local plan review and field enforcement (Paterson, R. G. 1994. "Construction Practices: the Good, the Bad, and the Ugly." *Watershed Protection Techniques* 1(3)). In his review, Paterson suggests that, given the critical importance of field implementation of erosion and sediment control programs and the apparent shortcomings that exist, much more focus should be given to plan implementation.

Several commenters disputed the data presented in the proposed rule for storm water discharges from smaller construction sites. One commenter stated that EPA has not adequately explained the basis for permitting construction activity down to 1 disturbed acre. Another commenter stated that EPA did not present sufficient data on water quality impacts from construction sites disturbing less than 5 acres.

EPA believes that the data presented above sufficiently support nationwide designation of storm water discharges from construction activity disturbing more than 1 acre. Based on total disturbed land area within a watershed, the cumulative effects of numerous small construction sites can have impacts similar to those of larger sites in a particular area. In addition, waivers for storm water discharges from smaller construction activity will exclude sites not expected to impair water quality. EPA will continue to collect water quality data on construction site storm water runoff.

C. Statutory Background

In 1972, Congress enacted the CWA to prohibit the discharge of any pollutant to waters of the United States from a point source unless the discharge is authorized by an NPDES permit. Congress added CWA section 402(p) in 1987 to require implementation of a comprehensive program for addressing storm water discharges. Section 402(p)(1) required EPA or NPDES-authorized States or Tribes to issue NPDES permits for the following five classes of storm water discharges composed entirely of storm water ("storm water discharges") specifically listed under section 402(p)(2):

(A) a discharge subject to an NPDES permit before February 4, 1987

(B) a discharge associated with industrial activity

(C) a discharge from a municipal separate storm sewer system serving a population of 250,000 or more

(D) a discharge from a municipal separate storm sewer system serving a population of 100,000 or more but less than 250,000

(E) a discharge that an NPDES permitting authority determines to be contributing to a violation of a water quality standard or a significant contributor of pollutants to the waters of the United States.

Section 402(p)(3)(A) requires storm water discharges associated with industrial activity to meet all applicable provisions of section 402 and section 301 of the CWA, including technology-based requirements and any more stringent requirements necessary to meet water quality standards. Section 402(p)(3)(B) establishes NPDES permit standards for discharges from municipal separate storm sewer systems, or MS4s. NPDES permits for discharges from MS4s (1) may be issued on a system or jurisdiction-wide basis, (2) must include a requirement to effectively prohibit non-storm water discharges into the storm sewers, and (3) must require controls to reduce pollutant discharges to the maximum extent practicable, including best management practices, and other provisions as the Administrator or the States determine to be appropriate for the control of such pollutants. At this time, EPA determines that water quality-based controls, implemented through the iterative processes described today are appropriate for the control of such pollutants and will result in reasonable further progress towards attainment of water quality standards. See sections II.L and II.H.3 of the preamble.

In CWA section 402(p)(4), Congress established statutory deadlines for the initial steps in implementing the NPDES program for storm water discharges. This section required development of NPDES permit application regulations, submission of NPDES permit applications, issuance of NPDES permits for sources identified in section 402(p)(2), and compliance with NPDES permit conditions. In addition, this section required industrial facilities and large MS4s to submit NPDES permit applications for storm water discharges by February 4, 1990. Medium MS4s were to submit NPDES permit applications by February 4, 1992. EPA and authorized NPDES States were prohibited from requiring an NPDES permit for any other storm water discharges until October 1, 1994.

Section 402(p)(5) required EPA to conduct certain studies and submit a report to Congress. This requirement is discussed in the following section.

Section 402(p)(6) requires EPA, in consultation with States and local officials, to issue regulations for the designation of additional storm water discharges to be regulated to protect water quality. It also requires EPA to extend the existing storm water program to regulate newly designated sources. At a minimum, the extension must establish (1) priorities, (2) requirements for State storm water management programs, and (3) expeditious deadlines. Section 402(p)(6) specifies that the program may include performance standards, guidelines, guidance, and management practices and treatment requirements, as appropriate. Today's rule implements this section.

D. EPA's Reports to Congress

Under CWA section 402(p)(5), EPA, in consultation with the States, was required to conduct a study. The study was to identify unregulated sources of storm water discharges, determine the nature and extent of pollutants in such discharges, and establish procedures and methods to mitigate the impacts of such discharges on water quality. Section 402(p)(5) also required EPA to report the results of the first two components of that study to Congress by October 1, 1988, and the final report by October 1, 1989.

In March 1995, EPA submitted to Congress a report that reviewed and analyzed the nature of storm water discharges from municipal and industrialacilities that were not already regulated under the initial NPDES regulations for storm water (U.S. Environmental Protection Agency, Office of Water. 1995. *Storm Water Discharges Potentially Addressed by Phase II of the National Pollutant Discharge Elimination System Storm Water Program: Report to Congress.* Washington, D.C. EPA 833-K-94-002) ("Report"). The Report also analyzed associated pollutant loadings and water quality impacts from these unregulated sources. Based on identification of unregulated municipal sources and analysis of information on impacts of storm water discharges from municipal sources, the Report recommended that the NPDES program for storm water focus on the 405 "urbanized areas" identified by the Bureau of the Census. The Report further found that a number of discharges from unregulated industrial facilities warranted further investigation to determine the need for regulation. It classified these unregulated industrial discharges in two groups: Group A and Group B. Group A comprised sources that may be considered a high priority for inclusion in the NPDES program for storm water because discharges from these sources are similar or identical to already regulated sources. These "look alike" storm water discharge sources were not covered in the initial NPDES regulations for storm water due to the language used to define "associated with industrial activity." In the initial regulations for storm water, "industrial activity" is identified using Standard Industrial Classification (SIC) codes. The use of SIC codes led to incomplete categorization of industrial activities with discharges that needed to be regulated to protect water quality. Group B consisted of 18 industrial sectors, which included sources that EPA expected to contribute to storm water contamination due to the activities conducted and pollutants anticipated onsite (e.g., vehicle maintenance, machinery and electrical repair, and intensive agricultural activities).

EPA reported on the latter component of the section 402(p)(5) study via President Clinton's Clean Water Initiative, which was released on February 1, 1994 (U.S. Environmental Protection Agency, Office of Water. 1994. *President Clinton's Clean Water Initiative.* Washington, D.C. EPA 800-R-94-001) ("Initiative"). The Initiative addressed a number of issues associated with NPDES requirements for storm water discharges and proposed (1) establishing a phased compliance with a water quality standards approach for discharges from municipal separate storm sewer systems with priority on controlling discharges from municipal growth and development areas, (2) clarifying that the maximum extent practicable standard should be applied in a site-specific, flexible manner, taking into account cost considerations as well as water quality effects, (3) providing an exemption from the NPDES program for storm water discharges from industrial facilities with no activities or significant materials exposed to storm water, (4) providing extensions to the statutory deadlines to complete implementation of the NPDES program for the storm water program, (5) targeting urbanized areas for the requirements in the NPDES program for storm water, and (6) providing control of discharges from inactive and abandoned mines located on Federal lands in a more targeted, flexible manner. Additionally, prior to promulgation of today's rule, section 431 of the Agency's Appropriation Act for FY 2000 (Departments of Veterans Affairs and Housing and Urban Development and Independent Agencies Appropriations Act of 2000, Public Law 106-74, section 432 (1999)) directed EPA to report on certain matters to be covered in today's rule. That report supplements the study required by CWA Section 402(p)(5). EPA is publishing the availability of that report elsewhere in this issue of the **Federal Register.**

Several commenters asserted that the Report to Congress is an inadequate basis for the designation and regulation of sources covered under today's final rule, specifically the nationwide designation of small municipal separate storm sewer systems within urbanized areas and construction activities disturbing between one and five acres.

EPA believes that it has developed an adequate record for today's regulation both through the Report to Congress a. the Clean Water Initiative and through more recent activities, including the FACA Subcommittee process, regulatory notices and evaluation of comments, and recent research and analysis. EPA does not interpret the congressional reporting requirements of CWA section 402(p)(5) to be the sole basis for determining sources to be regulated under today's final rule.

EPA's decision to designate on a national basis small MS4s in urbanized areas is supported by studies that clearly show a direct correlation between urbanization and adverse water quality impacts from storm water discharges. (Schueler, T. 1987. *Controlling Urban Runoff: A Practical Manual for Planning & Designing Urban BMPs.* Metropolitan Washington Council of Governments). "Urbanized areas"—within which all small MS4s would be covered—represent the most intensely developed and dense areas of the Nation. They constitute only two percent of the land area but 63 percent of the total population. See section I.B.1, Urban Development, above, for studies and assessments of the link between urban development and storm water impacts on water resources.

Commenters argued that the Report to Congress does not address storm water discharges from construction sites. They further argued that the designation of small construction sites per today's final rule goes beyond the President's 1994 Initiative because the Initiative only recommends requiring municipalities to implement a storm water management program to control unregulated storm water sources, "including discharges from construction of less than 5 acres, which are part of growth, development and significant redevelopment activities." They point out that the Initiative provides that unregulated storm water discharges not addressed through a municipal program would not be covered by the NPDES program. Commenters assert that EPA has not developed a record independent of its section 402(p)(5) studies that demonstrates the necessity of regulating under a separate NPDES permit storm water discharges from smaller construction sites "to protect water quality." EPA disagrees.

EPA evaluated the nature and extent of pollutants from construction site sources in a process that was separate and distinct from the development of the Report to Congress. Today's decision to regulate certain storm water discharges from construction sites disturbing less than 5 acres arose in part

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out of the 9th Circuit remand in *NRDC v. EPA*, 966 F.2d 1292 (9th Cir. 1992). In that case, the court remanded portions of the Phase I storm water regulations related to discharges from construction sites. Those regulations define "storm water discharges associated with industrial activity" to include only those storm water discharges from construction sites disturbing 5 acres or more of total land area (see 40 CFR 122.26(b)(14)(x)). In its decision, the court concluded that the 5-acre threshold was improper because the Agency had failed to identify information "to support its perception that construction activities on less than 5 acres are non-industrial in nature" (966 F.2d at 1306). The court remanded the below 5 acre exemption to EPA for further proceedings (966 F.2d at 1310).

In a **Federal Register** notice issued on December 18, 1992, EPA noted that it did not believe that the Court's decision had the effect of automatically subjecting small construction sites to the existing application requirements and deadlines. EPA believed that additional notice and comment were necessary to clarify the status of these sites. The information received during the notice and comment process and additional research, as discussed in section I.B.3 Construction Site Runoff, formed the basis for the designation of construction activity disturbing between one and five acres on a nationwide basis. EPA's objectives in today's proposal include an effort to (1) address the 9th Circuit remand, (2) address water quality concerns associated with construction activities that disturb less than 5 acres of land, and (3) balance conflicting recommendations and concerns of stakeholders.

One commenter noted that EPA's proposal would fail to regulate industrial facilities identified as Group A and Group B in the March 1995 *Report to Congress*. EPA is relying on the analysis in the Report, which provided that the recommendation for coverage was meant as guidance and was not intended to be an identification of specific categories that must be regulated under Section 402(p)(6). *Report to Congress*, p. 4–1. The Report recognized the existence of limited data on which to base loadings estimates to support the nationwide designation of individual or categories of sources. *Report to Congress*, p. 4–44. Furthermore, during FACA Subcommittee discussion, EPA continued to urge stakeholders to provide further data relating to industrial and commercial storm water sources, which EPA did not receive. EPA concluded that, due to insufficient data, these sources were not appropriate for nationwide designation at this time.

E. Industrial Facilities Owned or Operated by Small Municipalities

Congress granted extensions to the NPDES permit application process for selected classes of storm water discharges associated with industrial activity. On December 18, 1991, Congress enacted the Intermodal Surface Transportation Efficiency Act (ISTEA), which postponed NPDES permit application deadlines for most storm water discharges associated with industrial activity at facilities that are owned or operated by small municipalities. EPA and States authorized to administer the NPDES program could not require any municipality with a population of less than 100,000 to apply for or obtain an NPDES permit for any storm water discharge associated with industrial activity prior to October 1, 1992, except for storm water discharges from airports, power plants, or uncontrolled sanitary landfills. See 40 CFR 122.26(e)(1); 57 FR 11524, April 2, 1992 (reservation of NPDES application deadlines for ISTEA facilities).

The facilities exempted by ISTEA discharge storm water in the same manner (and are expected to use identical processes and materials) as the industrial facilities regulated under the 1990 Phase I regulations. Accordingly, these facilities pose similar water quality problems. The extended moratorium for these facilities was necessary to allow municipalities additional time to comply with NPDES requirements. The proposal for today's rule would have maintained the existing deadline for seeking coverage under an NPDES permit (August 7, 2001).

Today's rule changes the permit application deadline for such municipally owned or operated facilities discharging industrial storm water to make it consistent with the application date for small regulated MS4s. Because EPA missed its March 1999 deadline for promulgating today's rule, and the deadline for MS4s to submit permit applications has been extended to three years and 90 days from the date of this notice, the deadline for permitting ISTEA sources has been similarly extended. The permitting of these sources is discussed below in section "II.I.3. ISTEA Sources."

F. Related Nonpoint Source Programs

Today's rule addresses point source discharges of storm water runoff and non-storm water discharges into MS4s. Many of these sources have been addressed by nonpoint source control programs, which are described briefly below.

In 1987, section 319 was added to the CWA to provide a framework for funding State and local efforts to address pollutants from nonpoint sources not addressed by the NPDES program. To obtain funding, States are required to submit Nonpoint Source Assessment Reports identifying State waters that, without additional control of nonpoint sources of pollution, could not reasonably be expected to attain or maintain applicable water quality standards or other goals and requirements of the CWA. States are also required to prepare and submit for EPA approval a statewide Nonpoint Source Management Program for controlling nonpoint source water pollution to navigable waters within the State and improving the quality of such waters. State program submittals must identify specific best management practices (BMPs) and measures that the State proposes to implement in the first four years after program submission to reduce pollutant loadings from identified nonpoint sources to levels required to achieve the stated water quality objectives.

State nonpoint source programs funded under section 319 can include both regulatory and nonregulatory State and local approaches. Section 319(b)(2)(B) specifies that a combination of "nonregulatory or regulatory programs for enforcement, technical assistance, financial assistance, education, training, technology transfer, and demonstration projects' may be used, as necessary, to achieve implementation of the BMPs or measures identified in the section 319 submittals.

Section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA) of 1990 provides that States with approved coastal zone management programs must develop coastal nonpoint pollution control programs and submit them to EPA and the National Oceanic and Atmospheric Administration (NOAA) for approval. Failure to submit an approvable program will result in a reduction of Federal grants under both the Coastal Zone Management Act and section 319 of the CWA.

State coastal nonpoint pollution control programs under CZARA must include enforceable policies and mechanisms that ensure implementation of the management measures throughout the coastal management area. *EPA issued Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* under section 6217(g) in

January 1993. The guidance identifies management measures for five major categories of nonpoint source pollution. The management measures reflect the greatest degree of pollutant reduction that is economically achievable for each of the listed sources. These management measures provide reference standards for the States to use in developing or refining their coastal nonpoint programs. A few management measures, however, contain quantitative standards that specify pollutant loading reductions. For example, the New Development Management Measure, which is applicable to construction in urban areas, requires (1) that by design or performance the average annual total suspended solid loadings be reduced by 80 percent and (2) to the extent practicable, that the pre-development peak runoff rate and average volume be maintained.

EPA and NOAA published *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance* (1993). The document clarifies that States generally must implement management measures for each source category identified in the EPA guidance developed under section 6217(g). Coastal Nonpoint Pollution Control Programs are not required to address sources that are clearly regulated under the NPDES program as point source discharges. Specifically, such programs would not need to address small MS4s and construction sites covered under NPDES storm water permits (both general and individual).

II. Description of Program

A. Overview

1. Objectives EPA Seeks To Achieve in Today's Rule

EPA seeks to achieve several objectives in today's final rule. First, EPA is implementing the requirement under CWA section 402(p)(6) to provide a comprehensive storm water program that designates and controls additional sources of storm water discharges to protect water quality. Second, EPA is addressing storm water discharges from the activities exempted under the 1990 storm water permit application regulations that were remanded by the Ninth Circuit Court of Appeals in NRDC v. EPA, 966 F.2d 1292 (9th Circuit, 1992). These are construction activities disturbing less than 5 acres and so-called "light" industrial activities not exposed to storm water (see discussion of "no exposure" below). Third, EPA is providing coverage for the so-called "donut holes" created by the existing NPDES storm water program. Donut holes are geographic gaps in the NPDES storm water program's regulatory scheme. They are MS4s located within areas covered by the existing NPDES storm water program, but not currently addressed by the storm water program because it is based on political jurisdictions. Finally, EPA also is trying to promote watershed planning as a framework for implementing water quality programs where possible.

Although EPA had options for different approaches (see alternatives discussed in the January 9, 1998, proposed regulation), EPA believes it can best achieve its objectives through flexible innovations within the framework of the NPDES program. Unlike the interim section 402(p)(6) storm water regulations EPA promulgated in 1995, EPA no longer designates all of the unregulated storm water discharges for nationwide coverage under the NPDES program for storm water. The framework for today's final rule is one that balances automatic designation on a nationwide basis and locally-based designation and waivers. Nationwide designation applies to the classes or categories of storm water discharges that EPA believes present a high likelihood of having adverse water quality impacts, regardless of location. Specifically, today's rule designates discharges from small MS4s located in urbanized areas and storm water discharges from construction activities that result in land disturbance equal to or greater than one and less than five acres. As noted under Section I.B., Water Quality Concerns/Environmental Impact Studies and Assessments, these two categories of storm water sources, when unregulated, tend to cause significant adverse water quality impacts. Additional sources are not covered on a nationwide basis either because EPA currently lacks information indicating a consistent potential for adverse water quality impact or because EPA believes that the likelihood of adverse impacts on water quality is low, with some localized exceptions. Additional individual sources or categories of storm water discharges could, however, be covered under the program through a local designation process. A permitting authority may designate additional small MS4s after developing designation criteria and applying those criteria to small MS4s located outside of an urbanized area, in particular those with a population of 10,000 or more and a population density of at least 1,000. Exhibit 1 illustrates the designation framework for today's final rule.

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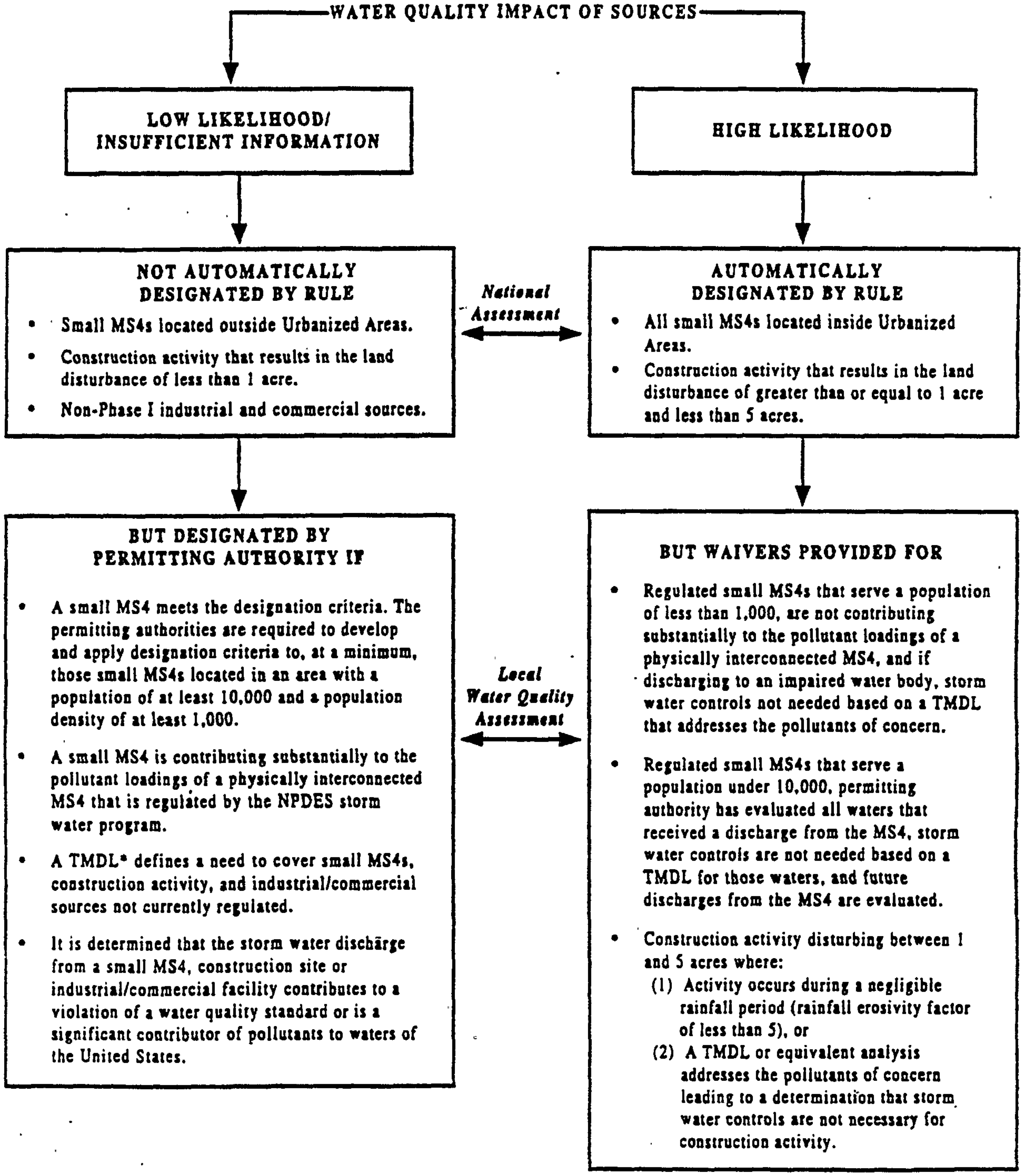
EXHIBIT 1.—PHASE II SOURCE DECISIONS



*EPA will continue to require States to comply with their Total Maximum Daily Load (TMDL) implementation schedules.

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The designation framework for today's final rule provides a significant degree of flexibility. The proposed provisions for nationwide designation of storm water discharges from construction and from small MS4s in urbanized areas allowed for a waiver of applicable requirements based on appropriate water quality conditions. Today's final rule expands and simplifies those waivers.

The permitting authority may waive the requirement for a permit for any small MS4 serving a jurisdiction with a population of less than 1,000 unless storm water controls are needed because the MS4 is contributing to a water quality impairment. The permitting authority may also waive permit coverage for MS4s serving a jurisdiction with a population of less than 10,000 if all waters that receive a discharge from the MS4 have been evaluated and discharges from the MS4 do not significantly contribute to a water quality impairment or have the potential to cause an impairment. Today's rule also allows States with a watershed permitting approach to phase in coverage for MS4s in jurisdictions with populations under 10,000.

Water quality conditions are also the basis for a waiver of requirements for storm water discharges from construction activities disturbing between one and five acres. For these small construction sources, the rule provides significant flexibility for waiving otherwise applicable regulatory requirements where a permitting authority determines, based on water quality and watershed considerations, that storm water discharge controls are not needed.

Coverage can be extended to municipal and construction sources outside the nationwide designated classes or categories based on watershed and case-by-case assessments. For the municipal storm water program, today's rule provides broad discretion to NPDES permitting authorities to develop and implement criteria for designating storm water discharges from small MS4s outside of urbanized areas. Other storm water discharges from unregulated industrial, commercial, and residential sources will not be subject to the NPDES permit requirements unless a permitting authority determines on a case-by-case basis (or on a categorical basis within identified geographic areas such as a State or watershed) that regulatory controls are needed to protect water quality. EPA believes that the flexibility provided in today's rule facilitates watershed planning.

2. General Requirements for Regulated Entities Under Today's Rule

As previously noted, today's final rule defines additional classes and categories of storm water discharges for coverage under the NPDES program. These designated dischargers are required to seek coverage under an NPDES permit. Furthermore, all NPDES-authorized States and Tribes are required to implement these provisions and make any necessary amendments to current State and Tribal NPDES regulations to ensure consistency with today's final rule. EPA remains the NPDES permitting authority for jurisdictions without NPDES authorization.

Today's final rule includes some new requirements for NPDES permitting authorities implementing the CWA section 402(p)(6) program. EPA has made a significant effort to build flexibility into the program while attempting to maintain an appropriate level of national consistency. Permitting authorities must ensure that NPDES permits issued to MS4s include the minimum control measures established under the program. Permitting authorities also have the ability to make numerous decisions including who is regulated under the program, i.e., case-by-case designations and waivers, and how responsibilities should be allocated between regulated entities.

Today's final rule extends the NPDES program to include discharges from the following: small MS4s within urbanized areas (with the exception of systems waived from the requirements by the NPDES permitting authority); other small MS4s meeting designation criteria to be established by the permitting authority; and any remaining MS4 that contributes substantially to the storm water pollutant loadings of a physically interconnected MS4 already subject to regulation under the NPDES program. Small MS4s include urban storm sewer systems owned by Tribes, States, political subdivisions of States, as well as the United States, and other systems located within an urbanized area that fall within the definition of an MS4. These include, for example, State departments of transportation (DOTs), public universities, and federal military bases.

Today's final rule requires all regulated small MS4s to develop and implement a storm water management program. Program components include, at a minimum, 6 minimum measures to address: public education and outreach; public involvement; illicit discharge detection and elimination; construction site runoff control; post-construction storm water management in new development and redevelopment; and pollution prevention and good housekeeping of municipal operations. These program components will be implemented through NPDES permits. A regulated small MS4 is required to submit to the NPDES permitting authority, either in its notice of intent (NOI) or individual permit application, the BMPs to be implemented and the measurable goals for each of the minimum control measures listed above.

The rule addresses all storm water discharges from construction site activities involving clearing, grading and excavating land equal to or greater than 1 acre and less than 5 acres, unless requirements are otherwise waived by the NPDES permitting authority. Discharges from such sites, as well as construction sites disturbing less than 1 acre of land that are designated by the permitting authority, are required to implement requirements set forth in the NPDES permit, which may reference the requirements of a qualifying local program issued to cover such discharges.

The rule also addresses certain other sources regulated under the existing NPDES program for storm water. For municipally-owned industrial sources required to be regulated under the existing NPDES storm water program but exempted from immediate compliance by the Intermodal Surface Transportation Act of 1991 (ISTEA), the rule revises the existing deadline for seeking coverage under an NPDES permit (August 7, 2001) to make it consistent with the application date for small regulated MS4s. (See section I.3. below.) The rule also provides relief from NPDES storm water permitting requirements for industrial sources with no exposure of industrial materials and activities to storm water.

3. Integration of Today's Rule With the Existing Storm Water Program

In developing an approach for today's final rule, numerous early interested stakeholders encouraged EPA to seek opportunities to integrate, where possible, the proposed Phase II requirements with existing Phase I requirements, thus facilitating a unified storm water discharge control program. EPA believes that this objective is met by using the NPDES framework. This framework is already applied to regulated storm water discharge sources and is extended to those sources designated under today's rule. This approach facilitates program consistency, public access to information, and program oversight.

EPA believes that today's final rule provides consistency in terms of program coverage and requirements for existing and newly designated sources. For example, the rule includes most of the municipal donut holes, those MS4s located in incorporated places, townships or towns with a population under 100,000 that are within Phase I counties. These MS4s are not addressed by the existing NPDES storm water program while MS4s in the surrounding county are currently addressed. In addition, the minimum control measures required in today's rule for regulated small MS4s are very similar to a number of the permit requirements for medium and large MS4s under the existing storm water program. Following today's rule, permit requirements for all regulated MS4s (both those under the existing program and those under today's rule) will require implementation of BMPs. Furthermore, with regard to the development of NPDES permits to protect water quality, EPA intends to apply the August 1, 1996, *Interim Permitting Approach for Water Quality-Based Effluent Limitations in Storm Water Permits* (hereinafter, "Interim Permitting Approach") (see Section II.L.1. for further description) to all MS4s covered by the NPDES program.

EPA is applying NPDES permit requirements to construction sites below 5 acres that are similar to the existing requirements for those above 5 acres and above. In addition, today's rule allows compliance with qualifying local, Tribal, or State erosion and sediment controls to meet the erosion and sediment control requirements of the general permits for storm water discharges associated with construction, both above and below 5 acres.

4. General Permits

EPA recommends using general permits for all newly regulated storm water sources under today's rule. The use of general permits, instead of individual permits, reduces the administrative burden on permitting authorities, while also limiting the paperwork burden on regulated parties seeking permit authorization. Permitting authorities may, of course, require individual permits in some cases to address specific concerns, including permit non-compliance.

EPA recommends that general permits for MS4s, in particular, be issued on a watershed basis, but recognizes that each permitting authority must decide how to develop its general permit(s). Permit conditions developed to address concerns and conditions of a specific watershed could reflect a watershed plan; such permit conditions must provide for attainment of applicable water quality standards (including designated uses), allocations of pollutant loads established by a TMDL, and timing requirements for implementation of a TMDL. If the permitting authority issues a State-wide general permit, the permitting authority may include separate conditions tailored to individual watersheds or urbanized areas. Of course, for a newly regulated MS4, modification of an existing individual MS4 permit to include the newly regulated MS4 as a "limited co-permittee" also remains an option.

5. Tool Box

During the FACA process, many Storm Water Phase II FACA Subcommittee representatives expressed an interest, which was endorsed by the full Committee, in having EPA develop a "tool box" to assist States, Tribes, municipalities, and other parties involved in the Phase II program. EPA made a commitment to work with Storm Water Phase II FACA Subcommittee representatives in developing such a tool box, with the expectation that a tool box would facilitate implementation of the storm water program in an effective and cost-efficient manner. EPA has developed a preliminary working tool box (available on EPA's web page at www.epa.gov/owm/sw/toolbox). EPA intends to have the tool box fully developed by the time of the first general permits. EPA also intends to update the tool box as resources and data become available. The tool box will include the following eight main components: fact sheets; guidances; a menu of BMPs for the six MS4 minimum measures; an information clearinghouse; training and outreach efforts; technical research; support for demonstration projects; and compliance monitoring/assistance tools. EPA intends to issue the menu of BMPs, both structural and non-structural, by October 2000. In addition, EPA will issue by October 2000 a "model" permit and will issue by October 2001 guidance materials on the development of measurable goals for municipal programs.

In an attempt to avoid duplication, the Agency has undertaken an effort to identify and coordinate sources of information that relate to the storm water discharge control program from both inside and outside the Agency. Such information includes research and demonstration projects, grants, storm water management-related programs, and compendiums of available documents, including guidances, related directly or indirectly to the comprehensive NPDES storm water program. Based on this effort, EPA is developing a tool box containing fact sheets and guidance documents pertaining to the overall program and rule requirements (e.g., guidance on municipal and construction programs, and permitting authority guidance on designation and waiver criteria); models of current programs aimed at assisting States, Tribes, municipalities, and others in establishing programs; a comprehensive list of reference documents organized according to subject area (e.g., illicit discharges, watersheds, water quality standards attainment, funding sources, and similar types of references); educational materials; technical research data; and demonstration project results. The information collected by EPA will not only provide the background for tool box materials, but will also be made available through an information clearinghouse on the world wide web.

With assistance from EPA, the American Public Works Association (APWA) developed a workbook and series of workshops on the proposed Phase II rule. Ten workshops were held from September 1998 through May 1999. Depending on available funding, these workshops may continue after publication of today's final rule. EPA also intends to provide training to enable regional offices to educate States, Tribes, and municipalities about the storm water program and the availability of the tool box materials.

The CWA currently provides funding mechanisms to support activities related to storm water. These mechanisms will be described in the tool box. Activities funded under grant and loan programs, which could be used to assist in storm water program development, include programs in the nonpoint source area, storm water demonstration projects, source water protection and wastewater construction projects. EPA has already provided funding for numerous research efforts in these areas, including a database of BMP effectiveness studies (described below), an assessment of technologies for storm water management, a study of the effectiveness of storm water BMPs for controlling the impacts of watershed imperviousness, protocols for wet weather monitoring, development of a dynamic model for wet weather flows, and numerous outreach projects.

EPA has entered into a cooperative agreement with the Urban Water Resources Research Council of the American Society of Civil Engineers (ASCE) to develop a scientifically-based management tool for the information needed to evaluate the effectiveness of urban storm water runoff BMPs nationwide. The long-term goal of the National Stormwater BMP Database project is to promote technical design improvements for BMPs and to better match their selection and design to the local storm water problems being addressed. The project team has collected and evaluated hundreds of existing published BMP performance studies and created a database covering about 75 test sites. The database includes detailed information on the design of each BMP and its watershed characteristics, as well as its performance. Eventually the database will include the nationwide collection of information on the characteristics of structural and non-structural BMPs, data collection efforts (*e.g.*, sampling and flow gaging equipment), climatological characteristics, watershed characteristics, hydrologic data, and constituent data. The database will continue to grow as new BMP data become available. The initial release of the database, which includes data entry and retrieval software, is available on CD-ROM and operates on Windows®-compatible personal computers. The ASCE project team envisions that periodic updates to the database will be distributed through the Internet. The team is currently developing a system for Internet retrieval of selected database records, and this system is expected to be available in early 2000.

EPA and ASCE invite BMP designers, owners and operators to participate in the continuing database development effort. To make this effort successful, a large database is essential. Interested persons are encouraged to submit their BMP performance evaluation data and associated BMP watershed characteristics for potential entry into the database. The software included in the CD-ROM allows data providers to enter their BMP data locally, retain and edit the data as needed, and submit them to the ASCE Database Clearinghouse when ready.

To obtain a copy of the database, please contact Jane Clary, Database Clearinghouse Manager, Wright Water Engineers, Inc., 2490 W. 26th Ave., Suite 100A, Denver, CO 80211; Phone 303–480–1700; E-mail clary@wrightwater.com.

In addition, EPA requests that researchers planning to conduct BMP performance evaluations compile and collect BMP reporting information according to the standard format developed by ASCE. The format is provided with the database software and is also available on the ASCE website at www.asce.org/peta/tech/nsbd01.html.

6. Deadlines Established in Today's Action

Exhibit 2 outlines the various deadlines established under today's final rule. EPA believes that the dates allow sufficient time for completion of both the NPDES permitting authority's and the permittee's program responsibilities.

EXHIBIT 2—STORM WATER PHASE II ACTIONS DEADLINES

Activity	Deadline date
NPDES-authorized States modify NPDES program if no statutory change is required.	1 year from date of publication of today's rule in the **Federal Register**.
NPDES-authorized States modify NPDES program if statutory change is required.	2 years from date of publication of today's rule in the **Federal Register**.
EPA issues a menu of BMPs for regulated small MS4s	October 27, 2000
ISTEA sources submit permit application	3 years and 90 days from date of publication of today's rule in the **Federal Register**.
Permitting authority issues general permit(s) (if this type of permit coverage is selected).	3 years from date of publication of today's rule in the **Federal Register**.
Regulated small MS4s submit permit application:	
a. If designated under § 122.32(a)(1) unless the permitting authority has established a phasing schedule under § 123.35(d)(3).	a. 3 years and 90 days from date of publication of today's rule in the **Federal Register**.
b. If designated under § 122.32(a)(2) or §§ 122.26(a)(9)(i) (C) or (D).	b. Within 180 days of notice.
Storm water discharges associated with small construction activity submit permit application:	
a. If designated under § 122.26(b)(15)(i)	a. 3 years and 90 days from date of publication of today's rule in the **Federal Register**
b. If designated under § 122.26(b)(15)(ii)	b. Within 180 days of notice.
Permitting authority designates small MS4s under § 123.35(b)(2)	3 years from date of publication of today's rule in the **Federal Register** or 5 years from date of publication of today's rule in the **Federal Register** if a watershed plan is in place
Regulated small MS4s' program fully developed and implemented	Up to 5 years from date of permit issuance.
Reevaluation of the municipal storm water rules by EPA	13 years from date of publication of today's rule in the **Federal Register**
Permitting authority determination on a petition	Within 180 days of receipt.
Non-municipal sources designated under § 122.26(a)(9)(i) (C) or (D) submit permit application.	Within 180 days of notice.
Submission of No Exposure Certification	Every 5 years.

B. Readable Regulations

Today, EPA is finalizing new regulations in a "readable regulation" format. This reader-friendly, plain language approach is a departure from traditional regulatory language and should enhance the rule's readability. These plain language regulations use questions and answers, "you" to identify the person who must comply, and terms like "must" rather than "shall" to identify a mandate. This new format, which minimizes layers of subparagraphs, should also allow the reader to easily locate specific provisions of the regulation.

Some sections of today's final rule are presented in the traditional language and format because these sections amend existing regulations. The readable regulation format was not used in these existing provisions in an attempt to avoid confusion or disruption

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of the readability of the existing regulations.

Most commenters supported EPA's use of plain language and agreed with EPA that the question and answer format makes the rule easier to understand. Three commenters thought that EPA should retain the traditional rule format. The June 1, 1998, Presidential memorandum directs all government agencies to write documents in plain language. Based on the majority of the comments, EPA has retained the plain language format used in the January 9, 1998, proposal in today's final rule.

The proposal to today's final rule included guidance as well as legal requirements. The word "must" indicates a requirement. Words like "should," "could," or "encourage" indicate a recommendation or guidance. In addition, the guidance was set off in parentheses to distinguish it from requirements.

EPA received numerous comments supporting the inclusion of guidance in the text of the Code of Federal Regulations (CFR), as well as comments opposing inclusion of guidance. Supporters stated that preambles and guidance documents are often not accessible when rules are implemented. Any language not included in the CFR is therefore not available when it may be most needed. Commenters that opposed including guidance in the CFR expressed the concern that any language in the rule might be interpreted as a requirement, in spite of any clarifying language. They suggested that guidance be presented in the preamble and additional guidance documents.

The majority of commenters on this issue thought that the guidance should be retained but the distinction between requirements and guidance should be better clarified. Suggestions included clarifying text, symbols, and a change from use of the word "should" to "EPA recommends" or "EPA suggests". EPA believes that it is important to include the guidance in the rule and agrees that the distinction between requirements and EPA recommendations must be very clear. In today's final rule, EPA has put the guidance in paragraphs entitled "Guidance" and replaced the word "should" with "EPA recommends." This is intended to clarify that the recommendations contained in the guidance paragraphs are not legally binding.

C. Program Framework: NPDES Approach

Today's rule regulates Phase II sources using the NPDES permit program. EPA interprets Clean Water Act section 402(p)(6) as authorizing the Agency to develop a storm water program for Phase II sources either as part of the existing NPDES permit program or as a stand alone non-NPDES program such as a self-implementing rule. Under either approach, EPA interprets section 402(p)(6) as directing EPA to publish regulations that "regulate" the remaining unregulated sources, specifically to establish requirements that are federally enforceable under the CWA. Although EPA believes that it has the discretion to not require sources regulated under CWA section 402(p)(6) to be covered by NPDES permits, the Agency has determined, for the reasons discussed below, that it is most appropriate to use NPDES permits in implementing the program to address the sources designated for regulation in today's rule.

As discussed in Section II.A, Overview, EPA sought to achieve certain goals in today's final rule. EPA believes that the NPDES program best achieves EPA's goals for today's final rule for the reasons discussed below.

Requiring Phase II sources to be covered by NPDES permits helps address the consistency problems currently caused by municipal "donut holes." Donut holes are gaps in program coverage where a small unregulated MS4 is located next to or within a regulated larger MS4 that is subject to an NPDES permit under the Phase I NPDES storm water program. The existence of such "donut holes" creates an equity problem because similar discharges may remain unregulated even though they cause or contribute to the same adverse water quality impacts. Using NPDES permits to regulate the unregulated discharges in these areas is intended to facilitate the development of a seamless regulatory program for the mitigation and control of contaminated storm water discharges in an urbanized area. For example, today's rule allows a newly regulated MS4 to join as a "limited" co-permittee with a regulated MS4 by referencing a common storm water management program. Such cooperation should be further encouraged by the fact that the minimum control measures required in today's rule for regulated small MS4s are very similar to a number of the permit requirements for medium and large MS4s under the Phase I storm water program. The minimum control measures applicable to discharges from smaller MS4s are described with slightly more generality than under the Phase I permit application regulations for larger MS4s, thus enabling maximum flexibility for operators of smaller MS4s to optimize efforts to protect water quality.

Today's rule also applies NPDES permit requirements to construction sites below 5 acres that are similar to the existing requirements for those 5 acres and above. In addition, the rule would allow compliance with qualifying local, Tribal, or State erosion and sediment controls to meet the erosion and sediment control requirements of the general permits for storm water discharges associated with construction, both above and below 5 acres.

Incorporating the CWA section 402(p)(6) program into the NPDES program capitalizes upon the existing governmental infrastructure for administration of the NPDES program. Moreover, much of the regulated community already understands the NPDES program and the way it works.

Another goal of the NPDES program approach is to provide flexibility in order to facilitate and promote watershed planning and sensitivity to local conditions. NPDES permits promote those goals in several ways. NPDES general permits may be used to cover a category of regulated sources on a watershed basis or within political boundaries. The NPDES permitting process provides a mechanism for storm water controls tailored on a case-by-case basis, where necessary. In addition, the NPDES permit requirements of a permittee may be satisfied by another cooperating entity. Finally, NPDES permits may incorporate the requirements of existing State, Tribal and local programs, thereby accommodating State and Tribes seeking to coordinate the storm water program with other programs, including those that focus on watershed-based nonpoint source regulation.

In promoting the watershed approach to program administration, EPA believes NPDES general permits can cover a category of dischargers within a defined geographic area. Areas can be defined very broadly to include political boundaries (e.g., county), watershed boundaries, or State or Tribal land.

NPDES permits generally require an application or a notice of intent(NOI) to trigger coverage. This information exchange assures communication between the permitting authority and the regulated community. This communication is critical in ensuring that the regulated community is aware of the requirements and the permitting authority is aware of the potential for adverse impacts to water quality from identifiable locations. The NPDES permitting process includes the public as a valuable stakeholder and ensures

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that the public is included and information is made publicly available.

Another concern for EPA and several stakeholders was that the program ensure citizen participation. The NPDES approach ensures opportunities for citizen participation throughout the permit issuance process, as well as in enforcement actions. NPDES permits are also federally enforceable under the CWA.

EPA believes that the use of NPDES permits makes a significant difference in the degree of compliance with regulations in the storm water program. The NPDES program provides for public participation in the development, enforcement and revision of storm water management programs. Citizen suit enforcement has assisted in focusing attention on adverse water quality impacts on a localized, public priority basis. Citizens frequently rely on the NPDES permitting process and the availability of NOIs to track program implementation and help them enforce regulatory requirements.

NPDES permits are also advantageous to the permittee. The NPDES permit informs the permittee about the scope of what it is expected do to be in compliance with the Clean Water Act. As explained more fully in EPA's April 1995 guidance, *Policy Statement on Scope of Discharge Authorization and Shield Associated with NPDES Permits*, compliance with an NPDES permit constitutes compliance with the Clean Water Act (see CWA section 402(k)). In addition, NPDES permittees are excluded from duplicative regulatory regimes under the Resource Conservation and Recovery Act and the Comprehensive Emergency Response, Compensation and Liability Act under RCRA's exclusions to the definition of "solid waste" and CERCLA's exemption for "federally permitted releases."

EPA considered suggestions that the Agency authorize today's rule to be implemented as a self-implementing rule. This would be a regulation promulgated at the Federal, State, or Tribal level to control some or all of the storm water dischargers regulated under today's rule. Under this approach, a rule would spell out the specific requirements for dischargers and impose the restrictions and conditions that would otherwise be contained in an NPDES permit. It would be effective until modified by EPA, a State, or a Tribe, unlike an NPDES permit which cannot exceed a duration of five years. Some stakeholders believed that this approach would reduce the burden on the regulated community (e.g., by not requiring permit applications), and considerably reduce the amount of additional paperwork, staff time and accounting required to administer the proposed permit requirements.

EPA is sensitive to the interest of some stakeholders in having a streamlined program that minimizes the burden associated with permit administration and maximizes opportunities for field time spent by regulatory authorities. Key provisions in today's rule address some of these concerns by promoting a streamlined approach to permit issuance by, for example, using general permits and allowing the incorporation of existing programs. By adopting the NPDES approach rather than a self-implementing rule, today's rule also allows for consistent regulation between larger MS4s and construction sites regulated under the existing storm water management rule and smaller sources regulated under today's rule.

EPA believes that it is most appropriate to use NPDES permits to implement a program to address the sources regulated by today's rule. In addition to the reasons discussed above, NPDES permits provide a better mechanism than would a self-implementing rule for tailoring storm water controls on a case-by-case basis, where necessary. One commenter reasoned this concern could be addressed by including provisions in the regulation that allow site-specific BMPs (*i.e.*, case-by-case permits), suggesting storm water discharges that might require site-specific BMPs can be identified during the designation process of the regulatory authority. EPA believes that, in addition to its complexity, the commenter's approach lacks the other advantages of the NPDES permitting process.

A self-implementing rule would not ensure the degree of public participation that the NPDES permit process provides for the development, enforcement and revision of the storm water management program. A self-implementing rule also might not have provided the regulated community the "permit shield" under CWA section 402(k) that is provided by an NPDES permit. Based on all these considerations, EPA declined to adopt a self-implementing rule approach and adopted the NPDES approach.

Some State representatives sought alternative approaches for State implementation of the storm water program for Phase II sources. These State representatives asserted that a non-NPDES alternative approach best facilitated watershed management and avoided duplication and overlapping regulations. These representatives believed the NPDES approach would undercut State programs that had developed storm water controls tailored to local watershed concerns. Finally, a number of commenters expressed the view that States implement a variety of programs not based on the CWA that are effective in controlling storm water, and that EPA should provide incentives for their implementation and improvement in performance.

Throughout the development of the rule, State representatives sought alternatives to the NPDES approach for State implementation of the storm water program for Phase II sources. Discussions focused on an approach whereby States could develop an alternative program that EPA would approve or disapprove based on identified criteria, including that the alternative non-NPDES program would result in "equivalent or better protection of water quality." The State representatives, however, were unable to propose or recommend criteria for gauging whether a program would provide equivalent protection. EPA also did not receive any suggestions for objective, workable criteria in response to the Agency's explicit request for specific criteria (by which EPA could objectively judge such programs) in the preamble to the proposed rule.

EPA evaluated several existing State initiatives to address storm water and found many cases where standards under State programs may be coordinated with the Federal storm water program. Where the NPDES permit is developed in coordination with State standards, there are opportunities to avoid duplication and overlapping requirements. Under today's rule, an NPDES permitting authority may include conditions in the NPDES permit that direct an MS4 to follow the requirements imposed under State standards, rather than the requirements of § 122.34(b). This is allowed as long as the State program at a minimum imposes the relevant requirements of § 122.34(b). Additional opportunities follow from other provisions in today's rule.

Seeking to further explore the feasibility of a non-NPDES approach, the Agency, after the proposal, had extensive discussions with representatives of a number of States. Discussions related specifically to possible alternatives for regulations of urban storm water discharges and MS4s specifically. The Agency also sought input on these issues from other stakeholders.

As a result of these discussions, many of the commenters provided input on issues such as: whether or not the Agency should require NPDES permits; whether location of MS4s in urbanized areas should be the basis for designation or whether designation should be based on other determinations relating to water quality; whether States should be allowed to satisfy the conditions of the rule through the use of existing State programs; and issues concerning timing and resources for program implementation.

In response, today's rule still follows the regulatory scheme of the proposed rule, but incorporates additional flexibility to address some of the concerns raised by commenters.

In order to facilitate implementation by States that utilize a watershed permitting approach or similar approach (*i.e.*, based on a State's unified watershed assessments), today's rule allows States to phase in coverage for MS4s in jurisdictions with a population less than 10,000. Under such an approach, States could focus their resources on a rolling basis to assist smaller MS4s in developing storm water programs.

In addition, in response to concerns that the rule should not require permit coverage for MS4s that do not significantly contribute to water quality impairments, today's rule provides options for two waivers for small MS4s. The rule allows permitting authorities to exempt from the requirement for a permit any MS4 serving a jurisdiction with a population less than 1,000, unless the State determines that the MS4 must implement storm water controls because it is significantly contributing to a water quality impairment. A second waiver option applies to MS4s serving a jurisdiction with a population less than 10,000. For those MS4s, the State must determine that discharges from the MS4 do not significantly contribute to a water quality impairment, or have the potential for such an impairment, in order to provide the exemption. The State must review this waiver on a periodic basis no less frequently than once every five years.

Throughout the development of today's rule, commenters questioned whether the Clean Water Act authorized the use of the NPDES permit program, pointing out that the text of CWA 402(p)(6) does not use the word "permit." Based on the absence of the word "permit" and the express mention of State storm water management programs, the commenters asserted that Congress did not intend for Phase II sources to be regulated using NPDES permits.

EPA disagrees with the commenters' interpretation of section 402(p)(6). Section 402(p)(6) does not preclude use of permits as part of the "comprehensive program" to regulate designated sources. The language provides EPA with broad discretion in the establishment of the "comprehensive program." Absence of the word "permit" (a term that the statute does not otherwise define) does not preclude use of a permit, which is a familiar and reasonably well understood regulatory implementation vehicle. First, section 402(p)(6) says that EPA must establish a comprehensive program that "shall, at a minimum, establish priorities, establish requirements for State stormwater management programs, and establish expeditious deadlines." The "at a minimum" language suggests that the Agency may, and perhaps should, develop a comprehensive program that does more than merely attend to these minimum criteria. Use of the term "at a minimum" preserves for the Agency broad discretion to establish a comprehensive program that includes use of NPDES permits.

Further, in the final sentence of the section, Congress included additional language to affirm the Agency's discretion. The final sentence clarifies that the Phase II program "may include performance standards, guidelines, guidance, and management practices and treatment requirements, as appropriate." Under existing CWA programs, performance standards, (effluent limitations) guidelines, management practices, and treatment requirements are typically implemented through NPDES or dredge and fill permits.

Although EPA believes that it had the discretion to not require permits, the Agency has determined that it is reasonable to interpret section 402(p)(6) to authorize permits. Moreover, for the reasons discussed above, the Agency believes that it is appropriate to use NPDES permits in implementing today's rule.

D. Federal Role

Today's final rule describes EPA's approach to expand the existing storm water program under CWA section 402(p)(6). As in all other Federal programs, the Federal government plays an integral role in complying with, developing, implementing, overseeing, and enforcing the program. This section describes EPA's role in the revised storm water program.

1. Develop Overall Framework of the Program

The storm water discharge control program under CWA section 402(p)(6) consists of the rule, tool box, and permits. EPA's primary role is to ensure timely development and implementation of all components. Today's rule is a refinement of the first step in developing the program. EPA is fully committed to continuing to work with involved stakeholders on developing the tool box and issuing permits. As noted in today's rule, EPA will assess the municipal storm water program based on (1) evaluations of data from the NPDES municipal storm water program, (2) research concerning water quality impacts on receiving waters from storm water, and (3) research on BMP effectiveness. (Section II.H, Municipal Role, provides a more detailed discussion of this provision.)

EPA is planning to standardize minimum requirements for construction and post-construction BMPs in a new rulemaking under Title III of the CWA. While larger construction sites are already subject to NPDES permits (and smaller sites will be subject to permits pursuant to today's rule), the permits generally do not contain specific requirements for BMP design or performance. The permits require the preparation of storm water pollution prevention plans, but actual BMP selection and design is at the discretion of permittees, in conformance with applicable State and local requirements. Where there are existing State and local requirements specific to BMPs, they vary widely, and many jurisdictions do not have such requirements.

In developing these regulations, EPA intends to evaluate the inclusion of design and maintenance criteria as minimum requirements for a variety of BMPs used for erosion and sediment control at construction sites, as well as for permanent BMPs used to manage post-construction storm water discharges. The Agency plans to consider the merits and performance of all appropriate management practices (both structural and non-structural) that can be used to reduce adverse water quality impacts. EPA does not intend to require the use of particular BMPs at specific sites, but plans to assist builders and developers in BMP selection by publishing data on the performance to be expected by various BMP types. EPA would like to build upon the successes of some of the effective State and local storm water programs currently in place around the country, and to establish nation-wide criteria to support builders and local jurisdictions in appropriate BMP selection.

2. Encourage Consideration of Smart Growth Approaches

In the proposal, EPA invited comment on possible approaches for providing

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incentives for local decision making that would limit the adverse impacts of growth and development on water quality. EPA asked for comments on this "smart growth" approach.

EPA received comments on all sides of this issue. A number of commenters supported the idea of "smart growth" incentives but did not present concrete ideas. Several commenters suggested "smart growth" criteria. States that have adopted "smart growth" laws were worried that EPA's focus on urbanized areas for municipal requirements could encourage development outside of designated growth areas. Today's final rule clearly allows States to expand coverage of their municipal storm water program outside of urbanized areas. In addition, the flexibility of the six municipal minimum measures should avoid encouragement of development into rural rather than urban areas. For example, as part of the post-construction minimum measure, EPA recommends that municipalities consider policies and ordinances that encourage infill development in higher density urban areas, and areas with existing infrastructure, in order to meet the measure's intent.

EPA also received several comments expressing concern that incorporating "smart growth" incentives threatened the autonomy of local governments. One commenter was worried that "incentives" could become more onerous than the minimum measures. EPA is very aware of municipal concerns about possible federal interference with local land use planning. EPA is also cognizant of the difficulty surrounding incentives for "smart growth" activities due to these concerns. However, the Agency believes it has addressed these concerns by proposing a flexible approach and will continue to support the concept of "smart growth" by encouraging policies that limit the adverse impacts of growth and development on water quality.

3. Provide Financial Assistance

Although Congress has not established a fund to fully finance implementation of the proposed extension of the existing NPDES storm water program under CWA section 402(p)(6), numerous federal financing programs (administered by EPA and other federal agencies) can provide some financial assistance. The primary funding mechanism is the Clean Water State Revolving Fund (SRF) program, which provides sources of low-cost financing for a range of water quality infrastructure projects, including storm water. In addition to the SRF, federal financial assistance programs include the Water Quality Cooperative Agreements under CWA section 104(b)(3), Water Pollution Control Program grants to States under CWA section 106, and the Transportation Equity Act for the 21st Century (TEA-21) among others. In addition, Section 319 funds may be used to fund any urban storm water activities that are not specifically required by a draft or final NPDES permit. EPA will develop a list of potential funding sources as part of the tool box implementation effort. EPA anticipates that some of these programs will provide funds to help develop and, in limited circumstances, implement the CWA section 402(p)(6) storm water discharge control program.

EPA received numerous comments that requested additional funding. Congress provided one substantial new source of potential funding for transportation related storm water projects—TEA-21. The Department of Transportation has included a number of water-related provisions in its TEA-21 planning. These include Transportation Enhancements, Environmental Restoration and Pollution Abatement, and Environmental Streamlining. More information on TEA-21 is available at the following internet sites: www.fhwa.dot.gov/tea21/outreach.htm and www.tea21.org.

4. Implement the Program in Jurisdictions Not Authorized To Administer the NPDES Program

Because today's final rule uses the NPDES framework, EPA will be the NPDES permitting authority in several States, Tribal jurisdictions, and Territories. As such, EPA will have the same responsibilities as any other NPDES permitting authority—issuing permits, designating additional sources, and taking appropriate enforcement actions—and will seek to tailor the storm water discharge control program to the specific needs in that State, Tribal jurisdiction, or Territory. EPA also plans to provide support and oversight, including outreach, training, and technical assistance to the regulated communities. Section II.G. of today's preamble provides a separate discussion related to the NPDES permitting authority's responsibilities for today's final rule.

5. Oversee State and Tribal Programs

Under the NPDES program, EPA plays an oversight role for NPDES-approved States and Tribes. In this role, EPA and the State or Tribe work together to implement, enforce, and improve the NPDES program. Part of this oversight role includes working with States and Tribes to modify their programs where programmatic or implementation concerns impede program effectivenes. This role will be vitally important whe States and Tribes make adjustments to develop, implement, and enforce today's extension of the existing NPDES storm water discharge control program. In addition, States maintain a continuing planning process (CPP) under CWA section 303(e), which EPA periodically reviews to assess the program's achievements.

In its oversight role, EPA takes action to address States and Tribes who have obtained NPDES authorization but are not fulfilling their obligations under the NPDES program. If an NPDES-authorized State or Tribe fails to implement an adequate NPDES storm water program, for example, EPA typically enters into extensive discussions to resolve outstanding issues. EPA has the authority to withdraw the entire NPDES program when resolution cannot be reached. Partial program withdrawal is not provided for under the CWA except for partial approvals.

EPA is also working with the States and Tribes to improve nonpoint source management programs and assessments to incorporate key program elements. Key nonpoint source program elements include setting short and long term goals and objectives; establishing public and private partnerships; using a balanced approach incorporating Statewide and watershed-wide abatement of existing impairments; preventing future impairments; developing processes to address both impaired and threatened waters; reviewing and upgrading all program components, including program revisions on a 5-year cycle; addressing federal land management and activities inconsistent with State programs; and managing State nonpoint source management programs effectively.

In particular, EPA works with the States and Tribes to strengthen their nonpoint source pollution programs to address all significant nonpoint sources, including agricultural sources, through the CWA section 319 program. EPA is working with other government agencies, as well as with community groups, to effect voluntary changes regarding watershed protection and reduced nonpoint source pollution.

In addition, EPA and NOAA have published programmatic and technical guidance to address coastal nonpoint source pollution. Under Section 6217 of the CZARA, States are developing and implementing coastal nonpoint pollution control programs approved by EPA and NOAA.

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6. Comply With Applicable Requirements as a Discharger

Today's final rule covers federally operated facilities in a variety of ways. These facilities are generally areas where people reside, such as a federal prison, hospital, or military base. It also includes federal parkways and road systems with separate storm sewer systems. Today's rule requires federal MS4s to comply with the same application deadlines that apply to regulated small MS4s generally. EPA believes that all federal MS4s serve populations of less than 100,000.

EPA received several comments that asked if individual buildings like post offices are considered to be small MS4s and thereby regulated in today's rule if they are in an urbanized area. Most of these buildings have at most a parking lot with runoff or a storm sewer that connects with a municipality's MS4. EPA does not intend that individual federal buildings be considered to be small MS4s. This is discussed in section II.H.2.b. of today's preamble.

Federal facilities can also be included under requirements addressing storm water discharges associated with small construction activities. In any case, discharges from these facilities will need to comply with all applicable NPDES requirements and any additional water quality-related requirements imposed by a State, Tribal, or local government. Failure to comply can result in enforcement actions. Federal facilities can act as models for municipal and private sector facilities and implement or test state-of-the-art management practices and control measures.

E. State Role

Today's final rule sets forth an NPDES approach for implementing the extension of the existing storm water discharge control program under CWA section 402(p)(6). State assumption of the NPDES program is voluntary, consistent with the principles of federalism. Because most States are approved to implement the NPDES program, they will tailor their storm water discharge control programs to address their water quality needs and objectives. While today's rule establishes the basic framework for the section 402(p)(6) program, States as well as Tribes (see discussion in section II.F) have an important role in fine-tuning the program to address the water quality issues within their jurisdictions. The basic framework allows for adjustments based on factors that vary geographically, including climate patterns and terrain.

Where States do not have NPDES authority, they are not required to implement the storm water discharge control program, but they may still participate in water quality protection through participation in the CWA section 401 certification process (for any permits) and through development of water quality standards and TMDLs.

1. Develop the Program

In expanding the existing NPDES program for storm water discharges, States must evaluate whether revisions to their NPDES programs are necessary. If so, modifications must be made in accordance with § 123.62. Under § 123.62, States must revise their NPDES programs within 1 year, or within 2 years if statutory changes are necessary.

Some States and departments of transportation (DOTs) commented that this timeframe is too short, anticipating that the State legislative process and the modification of regulations combined would take beyond 2 years. The deadline language in § 123.62 is not new language for the storm water discharge control program; it applies to all NPDES programs. EPA believes the vast majority of States will meet the deadline and will work with States in those cases where there may be difficulty meeting this deadline due to the timing of legislative sessions and the regulatory development process.

An authorized State NPDES program must meet the requirements of CWA section 402(b) and conform to the guidelines issued under CWA section 304(i)(2). Today's final rule under § 123.25 adds specific cross references to the storm water discharge control program components to ensure that States adequately address these requirements.

2. Comply With Applicable Requirements as a Discharger

Today's final rule covers State operated separate storm sewer systems in a variety of ways. These systems generally drain areas where people reside, such as a prison, hospital, or other populated facility. These systems are included under the definition of a regulated small MS4, which specifically identifies systems operated by State departments of transportation. Alternatively, storm water discharges from State activities may be regulated under the section addressing storm water discharges associated with small construction activities. In any case, discharges from these facilities must comply with all applicable NPDES requirements. Failure to comply can result in enforcement actions. State facilities can act as models for municipal and private sector facilities and implement or test state-of-the-art management practices and control measures.

3. Communicate With EPA

Under approved NPDES programs, States have an ongoing obligation to share information with EPA. This dialogue is particularly important in the CWA section 402(p)(6) storm water program where these governments continue to develop a great deal of the guidance and outreach related to water quality.

F. Tribal Role

The proposal to today's final rule provides background information on EPA's 1984 Indian Policy and the criteria for treatment of an Indian Tribe in the same manner as a State. Today's final rule extends the existing NPDES program for storm water discharges to two types of dischargers located in Indian country. First, the final rule designates storm water discharges from any regulated small MS4, including Tribal systems. Second, the final rule regulates discharges associated with construction activity disturbing between one and five acres of land, including sites located in Indian country. Operators in each of these categories of regulated activity must apply for coverage under an NPDES permit by 3 years and 90 days from the date of publication of today's final rule. Under existing regulations, however, EPA or an authorized NPDES Tribe may require a specified storm water discharger to apply for NPDES permit coverage before this deadline based on a determination that the discharge is contributing to a violation of a water quality standard (including designated uses) or is a significant contributor of pollutants.

Under today's rule, a Tribal governmental entity may regulate storm water discharges on its reservation in two ways—as either an NPDES-authorized Tribe or as a regulated MS4. If a Tribe is authorized to operate the NPDES program, the Tribe must implement today's final rule for the NPDES program for storm water for covered dischargers located within the EPA recognized boundaries. Otherwise, EPA is generally the permitting/program authority within Indian country. Discussions about the State Role in the preceding section also apply to NPDES authorized Tribes. For additional information on the role and responsibilities of the permitting authority in the NPDES storm water program, see § 123.35 (and Section II.G. of today's preamble) and § 123.25(a).

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Under today's final rule, if the Indian reservation is located entirely or partially within an "urbanized area," as defined in § 122.32(a)(1), the Tribe must obtain an NPDES permit if it operates a small MS4 within the urbanized area portion. Tribal MS4s located outside an urbanized area are not automatically covered, but may be designated by EPA pursuant to § 122.32(a)(2) of today's rule or may request designation as a regulated small MS4 from EPA. A Tribe that is a regulated MS4 for NPDES program purposes is required to implement the six minimum control measures to the extent allowable under Federal law.

The Tribal representative on the Storm Water Phase II FACA Subcommittee asked EPA to provide a list of the Tribes located in urbanized areas that would fall within the NPDES storm water program under today's final rule. In December 1996, EPA developed a list of federally recognized American Indian Areas located wholly or partially in Bureau of the Census-designated urbanized areas (see Appendix 1). Appendix 1 not only provides a listing of reservations and individual Tribes, but also the name of the particular urbanized area in which the reservation is located and an indication of whether the urbanized area contains a medium or large MS4 that is already covered by the existing Phase I regulations.

Some of the Tribes listed in Appendix 1 are only partially located in an urbanized area. If the Tribe's MS4 serves less than 1,000 people within an urbanized area, the permitting authority may waive the Tribe's MS4 storm water requirements if it meets the conditions of § 122.32(c). EPA does not have information on the Tribal populations within the urbanized areas, so it can not identify the Tribes that are eligible for a waiver. Therefore, a Tribe that believes it qualifies for a waiver should contact its permitting authority.

G. NPDES Permitting Authority's Role for the NPDES Storm Water Small MS4 Program

As noted previously, the NPDES permitting authority can be EPA or an authorized State or an authorized Tribe. The following discussion describes the role of the NPDES permitting authority under today's final rule.

1. Comply With Implementation Requirements

NPDES permitting authorities must perform certain duties to implement the NPDES storm water municipal program. Section 123.35(a) of today's final rule emphasizes that permitting authorities have existing obligations under the NPDES program. Section 123.35 focuses on specific issues related to the role of the NPDES authority to support administration and implementation of the municipal storm water program under CWA section 402(p)(6).

2. Designate Sources

Section 123.35(b) of today's final rule addresses the requirements for the NPDES permitting authority to designate sources of storm water discharges to be regulated under §§ 122.32 through 122.36. NPDES permitting authorities must develop a process, as well as criteria, to designate small MS4s. They must also have the authority to designate a small MS4 if and when circumstances that support a waiver under § 122.32(c) change. EPA may make designations if an NPDES-approved State or Tribe fails to do so.

NPDES permitting authorities must examine geographic jurisdictions that they believe should be included in the storm water discharge control program but are not located in an "urbanized area". Small MS4s in these areas are not designated automatically. Discharges from such areas should be brought into the program if found to have actual or potential exceedances of water quality standards, including impairment of designated uses, or other adverse impacts on water quality, as determined by local conditions or watershed and TMDL assessments. EPA's aim is to address discharges to impaired waters and to protect waters with the potential for problems. EPA encourages NPDES permitting authorities, local governments, and the interested public to work together in the context of a watershed plan to address water quality issues, including those associated with municipal storm water runoff.

EPA received comments stating that the process of developing criteria and applying it to all MS4s outside an urbanized area serving a population of 10,000 or greater and with a density of 1,000 people per square mile is too time-consuming and resource-intensive. These commenters believe that the permitting authority should decide which MS4s must be brought into the storm water discharge control program and that population and density should not be an overriding criteria. One suggested way of doing so was to only designate MS4s with demonstrated contributions to the impairment of water quality uses as shown by a TMDL. EPA disagrees with this suggestion. The TMDL process is time-consuming. MS4s outside of urbanized areas may cause water quality problems long before a TMDL is completed.

EPA believes that permitting authorities should consider the potential water quality impacts of storm water from all jurisdictions with a population of 10,000 or greater and a density of 1,000 people per square mile. EPA is using data summarized in the NURP study and in the CWA section 305(b) reports to support this approach for targeted designation outside of urbanized areas. EPA is not mandating which criteria are to be used, but has provided examples of criteria that may be useful in evaluating potential water quality impacts. EPA believes that the flexibility provided in this section of today's final rule allows the permitting authority to develop criteria and a designation process that is easy to use and protects water quality. Therefore, the provisions of § 123.35(b) remain as proposed.

a. Develop Designation Criteria

Under § 123.35(b), the NPDES permitting authority must establish designation criteria to evaluate whether a storm water discharge results in or has the potential to result in exceedances of water quality standards, including impairment of designated uses, or other significant water quality impacts, including adverse habitat and biological impacts.

EPA recommends that NPDES permitting authorities consider, in a balanced manner, certain locally-focused criteria for designating any MS4 located outside of an urbanized area on the basis of significant water quality impacts. EPA recommends consideration of criteria such as discharge to sensitive waters, high growth or growth potential, high population density, contiguity to an urbanized area, significant contribution of pollutants to waters of the United States, and ineffective control of water quality concerns by other programs. These suggested designation criteria are intended to help encourage the permitting authority to use an objective method for identifying and designating, on a local basis, sources that adversely impact water quality. More information about these criteria and the reasons why they are suggested by EPA is included in the January 9, 1998, proposal (63 FR 1561) for today's final rule.

The suggested criteria are meant to be taken in the aggregate, with a great deal of flexibility as to how each should be weighed in order to best account for watershed and other local conditions and to allow for a more tailored case-by-case analysis. The application of criteria is meant to be geographically specific. Furthermore, each criterion does not have to be met in order for a small MS4

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to qualify for designation, nor should an MS4 necessarily be designated on the basis of one or two criteria alone.

EPA believes that the application of the recommended designation criteria provides an objective indicator of real and potential water quality impacts from urban runoff on both the local and watershed levels. EPA encourages the application of the recommended criteria in a watershed context, thereby allowing for the evaluation of the water quality impacts of the portions of a watershed outside of an urbanized area. For example, situations exist where the urbanized area represents a small portion of a degraded watershed, and the adjacent nonurbanized areas of the watershed have significant cumulative effects on the quality of the receiving waters.

EPA received numerous suggestions of additional criteria that should be added and reasons why some of the criteria in the proposal to today's final rule were not appropriate. EPA developed its suggested designation criteria based on findings of the NURP study and other studies that indicate pollutants of concern, including total suspended solids, chemical oxygen demand, and temperature. These criteria were the subject of considerable discussion by the Storm Water Phase II FACA Subcommittee. EPA developed them in response to recommendations from the subcommittee during development of the proposed rule. The listed criteria are only suggestions. Permitting authorities are required to develop their own criteria. EPA has not found any reason to change its suggested list of criteria and the suggestions remain as proposed.

b. Apply Designation Criteria

After customizing the designation criteria for local conditions, the permitting authority must apply such criteria, at a minimum, to any MS4 located outside of an urbanized area serving a jurisdiction with a population of at least 10,000 and a population density of 1,000 people per square mile or greater (see § 123.35(b)(2)). If the NPDES permitting authority determines that an MS4 meets the criteria, the permitting authority must designate it as a regulated small MS4. This designation must occur within 3 years of publication of today's final rule. Alternatively, the NPDES authority can designate within 5 years from the date of final regulation if the designation criteria are applied on a watershed basis where a comprehensive watershed plan exists (a comprehensive watershed plan is one that includes the equivalents of TMDLs) (see § 123.35(b)(3)). The extended 5 year deadline is intended to provide incentives for watershed-based designations. If an NPDES-authorized State or Tribe does not develop and apply designation criteria within this timeframe, then EPA has the opportunity to do so in lieu of the authorized State or Tribe.

NPDES permitting authorities can designate any small MS4, including one below 10,000 in population and 1,000 in density. EPA established the 10,000/1,000 threshold based on the likelihood of adverse water quality impacts at these population and density levels. In addition, the 1,000 persons per square mile threshold is consistent with both the Bureau of the Census definition of an "urbanized area" (see Section II.H.2. below) and stakeholder discussions concerning the definition of a regulated small MS4.

One commenter requested that EPA develop interim deadlines for development of designation criteria. EPA believes that the designation deadline identified in today's final rule at § 123.35(b)(3) provides States and Tribes with a flexibility that allows them to develop and apply the criteria locally in a timely fashion, while at the same time establishing an expeditious deadline.

c. Designate Physically Interconnected Small MS4s

In addition to applying criteria on a local basis for potential designation, the NPDES permitting authority must designate any MS4 that contributes substantially to the pollutant loadings of a physically interconnected municipal separate storm sewer that is regulated by the NPDES program for storm water discharges (see § 123.35(b)(4)). To be "physically interconnected," the MS4 of one entity, including roads with drainage systems and municipal streets, is physically connected directly to the municipal separate storm sewer of another entity. This provision applies to all MS4s located outside of an urbanized area. EPA added this section in recognition of the concerns of local government stakeholders that a local government should not have to shoulder total responsibility for a storm water program when storm water discharges from another MS4 are also contributing pollutants or adversely affecting water quality. This provision also helps to provide some consistency among MS4 programs and to facilitate watershed planning in the implementation of the NPDES storm water program. EPA recommended physical interconnectedness in the existing NPDES storm water regulations as a factor for consideration in the designation of additional sources.

Today's final rule does not include interim deadlines for identifying physically interconnected MS4s. However, consistent with the deadlines identified in § 123.35(b)(3) of today's final rule, EPA encourages the permitting authority to make these determinations within 3 years from the date of publication of the final rule or within 5 years if the permitting authority is implementing a comprehensive watershed plan. Alternatively, the affected jurisdiction could use the petition process under 40 CFR 122.26(f) in seeking to have the permitting authority designate the contributing jurisdiction.

Several commenters expressed concerns about who could be designated under this provision (§ 123.35(b)(4)). One commenter requested that the word "substantially" be deleted from the rule because they believe any MS4 that contributes at all to a physically interconnected municipal separate storm sewer should be regulated. EPA believes that the word "substantially" provides necessary flexibility to the permitting authorities. The permitting authority can decide if an MS4 is contributing discharges to another municipal separate storm sewer in a manner that requires regulation. If the operator of a regulated municipal separate storm sewer believes that some of its pollutant loadings are coming from an unregulated MS4, it can petition the permitting authority to designate the unregulated MS4 for regulation.

d. Respond to Public Petitions for Designation

Today's final rule reiterates the existing opportunity for the public to petition the permitting authority for designation of a point source to be regulated to protect water quality. The petition opportunity also appears in existing NPDES regulations at 40 CFR 122.26(f). Any person may petition the permitting authority to require an NPDES permit for a discharge composed entirely of storm water that contributes to a violation of a water quality standard or is a significant contributor of pollutants to the waters of the United States (see § 123.32(b)). The NPDES permitting authority must make a final determination on any petition within 180 days after receiving the petition (see § 123.35(c)). EPA believes that a 180 day limit balances the public's need for a timely final determination with the NPDES permitting authority's need to prioritize its workload. If an NPDES-approved State or Tribe fails to act

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within the 180-day timeframe, EPA may make a determination on the petition. EPA believes that public involvement is an important component of the NPDES program for storm water and feels that this provision encourages public participation. Section II.K, Public Involvement/Public Role, further discusses this topic.

3. Provide Waivers

Today's rule provides two opportunities for the NPDES permitting authority to exempt certain small MS4s from the need for a permit based on water quality considerations. See §§ 122.32(d) and (e). The two waiver opportunities have different size thresholds and take different approaches to considering the water quality impacts of discharges from the MS4.

In the proposal, EPA requested comment on the option of waiving coverage for all MS4s with less than 1,000 people unless the permitting authority determined that the small MS4 should be regulated based on significant adverse water quality impacts. A number of commenters supported this option. They expressed concern that compliance with the rule requirements and certification of one of the waiver provisions were both costly for very small communities. They stated that the permitting authority should identify a water quality problem before requiring compliance. Today's rule essentially adopts this alternative approach for MS4s serving a population under 1,000.

The final rule has expanded the waiver provision that EPA proposed for small MS4s with a population less than 1,000. The proposed rule would have required a small MS4 operator to certify that storm water controls are not needed based on either wasteload allocations that are part of TMDLs that address the pollutants of concern, or a comprehensive watershed plan implemented for the waterbody that includes the equivalents of TMDLs and addresses the pollutant(s) of concern. Commenters noted that the proposed waivers would be unattainable if a TMDL or equivalent analysis was required for every pollutant that could possibly be present in any amount in discharges from an MS4 regardless of whether the pollutant is causing water quality impairment. Commenters asked that EPA identify what constitutes the "pollutant(s) of concern" for which a TMDL or its equivalent must be developed. For example, § 122.30(c) indicates that the MS4 program is intended to control "sediment, suspended solids, nutrients, heavy metals, pathogens, toxins, oxygen-demanding substances, and floatables." Commenters asked whether TMDLs or equivalent analyses have to address all of these.

EPA has revised the proposed waiver in response to these concerns. Under today's rule, NPDES permitting authorities may waive the requirements of today's rule for any small MS4 with a population less than 1,000 that does not contribute substantially to the pollutant loadings of a physically interconnected MS4, unless the small MS4 discharges pollutants that have been identified as a cause of impairment of the waters to which the small MS4 discharges. If the small MS4 does discharge pollutants that have been identified as impairing the water body into which the small MS4 discharges, the NPDES permitting authority may grant a waiver only if it determines that storm water controls are not needed based on an EPA approved or established TMDL that addresses the pollutant(s) of concern.

Unlike the proposed rule, § 122.32(d) does not allow the waiver for MS4s serving a population under 1,000 to be based on "the equivalent of a TMDL." Because § 122.32(d) requires a pollutant specific analysis only for a pollutant that has been identified as a cause of impairment, a TMDL is required for such pollutant before the waiver may be granted. Once a pollutant has been identified as the cause of impairment of a water body, the State should develop a TMDL for that pollutant for that water body. Thus, § 122.32(d) takes a different approach than that taken for the waiver in § 122.32(e) for MS4s serving a population under 10,000, which can be based upon an analysis that is "the equivalent of a TMDL." This is because § 122.32(d) requires an analysis to support the waiver for MS4s under 1,000 only if a waterbody to which the MS4 discharges has been identified as impaired. The § 122.32(e) waiver, on the other hand, would be available for larger MS4s but only after the State affirmatively establishes lack of impairment based upon a comprehensive analysis of smaller urban waters that might not otherwise be evaluated for the purposes of CWA section 303. Since § 122.32(e) requires the analysis of waters that have not been identified as impaired, an actual TMDL is not required and an analysis that is the equivalent of a TMDL can suffice to support the waiver.

Where a State is the NPDES permitting authority, the permitting authority is responsible for the development of the TMDLs as well as the assessment of the extent to which a small MS4's discharge contributes pollutants to a neighboring regulated system. In States where EPA is the permitting authority, EPA will use a State's TMDLs to determine whether storm water controls are required for the small MS4s.

The proposed rule would have required the operator of the small MS4 serving a population under 1,000 to certify that its discharge was covered under a TMDL that indicated that discharges from its particular system were not having an adverse impact on water quality (*i.e.*, it was either not assigned wasteload allocations under TMDLs or its discharge is within an assigned allocation). Many commenters expressed concerns that MS4 operators serving less than 1,000 persons may lack the technical capacity to certify that their discharges are not contributing to adverse water quality impacts. These commenters thought that the permitting authority should make such a certification. Today's rule provides flexibility as to how the waiver is administered. Permitting authorities are ultimately responsible for granting the waiver, but are free to determine whether or not to require small MS4 operators that are seeking waivers to submit information or a written certification.

Under § 122.32(e) a State may grant a waiver to an MS4 serving a population between 1,000 and 10,000 only if the State has made a comprehensive effort to ensure that the MS4 will not cause or contribute to water quality impairment. To grant a § 122.32(e) waiver, the NPDES permitting authority must evaluate all waters of the U.S. that receive a discharge from the MS4 and determine that storm water controls are not needed. The permitting authority's evaluation must be based on wasteload allocations that are part of an EPA approved or established TMDL or, if a TMDL has not been developed or approved, an equivalent analysis that determines sources and allocations for the pollutant(s) of concern. The pollutants of concern that the permitting authority must evaluate include biochemical oxygen demand (BOD), sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation), pathogens, oil and grease, and any other pollutant that has been identified as a cause of impairment of any water body that will receive a discharge from the MS4. Finally, the permitting authority must have determined that future discharges from the MS4 do not have the potential to result in exceedances of water quality standards, including impairment of designated uses, or other significant water quality impacts, including habitat and biological impacts.

Although EPA did not propose this specific approach, the Agency did request comment on whether to increase the proposed 1,000 population threshold for a waiver. The § 122.32(e) waiver was developed in response to comments, including States' concerns that they needed greater flexibility to focus their efforts on MS4s that were causing water quality impairment. Several commenters thought that the threshold should be increased from 1,000 to 5,000 or 10,000. Others suggested additional ways of qualifying for a waiver for MS4s that discharge to waters that are not covered by a TMDL or watershed plan. EPA carefully considered all the options for expanding the waiver provisions and has decided to expand the waiver only in the very narrow circumstances described above where a comprehensive analysis has been undertaken to demonstrate that the MS4 is not causing water quality impairment.

The NPDES permitting authority can, at any time, mandate compliance with program requirements from a previously waived small MS4 if circumstances change. For example, a waiver can be withdrawn in circumstances where the permitting authority later determines that a waived small MS4's storm water discharge to a small stream will cause adverse impacts to water quality or significantly interfere with attainment of water quality standards. A "change in circumstances" could involve receipt of new information. Changed circumstances can also allow a regulated small MS4 operator to request a waiver at any time.

Some commenters expressed concerns about allowing any small MS4 waivers. One commenter stated that storm water pollution prevention plans are necessary to control storm water pollution and should be required from all regulated small MS4s. For the reasons stated in the Background section above, EPA agrees that the discharges from most MS4s in urbanized areas should be addressed by a storm water management program outlined in today's rule. For MS4s serving very small areas, however, the TMDL development process provides an opportunity to determine whether an MS4 serving a population less than 1,000 is having a negative impact on any receiving water that is impaired by a pollutant that the MS4 discharges. MS4s serving populations up to 10,000 may receive a waiver only if a comprehensive analysis of its impact on receiving water has been performed.

Other commenters said that waivers should not be allowed for small MS4s that discharge into another regulated MS4. These commenters stated that the word "substantially" should be removed from § 122.32(d)(i) so that a waiver would not be allowed for any system "contributing to the storm water pollutant loadings of a physically interconnected regulated MS4." As previously mentioned under the designation discussion of section II.G.2.c, EPA believes that the word "substantially" provides needed flexibility to the permitting authorities. It is important to note that this is only one aspect that the permitting authority must consider when deciding on the appropriateness of a waiver.

4. Issue Permits

NPDES permitting authorities have a number of responsibilities regarding the permit process. Sections 123.35(d) through (g) ensure a certain level of consistency for permits, yet provide numerous opportunities for flexibility. NPDES permitting authorities must issue NPDES permits to cover municipal sources to be regulated under § 122.32, unless waived under § 122.32(c). EPA encourages permitting authorities to use general permits as the vehicle for permitting and regulating small MS4s. The Agency notes, however, that some operators may wish to take advantage of the option to join as a co-permittee with an MS4 regulated under the existing NPDES storm water program.

Today's final rule includes a provision, § 123.35(f), that requires NPDES permitting authorities to either include the requirements in § 122.34 for NPDES permits issued for regulated small MS4s or to develop permit limits based on a permit application submitted by a small MS4. See Section II.H.3.a, Minimum Control Measures, for more details on the actual § 122.34 requirements. See Section II.H.3.c for alternative and joint permitting options.

In an attempt to avoid duplication of effort, § 122.34(c) allows NPDES permitting authorities to include permit conditions that direct an MS4 to meet the requirements of a qualifying local, Tribal, or State municipal storm water management program. For a local, Tribal, or State program to "qualify," it must impose, at a minimum, the relevant requirements of § 122.34(b). A regulated small MS4 must still follow the procedural requirements for an NPDES permit (*i.e.*, submit an application, either an individual application or an NOI under a general permit) but will instead follow the substantive pollutant control requirements of the qualifying local, Tribal, or State program.

Under § 122.35(b), NPDES permitting authorities may also recognize existing responsibilities among governmental entities for the minimum control measures in an NPDES small MS4 storm water permit. For example, the permit might acknowledge the existence of a State administered program that addresses construction site runoff and require that the municipalities only develop substantive controls for the remaining minimum control measures. By acknowledging existing programs, this provision is meant to reduce the duplication of efforts and to increase the flexibility of the NPDES storm water program.

Section 123.35(e) of today's final rule requires permitting authorities to specify a time period of up to 5 years from the issuance date of an NPDES permit for regulated small MS4 operators to fully develop and implement their storm water programs. As discussed more fully below, permitting authorities should be providing extensive support to the local governments to assist them in developing and implementing their programs.

In the proposed rule, EPA stated that the permitting authority would develop the menu of BMPs and if they failed to do so, EPA would develop the menu. Commenters felt that EPA should develop a menu of BMPs, rather than just providing guidance. In the settlement agreement for seeking an extension to the deadline for issuing today's rule, EPA committed to developing a menu of BMPs by October 27, 2000. Permitting authorities can adopt EPA's menu or develop their own. The menu itself is not intended to replace more comprehensive BMP guidance materials. As part of the tool box efforts, EPA will provide separate guidance documents that discuss the results from EPA-sponsored nationwide studies on the design, operation and maintenance of BMPs. Additionally, EPA expects that the new rulemaking on construction BMPs may provide more specific design, operation and maintenance criteria.

5. Support and Oversee the Local Programs

NPDES permitting authorities are responsible for supporting and overseeing the local municipal programs. Section 123.35(h) of today's final rule highlights issues associated with these responsibilities.

To the extent possible, NPDES permitting authorities should provide financial assistance to MS4s, which often have limited resources, for the development and implementation of local programs. EPA recognizes that funding for programs at the State and Tribal levels may also be limited, but strongly encourages States and Tribes to provide whatever assistance is possible. In lieu of actual dollars, NPDES permitting authorities can provide cost-cutting assistance in a number of ways. For example, NPDES permitting authorities can develop outreach materials for MS4s to distribute or the NPDES permitting authority can actually distribute the materials. Another option is to implement an erosion and sediment control program across an entire State (or Tribal land), thus alleviating the need for the MS4 to implement its own program. The NPDES permitting authority must balance the need for site-specific controls, which are best handled by a local MS4, with its ability to offer financial assistance. EPA, States, Tribes, and MS4s should work as a team in making these kinds of decisions.

NPDES permitting authorities are responsible for overseeing the local programs. Permitting authorities should work with the regulated community and other stakeholders to assist in local program development and implementation. This might include sharing information, analyzing reports, and taking enforcement actions, as necessary. NPDES permitting authorities play a vital role in supporting local programs by providing technical and programmatic assistance, conducting research projects, and monitoring watersheds. The NPDES permitting authority can also assist the MS4 permittee in obtaining adequate legal authority at the local level in order to implement the local component of the CWA section 402(p)(6) program.

NPDES permitting authorities are encouraged to coordinate and utilize the data collected under several programs. States and Tribes address point and nonpoint source storm water discharges through a variety of programs. In developing programs to carry out CWA section 402(p)(6), EPA recommends that States and Tribes coordinate all of their water pollution evaluation and control programs, including the continuing planning process under CWA section 303(e), the existing NPDES program, the CZARA program, and nonpoint source pollution control programs.

In addition, NPDES permitting authorities are encouraged to provide a brief (*e.g.*, two-page) reporting format to facilitate compilation and analysis of data from reports submitted under § 122.34(g)(3). EPA intends to develop a model form for this purpose.

H. Municipal Role

1. Scope of Today's Rule

Today's final rule attempts to establish an equitable and comprehensive four-pronged approach for the designation of municipal sources. First, the approach defines for automatic coverage the municipal systems believed to be of highest threat to water quality. Second, the approach designates municipal systems that meet a set of objective criteria used to measure the potential for water quality impacts. Third, the approach designates on a case-by-case basis municipal systems that "contribute substantially to the pollutant loadings of a physically-interconnected [regulated] MS4." Finally, the approach designates on a case-by-case basis, upon petition, municipal systems that "contribute to a violation of a water quality standard or are a significant contributor of pollutants."

Today's final rule automatically designates for regulation small MS4s located in urbanized areas, and requires that NPDES permitting authorities examine for potential designation, at a minimum, a particular subset of small MS4s located outside of urbanized areas. Today's rule also includes provisions that allow for waivers from the otherwise applicable requirements for the smallest MS4s that are not causing impairment of a receiving water body. Qualifications for the waivers vary depending on whether the MS4 serves a population under 1,000 or a population under 10,000. See §§ 122.32(d) and (e). These waivers are discussed further in section II.G.3. Any small MS4 automatically designated by the final rule or designated by the permitting authority under today's final rule is defined as a "regulated" small MS4 unless it receives a waiver.

In today's final rule, all regulated small MS4s must establish a storm water discharge control program that meets the requirements of six minimum control measures. These minimum control measures are public education and outreach on storm water impacts, public involvement participation, illicit discharge detection and elimination, construction site storm water runoff control, post-construction storm water management in new development and redevelopment, and pollution prevention/good housekeeping for municipal operations.

Today's rule allows for a great deal of flexibility in how an operator of a regulated small MS4 is authorized to discharge under an NPDES permit, by providing various options for obtaining permit coverage and satisfying the required minimum control measures. For example, the NPDES permitting authority can incorporate by reference qualifying State, Tribal, or local programs in an NPDES general permit and can recognize existing responsibilities among different governmental entities for the implementation of minimum control measures. In addition, a regulated small MS4 can participate in the storm water management program of an adjoining regulated MS4 and can arrange to have another governmental entity implement a minimum control measure on their behalf.

2. Municipal Definitions

a. Municipal Separate Storm Sewer Systems (MS4s)

The CWA does not define the term "municipal separate storm sewer." EPA defined municipal separate storm sewer in the existing storm water permit application regulations to mean, in part, a conveyance or system of conveyances (including roads with drainage systems and municipal streets) that is "owned or operated by a State, city, town borough, county, parish, district, association, or other public body * * * designed or used for collecting or conveying storm water which is not a combined sewer and which is not part of a Publicly Owned Treatment Works as defined at 40 CFR 122.2" (see § 122.26(b)(8)(i)). Section 122.26 contains definitions of medium and large municipal separate storm sewer systems but no definition of a municipal separate storm sewer *system*, even though the term MS4 is commonly used. In today's rule, EPA is adding a definition of municipal separate storm sewer system and small municipal separate storm sewer system along with the abbreviations MS4 and small MS4.

The existing municipal permit application regulations define "medium" and "large" MS4s as those located in an incorporated place or county with a population of at least 100,000 (medium) or 250,000 (large) as determined by the latest Decennial Census (see §§ 122.26(b)(4) and 122.26(b)(7)). In today's final rule, these regulations have been revised to define all medium and large MS4s as those meeting the above population thresholds according to the 1990 Decennial Census.

Today's rule also corrects the titles and contents of Appendices F, G, H,& I to Part 122. EPA is adding those incorporated places and counties whose 1990 population caused them to be defined as a "medium" or "large" MS4. All of these MS4s have applied for

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permit coverage so the effect of this change to the appendices is simply to make them more accurate. They will not need to be revised again because today's rule "freezes" the definition of "medium" and "large" MS4s at those that qualify based on the 1990 census.

EPA received several comments supporting and opposing the proposal to "freeze" the definitions based on the 1990 census. Commenters who disagreed with EPA's position cited the unfairness of municipalities that reach the medium or large threshold at a later date having fewer permitting requirements compared to those that were already at the population thresholds when the existing storm water regulations took effect. EPA recognizes this disparity but does not believe it is unfair, as explained in the proposed rule. The decision was based on the fact that the deadlines from the existing regulations have lapsed, and because the permitting authority can always require more from operators of MS4s serving "newly over 100,000" populations.

b. Small Municipal Separate Storm Sewer Systems

The proposal to today's final rule added "the United States" as a potential owner or operator of a municipal separate storm sewer. This addition was intended to address an omission from existing regulations and to clarify that federal facilities are, in fact, covered by the NPDES program for municipal storm water discharges when the federal facility is like other regulated MS4s. EPA received a comment that this change would cause federal facilities located in Phase 1 areas to be considered Phase 1 dischargers due to the definition of medium and large MS4s. All MS4s located in Phase 1 cities or counties are defined as Phase 1 medium or large MS4s. EPA believes that all federal facilities serve a population of under 100,000 and should be regulated as small MS4s. Therefore, in § 122.26(a)(16) of today's final rule, EPA is adding federal facilities to the NPDES storm water discharge control program by changing the proposed definition of small municipal separate storm sewer system. Paragraph (i) of this section restates the definition of municipal separate storm sewer with the addition of "the United States" as a owner or operator of a small municipal separate storm sewer. Paragraph (ii) repeats the proposed language that states that a small MS4 is a municipal separate storm sewer that is not medium or large.

Most commenters agreed that federal facilities should be covered in the same way as other similar MS4s. However, EPA received several comments asking whether individual federal buildings such as post offices or urban offices of the U.S. Park Service must apply for coverage as regulated small MS4s. Most of these buildings have, at most, a parking lot with runoff or a storm sewer that connects with a municipality's MS4. In § 122.26(a)(16)(iii), EPA clarifies that the definition of small MS4 does not include individual buildings. These buildings may have a municipal separate storm sewer but they do not have a "system" of conveyances. The minimum measures for small MS4s were written to apply to storm sewer "systems" providing storm water drainage service to human populations and not to individual buildings. This is true of municipal separate storm sewers from State buildings as well as from federal buildings.

There will likely be situations where the permitting authority must decide if a federal or State complex should be regulated as a small MS4. A federal complex of two or three buildings could be treated as a single building and not be required to apply for coverage. In these situations, permitting authorities will have to use their best judgment as to the nature of the complex and its storm water conveyance system. Permitting authorities should also consider whether the federal or State complex cooperates with its municipality's efforts to implement their storm water management program.

Along with the questions about individual buildings, EPA received many questions about how various provisions of the rule should be interpreted for federal and State facilities. EPA acknowledges that federal and State facilities are different from municipalities. EPA believes, however, that the minimum measures are flexible enough that they can be implemented by these facilities. As an example, DOD commenters asked about how to interpret the term "public" for military installations when implementing the public education measure. EPA agrees with the suggested interpretation of "public" for DOD facilities as "the resident and employee population within the fence line of the facility."

EPA also received many comments from State departments of transportation (DOTs) that suggested the ways in which they are different from municipalities and should therefore be regulated differently. Storm water discharges from State DOTs in Phase 1 areas should already be regulated under Phase I. The preamble to Phase 1 clearly states that "all systems within a geographical area including highways and flood control districts will be covered." Many permitting authorities regulated State DOTs as co-permittees with the Phase 1 municipality in which the highway is located. State DOTs that are already regulated under Phase I are not required to comply with Phase II. State DOTs that are not already regulated have various options for meeting the requirements of today's rule. These options are discussed in Section II.H.3.c.iv below. Several DOTs commented that some of the minimum measures are outside the scope of their mission or that they do not have the legal authority required for implementation. EPA believes that the flexibility of the minimum measures allows them to be implemented by most MS4s, including DOTs. When a DOT does not have the necessary legal authority, EPA encourages the DOT to coordinate their storm water management efforts with the surrounding municipalities and other State agencies. Under today's rule, DOTs can use any of the options of § 122.35 to share their storm water management responsibilities. DOTs may also want to work with their permitting authority to develop a State-wide DOT storm water permit.

There are many storm water discharges from State DOTs and other State MS4s located in Phase 1 areas that were not regulated under Phase 1. Today's rule adds many more State facilities as well as all federal facilities located in urbanized areas. All of these State and federal facilities that fit the definition of a small MS4 must be covered by a storm water management program. The individual permitting authorities must decide what type of permit is most applicable.

The existing NPDES storm water program already regulates storm water from federally or State-operated industrial sources. Federal or State facilities that are currently regulated due to their industrial discharges may already be implementing some of today's rule requirements.

EPA received comments that questioned the apparent inconsistency between regulating a federal facility such as a hospital and not regulating a similar private facility. Normally, this type of private facility is regulated by the MS4. EPA believes that federal facilities are subject to local water quality regulations, including storm water requirements, by virtue of the waiver of sovereign immunity in CWA section 313. However, there are special problems faced by MS4s in their efforts to regulate federal facilities that have not been encountered in regulating similar private facilities. To ensure comprehensive coverage, today's rule merely clarifies the need for permit coverage for these federal facilities.

i. Combined Sewer Systems (CSS). The definition of small MS4s does not include combined sewer systems. A combined sewer system is a wastewater collection system that conveys sanitary wastewater and storm water through a single set of pipes to a publicly-owned treatment works (POTW) for treatment before discharging to a receiving waterbody. During wet weather events when the capacity of the combined sewer system is exceeded, the system is designed to discharge prior to the POTW treatment plant directly into a receiving waterbody. Such an overflow is a combined sewer overflow or CSO. Combined sewer systems are not subject to existing regulations for municipal storm water discharges, nor will they be subject to today's regulations. EPA addresses combined sewer systems and CSOs in the National Combined Sewer Overflow (CSO) Control Policy issued on April 19, 1994 (59 FR 18688). The CSO Control Policy contains provisions for developing appropriate, site-specific NPDES permit requirements for combined sewer systems. CSO discharges are subject to limitations based on the best available technology economically achievable for toxic pollutants and based on the best conventional pollutant control technology for conventional pollutants. MS4s are subject to a different technology standard for all pollutants, specifically to reduce pollutants to the maximum extent practicable.

Some municipalities are served by both separate storm sewer systems and combined sewer systems. If such a municipality is located within an urbanized area, only the separate storm sewer systems within that municipality is included in the NPDES storm water program and subject to today's final rule. If the municipality is not located in an urbanized area, then the NPDES permitting authority has discretion as to whether the discharges from the separate storm sewer system is subject to today's final rule. The NPDES permitting authority will use the same process to designate discharges from portions of an MS4 for permit coverage where the municipality is also served by a combined sewer system.

EPA recognizes that municipalities that have both combined and separate storm sewer systems may wish to find ways to develop a unified program to meet all wet weather water pollution control requirements more efficiently. In the proposal to today's final rule, EPA sought comment on ways to achieve such a unified program. Many municipalities that are served by CSSs and MS4s commented that it is inequitable to force them to comply with Phase II at this time because implementation of the CSO Control Policy through their NPDES permits already imposes a significant financial burden. They requested an extension of the implementation time frame. They did not provide ideas on how to unify the two programs. EPA encourages permitting authorities to work with these municipalities as they develop and begin implementation of their CSO and storm water management programs. If both sets of requirements are carefully coordinated early, a cost-effective wet weather program can be developed that will address both CSO and storm water requirements.

ii. Owners/Operators. Several commenters mentioned the difference between the existing storm water application requirement for municipal operators and the proposed municipal requirement for owners or operators to apply. They felt that this inconsistency is confusing. The preamble to the existing regulations makes numerous references to owner/operator so there was no intent to make a clear distinction between Phase I and Phase II. Section 122.21(b) states that when the owner and operator are different, the operator must obtain the permit. MS4s often have several operators. The owner may be responsible for one part of the system and a regional authority may be responsible for other aspects. EPA proposed the "owner or operator" language to convey this dual responsibility. However, when the owner is responsible for some part of a storm water management plan, it is also an operator.

EPA has revised the regulation language to clarify that "an operator" must apply for a permit. When responsibilities for the MS4 are shared, all operators must apply.

c. Regulated Small MS4s

In today's final rule, all small MS4s located in an urbanized area are automatically designated as "regulated" small MS4s provided that they were not previously designated into the existing storm water program. Unlike medium and large MS4s under the existing storm water regulations, not all small MS4s are designated under today's final rule. Therefore, today's rule distinguishes between "small" MS4s and "regulated small" MS4s.

EPA's definition of "regulated small MS4s" in the proposal to today's rule included mention of incorporated places and counties. Along with the definition, EPA included Appendices 6 and 7 to assist in the identification of areas that would probably require coverage as "automatically designated" (Appendix 6) or "potentially designated" (Appendix 7). The definition and the appendices raised many questions about exactly who was required to comply with the proposed requirements. Commenters raised issues about the definition of "incorporated place" and the status of towns, townships, and other places that are not considered incorporated by the Census Bureau. They also asked about special districts, regional authorities, MS4s already regulated, and other questions in order to clarify the rule's coverage.

EPA has revised § 122.32(a) to clarify that discharges are regulated under today's rule if they are from a small MS4 that is in an urbanized area and has not received a waiver or they are designated by the permitting authority. Today's rule does not regulate the county, city, or town. Today's rule regulates the MS4. Therefore, even though a county may be listed in Appendix 6, if that county does not own or operate the municipal storm sewer systems, the county does not have to submit an application or develop a storm water management program. If another entity does own or operate an MS4 within the county, for example, a regional utility district, that other entity needs to submit the application and develop the program.

Some commenters suggested that EPA should change the rule language to specifically allow regional authorities to be the permitted entity and to allow small MS4s to apply as co-permittees. EPA believes that the best way to clarify that regional authorities can be the primary permitted entity is the change to § 122.32(a) and the explanation above. Because EPA assumes that today's regulation will be implemented through general permits, MS4s will not be co-permittees under a general permit in the same manner as under individual permits. EPA has added § 122.33(a)(4) and made a minor change to § 122.35(a) to clarify that small MS4s can work together to share the responsibilities of a storm water management program. This is discussed further in Section II.H.3.c.iv below.

The proposed rule stated that when a county or Federal Indian reservation is only partially included in an urbanized area, only MS4s in the urbanized portion of the county or Federal Indian reservation would be regulated. In the rare cases when an incorporated place is only partially included in the urbanized area, the entire incorporated place would be regulated. EPA received comments asking about towns and

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townships, because they were not considered to be incorporated areas according to the Census Bureau's definition. Would the whole town/ township be covered or only the part of the town/township in the urbanized area? States use many different types of systems in their geographical divisions. Some towns are similar to incorporated cities and others are large areas that are more similar to counties. Some commenters thought that the urbanized area boundary was arbitrary, and if part of a town or county was covered, it all should be covered. Other commenters noted that some townships and counties encompass very large areas of which only a small portion is urbanized. Due to the great variety of situations, EPA has decided that for all geographical entities, only MS4s in the urbanized area are automatically designated. The population densities associated with the Census Bureau's designation of urbanized areas provide the basis for designation of these areas to protect water quality. This focused designation provides for consistency and allows for flexibility on the part of the MS4 and the permitting authority. In those situations where an incorporated place or a town is not all in an "urbanized area", there is a good possibility that it is served by more than one MS4. In those cases where the area is served by the same MS4, it makes sense to develop a storm water program for the whole area. Permitting authorities may also decide to designate all MS4s within a county or township, if they believe it is necessary to protect water quality.

Most operators of MS4s will not need to independently determine the status of coverage under today's rule. EPA has revised the proposed Appendices 6 and 7 to include towns and townships. Therefore, these appendices will alert most MS4s as to whether they are likely to be covered under today's rule. However, each permitting authority must make the decision as to who requires coverage. Most likely, an illustrative list of the regulated areas will be published with the general permit. If not, the operator can contact its permitting authority or the Bureau of the Census to find out if their separate storm sewer systems are within an urbanized area.

i. Urbanized Area Description. Under the Bureau of the Census definition of "urbanized area," adopted by EPA for the purposes of today's final rule, "an urbanized area (UA) comprises a place and the adjacent densely settled surrounding territory that together have a minimum population of 50,000 people." The proposal to today's rule provided the full definition and case studies to help explain the census category of "urbanized area." Appendix 2 is a simplified urbanized area illustration to help demonstrate the concept of urbanized areas in relation to today's final rule. The "urbanized area" is the shaded area that includes within its boundaries incorporated places, a portion of a Federal Indian reservation, portions of two counties, an entire town, and portions of another town. All small MS4s located in the shaded area are covered by the rule, unless and until waived by the permitting authority. Any small MS4s located outside of the shaded area are subject to potential designation by the permitting authority.

There are 405 urbanized areas in the United States that cover 2 percent of total U.S. land area and contain approximately 63 percent of the nation's population (see Appendix 3 for a listing of urbanized areas of the United States and Puerto Rico). These numbers include U.S. Territories, although Puerto Rico is the only territory to have Census-designated urbanized areas. Urbanized areas constitute the largest and most dense areas of settlement. The purpose of determining an "urbanized area" is to delineate the boundaries of development and map the actual built-up urban area. The Bureau of the Census geographers liken it to flying over an urban area and drawing a line around the boundary of the built-up area as seen from the air.

Using data from the latest decennial census, the Census Bureau applies the urbanized area definition nationwide (including U.S. Tribes and Territories) and determines which places and counties are included within each urbanized area. For each urbanized area, the Bureau provides full listings of who is included, as well as detailed maps and special CD-ROM files for use with computerized mapping systems (such as GIS). Each State's data center receives a copy of the list, and some maps, automatically. The States also have the CD-ROM files and a variety of publications available to them for reference from the Bureau of the Census. In addition, local or regional planning agencies may have urbanized area files already. New listings for urbanized areas based on the 2000 Census will be available by July/August 2001, but the more comprehensive computer files will not be available until late 2001/early 2002.

Additional designations based on subsequent census years will be governed by the Bureau of the Census' definition of an urbanized area in effect for that year. Based on historical trends, EPA expects that any area determined by the Bureau of the Census to be included within an urbanized area as of the 1990 Census will not later be excluded from the urbanized area as of the 2000 Census. However, it is important to note that even if this situation were to occur, for example, due to a possible change in the Bureau of the Census' urbanized area definition, a small MS4 that is automatically designated into the NPDES program for storm water under an urbanized area calculation for any given Census year will remain regulated regardless of the results of subsequent urbanized area calculations.

ii. Rationale for Using Urbanized Areas. EPA is using urbanized areas to automatically designate regulated small MS4s on a nationwide basis for several reasons: (1) studies and data show a high correlation between degree of development/ urbanization and adverse impacts on receiving waters due to storm water (U.S. EPA, 1983; Driver et al., 1985; Pitt, R.E. 1991. "Biological Effects of Urban Runoff Discharges." Presented at the Engineering Foundation Conference: *Urban Runoff and Receiving Systems; An Interdisciplinary Analysis of Impact, Monitoring and Management,* August 1991. Mt. Crested Butte, CO. American Society of Civil Engineers, New York. 1992.; Pitt, R.E. 1995. "Biological Effects of Urban Runoff Discharges," in *Storm water Runoff and Receiving Systems: Impact, Monitoring, and Assessment.* Lewis Publishers, New York.; Galli, J. 1990. *Thermal Impacts Associated with Urbanization and Storm water Management Best Management Practices.* Prepared for the Sediment and Storm water Administration of the Maryland Department of the Environment.; Klein, 1979), (2) the blanket coverage within the urbanized area encourages the watershed approach and addresses the problem of "donut-holes," where unregulated areas are surrounded by areas currently regulated (storm water discharges from donut hole areas present a problem due to their contributing uncontrolled adverse impacts on local waters, as well as by frustrating the attainment of water quality goals of neighboring regulated communities), (3) this approach targets present and future growth areas as a preventative measure to help ensure water quality protection, and (4) the determination of urbanized areas by the Bureau of the Census allows operators of small MS4s to quickly determine whether they are included in the NPDES storm water program as a regulated small MS4.

Urbanized areas have experienced significant growth over the past 50 years. According to EPA calculations based on Census data from 1980 to 1990, the national average rate of growth in the United States during that 10-year period was more than 4 percent. For the same period, the average growth within urbanized areas was 15.7 percent and the average for outside of urbanized areas was just more than 1 percent. The new development occurring in these growing areas can provide some of the best opportunities for implementing cost-effective storm water management controls.

EPA received many comments on the proposal to designate discharges based on location within urbanized areas. EPA considered numerous other approaches, several of which are discussed in the proposal to today's final rule. Several commenters wanted designation to be based on proven water quality problems rather than inclusion in an urbanized area. One commenter proposed an approach based on the CWA 303(d) listing of impaired waters and the wasteload allocation conducted under the TMDL process. (See section II.L. on the section 303(d) and TMDL process). The commenter's proposal would designate small MS4s on a case-by-case basis, covering only those discharges where receiving streams are shown to have water quality problems, particularly a failure to meet water quality standards, including designated uses. The commenter further described a non-NPDES approach where a State would require cost-effective measures based on a proportionate share under a waste load allocation, equitably allocated among all pollutant contributors. These waste load allocations would be developed with input from all stakeholders, and remedial measures would be implemented in a phased manner based on the probability of results and/or economic feasibility. The States would then periodically reassess the receiving streams to determine whether the remedial measures are working, and if not, require additional control measures using the same procedure used to establish the initial measures. What the commenter describes is almost a TMDL.

EPA considered a remedial approach based on water quality impairment and rejected it for failure to prevent almost certain degradation caused by urban storm water. EPA's main concern in opting not to take a case-by-case approach to designation was that this approach would not provide controls for storm water discharges in receiving streams until after a site-specific demonstration of adverse water quality impact. The commenter's suggestion would do nothing to prevent pollution in waters that may be meeting water quality standards, including supporting designated uses. The approach would also rely on identifying storm water management programs following comprehensive watershed plans and TMDL development. In most States, water quality assessments have traditionally been conducted for principal mainstream rivers and their major tributaries, not all surface waters. The establishment of TMDLs nationwide will take many years, and many States will conduct additional monitoring to determine water quality conditions prior to establishing TMDLs. In addition, a case-by-case approach would not address the problem of "donut holes" within urbanized areas and a lack of consistency among similarly situated municipal systems would remain commonplace. After careful consideration of all comments, EPA still believes that the approach in today's rule is the most appropriate to protect water quality. Protection includes prevention as well as remediation.

d. Municipal Designation by the Permitting Authority

Today's final rule also allows NPDES permitting authorities to designate MS4s that should be included in the storm water program as regulated small MS4s but are not located within urbanized areas. The final rule requires, at a minimum, that a set of designation criteria be applied to all small MS4s within a jurisdiction that serves a population of at least 10,000 and has a population density of at least 1,000. Appendix 7 to this preamble provides an illustrative list of places that the Agency anticipates meet this criteria. In addition, any small MS4 may be the subject of a petition to the NPDES permitting authority for designation. See Section II.G, NPDES Permitting Authority's Role for more details on the designation and petition processes. EPA believes that the approach of combining nationwide and local designation to determine municipal coverage balances the potential for significant adverse impacts on water quality with local watershed protection and planning efforts.

e. Waiving the Requirements for Small MS4s

Today's final rule includes some flexibility in the nationwide coverage of all small MS4s located in urbanized areas by providing the NPDES permitting authority with the discretion to waive the otherwise applicable requirements of the smallest MS4s that are not causing the impairment of a receiving water body. Qualifications for the waiver vary depending on whether the MS4 serves a population under 1,000 or a population between 1,000 and 10,000. Note that even if a small MS4 has requirements waived, it can subsequently be brought back into the program if circumstances change. See Section II.G, NPDES Permitting Authority's Role, for more details on this process.

3. Municipal Permit Requirements

a. Overview

i. Summary of Permitting Options. Today's rule outlines six minimum control measures that constitute the framework for a storm water discharge control program for regulated small MS4s that, when properly implemented, will reduce pollutants to the maximum extent practicable (MEP). These six minimum control measures are specified in § 122.34(b) and are discussed below in section "II.H.3.b, Program Requirements-Minimum Control Measures." All operators of regulated small MS4s are required to obtain coverage under an NPDES permit, unless the requirement is waived by the permitting authority in accordance with today's rule. Implementation of § 122.34(b) may be required either through an individual permit or, if the State or EPA makes one available to the facility, through a general permit. The process for issuing and obtaining these permits is discussed below in section "II.H.3.c, Application Requirements."

As an alternative to implementing a program that complies with the requirements of § 122.34, today's rule provides operators of regulated small MS4s with the option of applying for an individual permit under § 122.26(d). The permit application requirements in § 122.26 were originally drafted to apply to medium and large MS4s. Although EPA believes that the requirements of § 122.34 provide a regulatory option that is appropriate for most small MS4s, the operators of some small MS4s may prefer more individualized requirements. This alternative permitting option for regulated small MS4s that wish to develop their own program is discussed below in section "II.H.3.c.iii. Alternative Permit Option." The second alternative permitting option for regulated small MS4s is to become co-permittees with a medium or large MS4 regulated under § 122.26(d), as discussed below in section "II.H.3.c.v. Joint Permit Programs."

ii. Water Quality-Based Requirements. Any NPDES permit issued under today's rule must, at a minimum, require the operator to develop, implement, and

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enforce a storm water management program designed to reduce the discharge of pollutants from a regulated system to the MEP, to protect water quality, and satisfy the appropriate water quality requirements of the Clean Water Act (see MEP discussion in the following section). Absent evidence to the contrary, EPA presumes that a small MS4 program that implements the six minimum measures in today's rule does not require more stringent limitations to meet water quality standards. Proper implementation of the measures will significantly improve water quality. As discussed further below, however, small MS4 permittees should modify their programs if and when available information indicates that water quality considerations warrant greater attention or prescriptiveness in specific components of the municipal program. If the program is inadequate to protect water quality, including water quality standards, then the permit will need to be modified to include any more stringent limitations necessary to protect water quality.

Regardless of the basis for the development of the effluent limitations (whether designed to implement the six minimum measures or more stringent or prescriptive limitations to protect water quality), EPA considers narrative effluent limitations requiring implementation of BMPs to be the most appropriate form of effluent limitations for MS4s. CWA section 402(p)(3)(b)(iii) expresses a preference for narrative rather than numeric effluent limits, for example, by reference to "management practices, control techniques and system, design and engineering methods, and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants." 33 U.S.C. 1342(p)(3)(B)(iii). EPA determines that pollutants from wet weather discharges are most appropriately controlled through management measures rather than end-of-pipe numeric effluent limitations. As explained in the Interim Permitting Policy for Water Quality-Based Effluent Limitations in Storm Water Permits, issued on August 1, 1996 [61 FR 43761 (November 26, 1996), EPA believes that the currently available methodology for derivation of numeric water quality-based effluent limitations is significantly complicated when applied to wet weather discharges from MS4s (compared to continuous or periodic batch discharges from most other types of discharge). Wet weather discharges from MS4s introduce a high degree of variability in the inputs to the models currently available for derivation of water quality based effluent limitations, including assumptions about instream and discharge flow rates, as well as effluent characterization. In addition, EPA anticipates that determining compliance with any such numeric limitations may be confounded by practical limitations in sample collection.

In the first two to three rounds of permit issuance, EPA envisions that a BMP-based storm water management program that implements the six minimum measures will be the extent of the NPDES permit requirements for the large majority of regulated small MS4s. Because the six measures represent a significant level of control if properly implemented, EPA anticipates that a permit for a regulated small MS4 operator implementing BMPs to satisfy the six minimum control measures will be sufficiently stringent to protect water quality, including water quality standards, so that additional, more stringent and/or more prescriptive water quality based effluent limitations will be unnecessary.

If a small MS4 operator implements the six minimum control measures in § 122.34(b) and the discharges are determined to cause or contribute to non-attainment of an applicable water quality standard, the operator needs to expand or better tailor its BMPs within the scope of the six minimum control measures. EPA envisions that this process will occur during the first two to three permit terms. After that period, EPA will revisit today's regulations for the municipal separate storm sewer program.

If the permitting authority (rather than the regulated small MS4 operator) needs to impose additional or more specific measures to protect water quality, then that action will most likely be the result of an assessment based on a TMDL or equivalent analysis that determines sources and allocations of pollutant(s) of concern. EPA believes that the small MS4's additional requirements, if any, should be guided by its equitable share based on a variety of considerations, such as cost effectiveness, proportionate contribution of pollutants, and ability to reasonably achieve wasteload reductions. Narrative effluent limitations in the form of BMPs may still be the best means of achieving those reductions.

See Section II.L, Water Quality Issues, for further discussion of this approach to permitting, consistent with EPA's interim permitting guidance. Pursuant to CWA section 510, States implementing their own NPDES programs may develop more stringent or more prescriptive requirements than those in today's rule.

EPA's interpretation of CWA section 402(p)(3)(B)(iii) was recently reviewed by the Ninth Circuit in *Defenders of Wildlife, et al* v. *Browner*, No. 98–71080 (September 15, 1999). The Court upheld the Agency's action in issuing five MS4 permits that included water quality-based effluent limitations. The Court did, however, disagree with EPA's interpretation of the relationship between CWA sections 301 and 402(p). The Court reasoned that MS4s are not compelled by section 301(b)(1)(C) to meet all State water quality standards, but rather that the Administrator or the State may rely on section 402(p)(3)(B)(iii) to require such controls. Accordingly, the *Defenders of Wildlife* decision is consistent with the Agency's 1996 "Interim Permitting Policy for Water Quality-Based Effluent Limitations in Storm Water Permits."

As noted, the 1996 Policy describes how permits would implement an iterative process using BMPs, assessment, and refocused BMPs, leading toward attainment of water quality standards. The ultimate goal of the iteration would be for water bodies to support their designated uses. EPA believes this iterative approach is consistent with and implements section 301(b)(1)(C), notwithstanding the Ninth Circuit's interpretation. As an alternative to basing these water quality-based requirements on section 301(b)(1)(C), however, EPA also believes the iterative approach toward attainment of water quality standards represents a reasonable interpretation of CWA section 402(p)(3)(B)(iii). For this reason, today's rule specifies that the "compliance target" for the design and implementation of municipal storm water control programs is "to reduce pollutants to the maximum extent practicable (MEP), to protect water quality, and to satisfy the appropriate water quality requirements of the CWA." The first component, reductions to the MEP, would be realized through implementation of the six minimum measures. The second component, to protect water quality, reflects the overall design objective for municipal programs based on CWA section 402(p)(6). The third component, to implement other applicable water quality requirements of the CWA, recognizes the Agency's specific determination under CWA section 402(p)(3)(B)(iii) of the need to achieve reasonable further progress toward attainment of water quality standards according to the iterative BMP process, as well as the determination that State or EPA officials who establish TMDLs could allocate waste loads to

MS4s, as they would to other point sources.

EPA does not presume that water quality will be protected if a small MS4 elects not to implement all of the six minimum measures and instead applies for alternative permit limits under § 122.26(d). Operators of such small MS4s that apply for alternative permit limits under § 122.26(d) must supply additional information through individual permit applications so that the permit writer can determine whether the proposed program reduces pollutants to the MEP and whether any other provisions are appropriate to protect water quality and satisfy the appropriate water quality requirements of the Clean Water Act.

iii. *Maximum Extent Practicable.* Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that operators of regulated MS4s must achieve. The CWA requires that NPDES permits for discharges from MS4s "shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods." CWA Section 402(p)(3)(B)(iii). This section also calls for "such other provisions as the [EPA] Administrator or the State determines appropriate for the control of such pollutants." EPA interprets this standard to apply to all MS4s, including both existing regulated (large and medium) MS4s, as well as the small MS4s regulated under today's rule.

For regulated small MS4s under today's rule, authorization to discharge may be under either a general permit or individual permit, but EPA anticipates and expects that general permits will be the most common permit mechanism. The general permit will explain the steps necessary to obtain permit authorization. Compliance with the conditions of the general permit and the series of steps associated with identification and implementation of the minimum control measures will satisfy the MEP standard. Implementation of the MEP standard under today's rule will typically require the permittee to develop and implement appropriate BMPs to satisfy each of the required six minimum control measures.

In issuing the general permit, the NPDES permitting authority will establish requirements for each of the minimum control measures. Permits typically will require small MS4 permittees to identify in their NOI the BMPs to be performed and to develop the measurable goals by which implementation of the BMPs can be assessed. Upon receipt of the NOI from a small MS4 operator, the NPDES permitting authority will have the opportunity to review the NOI to verify that the identified BMPs and measurable goals are consistent with the requirement to reduce pollutants under the MEP standard, to protect water quality, and to satisfy the appropriate water quality requirements of the Clean Water Act. If necessary, the NPDES permitting authority may ask the permittee to revise their mix of BMPs, for example, to better reflect the MEP pollution reduction requirement. Where the NPDES permit is not written to implement the minimum control measures specified under § 122.34(b), for example in the case of an individual permit under § 122.33(b)(2)(ii), the MEP standard will be applied based on the best professional judgment of the permit writer.

Commenters argued that MEP is, as yet, an undefined term and that EPA needs to further clarify the MEP standards by providing a regulatory definition that includes recognition of cost considerations and technical feasibility. Commenters argued that, without a definition, the regulatory community is not adequately on notice regarding the standard with which they need to comply. EPA disagrees that affected MS4 permittees will lack notice of the applicable standard. The framework for the small MS4 permits described in this notice provides EPA's interpretation of the standard and how it should be applied.

EPA has intentionally not provided a precise definition of MEP to allow maximum flexibility in MS4 permitting. MS4s need the flexibility to optimize reductions in storm water pollutants on a location-by-location basis. EPA envisions that this evaluative process will consider such factors as conditions of receiving waters, specific local concerns, and other aspects included in a comprehensive watershed plan. Other factors may include MS4 size, climate, implementation schedules, current ability to finance the program, beneficial uses of receiving water, hydrology, geology, and capacity to perform operation and maintenance.

The pollutant reductions that represent MEP may be different for each small MS4, given the unique local hydrologic and geologic concerns that may exist and the differing possible pollutant control strategies. Therefore, each permittee will determine appropriate BMPs to satisfy each of the six minimum control measures through an evaluative process. Permit writers may evaluate small MS4 operator's proposed storm water management controls to determine whether reduction of pollutants to the MEP can be achieved with the identified BMPs.

EPA envisions application of the MEP standard as an iterative process. MEP should continually adapt to current conditions and BMP effectiveness and should strive to attain water quality standards. Successive iterations of the mix of BMPs and measurable goals will be driven by the objective of assuring maintenance of water quality standards. If, after implementing the six minimum control measures there is still water quality impairment associated with discharges from the MS4, after successive permit terms the permittee will need to expand or better tailor its BMPs within the scope of the six minimum control measures for each subsequent permit. EPA envisions that this process may take two to three permit terms.

One commenter observed that MEP is not static and that if the six minimum control measures are not achieving the necessary water quality improvements, then an MS4 should be expected to revise and, if necessary, expand its program. This concept, it is argued, must be clearly part of the definition of MEP and thus incorporated into the binding and operative aspects of the rule. As is explained above, EPA believes that it is. The iterative process described above is intended to be sensitive to water quality concerns. EPA believes that today's rule contains provisions to implement an approach that is consistent with this comment.

b. Program Requirements'Minimum Control Measures

A regulated small MS4 operator must develop and implement a storm water management program designed to reduce the discharge of pollutants from their MS4 to protect water quality. The storm water management program must include the following six minimum measures.

i. *Public Education and Outreach on Storm Water Impacts.* Under today's final rule, operators of small MS4s must implement a public education program to distribute educational materials to the community or conduct equivalent outreach activities about the impacts of storm water discharges on water bodies and the steps to reduce storm water pollution. The public education program should inform individuals and households about the problem and the steps they can take to reduce or prevent storm water pollution.

EPA believes that as the public gains a greater understanding of the storm water program, the MS4 is likely to gain

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more support for the program (including funding initiatives). In addition, compliance with the program will probably be greater if the public understands the personal responsibilities expected of them. Well-informed citizens can act as formal or informal educators to further disseminate information and gather support for the program, thus easing the burden on the municipalities to perform all educational activities.

MS4s are encouraged to enter into partnerships with their States in fulfilling the public education requirement. It may be more cost-effective to utilize a State education program instead of numerous MS4s developing their own programs. MS4 operators are also encouraged to work with other organizations (e.g., environmental, nonprofit and industry organizations) that might be able to assist in fulfilling this requirement.

The public education program should be tailored, using a mix of locally appropriate strategies, to target specific audiences and communities (particularly minority and disadvantaged communities). Examples of strategies include distributing brochures or fact sheets, sponsoring speaking engagements before community groups, providing public service announcements, implementing educational programs targeted at school age children, and conducting community-based projects such as storm drain stenciling, and watershed and beach cleanups. Operators of MS4s may use storm water educational information provided by the State, Tribe, EPA, or environmental, public interest, trade organizations, or other MS4s. Examples of successful public education efforts concerning polluted runoff can be found in many State nonpoint source pollution control programs under CWA section 319.

The public education program should inform individuals and households about steps they can take to reduce storm water pollution, such as ensuring proper septic system maintenance, ensuring the use and disposal of landscape and garden chemicals including fertilizers and pesticides, protecting and restoring riparian vegetation, and properly disposing of used motor oil or household hazardous wastes. Additionally, the program could inform individuals and groups on how to become involved in local stream and beach restoration activities as well as activities coordinated by youth service and conservation corps and other citizen groups. Finally, materials or outreach programs should be directed toward targeted groups of commercial, industrial, and institutional entities likely to have significant storm water impacts. For example, MS4 operators should provide information to restaurants on the impact of grease clogging storm drains and to auto garages on the impacts of used oil discharges.

EPA received comments from representatives of State DOTs and U.S. Department of Defense (DOD) installations seeking exemption from the public education requirement. While today's rule does not exempt DOTs and military bases from the user education requirement, the Agency believes the flexibility inherent in the Rule addresses many of the concerns expressed by these commenters.

Certain DOT representatives commented that if their agencies were not exempt from the user education measure's requirements, they should at least be allowed to count DOT employee education as an adequate substitute. EPA supports the use of existing materials and programs, granted such materials and programs meet the rule's requirement that the MS4 user community (*i.e.*, the public) is also educated concerning the impacts of storm water discharges on water bodies and the steps to reduce storm water pollution.

Finally, certain DOD representatives requested that "public," as applied to their installations, be defined as the resident and employee populations within the fence line of the facility. EPA agrees that the education effort should be directed toward those individuals who frequent the federally owned land (*i.e.*, residents and individuals who come there to work and use the MS4 facilities).

EPA also received a number of comments from municipalities stating that education would be more thorough and cost effective if accomplished by EPA on the national level. EPA believes that a collaborative State and local approach, in conjunction with significant EPA technical support, will best meet the goal of targeting, and reaching, specific local audiences. EPA technical support will include a tool box which will contain fact sheets, guidance documents, an information clearinghouse, and training and outreach efforts.

Finally, EPA received comments expressing concern that the public education program simply encourages the distribution of printed material. EPA is sensitive to this concern. Upon evaluation, the Agency made changes to the proposal's language for today's rule. The language has been changed to reflect EPA's belief that a successful program is one that includes a variety of strategies locally designed to reach specific audiences.

ii. Public Involvement/Participation. Public involvement is an integral part of the small MS4 storm water program. Accordingly, today's final rule requires that the municipal storm water management program must comply with applicable State and local public notice requirements. Section 122.34(b)(2) recommends a public participation process with efforts to reach out and engage all economic and ethnic groups. EPA believes there are two important reasons why the public should be allowed and encouraged to provide valuable input and assistance to the MS4's program.

First, early and frequent public involvement can shorten implementation schedules and broaden public support for a program. Opportunities for members of the public to participate in program development and implementation could include serving as citizen representatives on a local storm water management panel, attending public hearings, working as citizen volunteers to educate other individuals about the program, assisting in program coordination with other pre-existing programs, or participating in volunteer monitoring efforts. Moreover, members of the public may be less likely to raise legal challenges to a MS4's storm water program if they have been involved in the decision making process and program development and, therefore, internalize personal responsibility for the program themselves.

Second, public participation is likely to ensure a more successful storm water program by providing valuable expertise and a conduit to other programs and governments. This is particularly important if the MS4's storm water program is to be implemented on a watershed basis. Interested stakeholders may offer to volunteer in the implementation of all aspects of the program, thus conserving limited municipal resources.

EPA recognizes that there are a number of challenges associated with public involvement. One challenge is in engaging people in the public meeting and program design process. Another challenge is addressing conflicting viewpoints. Nevertheless, EPA strongly believes that these challenges can be addressed by use of an aggressive and inclusive program. Section II.K. provides further discussion on public involvement.

A number of municipalities sought clarification from EPA concerning what the public participation program must actually include. In response, the actual requirements are minimal, but the Agency's *recommendations* are more comprehensive. The public participation program must only comply with applicable State and local public notice requirements. The remainder of the preamble, as well as the Explanatory Note accompanying the regulatory text, provide guidance to the MS4s concerning what elements a successful and inclusive program should include. EPA will provide technical support as part of the tool box (*i.e.*, providing model public involvement programs, conducting public workshops, *etc.*) to assist MS4 operators meet the intent of this measure.

Finally, the Agency encourages MS4s to seek public participation prior to submitting an NOI. For example, public participation at this stage will allow the MS4 to involve the public in developing the BMPs and measurable goals for their NOI.

iii. Illicit Discharge Detection and Elimination. Discharges from small MS4s often include wastes and wastewater from non-storm water "illicit" discharges. Illicit discharge is defined at 40 CFR 122.26(b)(2) as any discharge to a municipal separate storm sewer that is not composed entirely of storm water, except discharges pursuant to an NPDES permit and discharges resulting from fire fighting activities. As detailed below, other sources of non-storm water, that would otherwise be considered illicit discharges, do not need to be addressed unless the operator of the MS4 identifies one or more of them as a significant source of pollutants into the system. EPA's Nationwide Urban Runoff Program (NURP) indicated that many storm water outfalls still discharge during substantial dry periods. Pollutant levels in these dry weather flows were shown to be high enough to significantly degrade receiving water quality. Results from a 1987 study conducted in Sacramento, California, revealed that slightly less than one-half of the water discharged from a municipal separate storm sewer system was not directly attributable to precipitation runoff (U.S. Environmental Protection Agency, Office of Research and Development. 1993. *Investigation of Inappropriate Pollutant Entries Into Storm Drainage Systems—A User's Guide.* Washington, DC EPA 600/R–92/238.) A significant portion of these dry weather flows results from illicit and/or inappropriate discharges and connections to the municipal separate storm sewer system. Illicit discharges enter the system through either direct connections (*e.g.*, wastewater piping either mistakenly or deliberately connected to the storm drains) or indirect connections (*e.g.*, infiltration into the storm drain system or spills collected by drain inlets).

Under the existing NPDES program for storm water, permit applications for large and medium MS4s are to include a program description for effective prohibition against non-storm water discharges into their storm sewers (see 40 CFR 122.26 (d)(1)(v)(B) and (d)(1)(iv)(B)). Further, EPA believes that in implementing municipal storm water management plans under these permits, large and medium MS4 operators generally found their illicit discharge detection and elimination programs to be cost-effective. Properly implemented programs also significantly improved water quality.

In today's rule, any NPDES permit issued to an operator of a regulated small MS4 must, at a minimum, require the operator to develop, implement and enforce an illicit discharge detection and elimination program. Inclusion of this measure for regulated small MS4s is consistent with the "effective prohibition" requirement for large and medium MS4s. Under today's rule, the NPDES permit will require the operator of a regulated small MS4 to: (1) Develop (if not already completed) a storm sewer system map showing the location of all outfalls, and names and location of all waters of the United States that receive discharges from those outfalls; (2) to the extent allowable under State, Tribal, or local law, effectively prohibit through ordinance, or other regulatory mechanism, illicit discharges into the separate storm sewer system and implement appropriate enforcement procedures and actions as needed; (3) develop and implement a plan to detect and address illicit discharges, including illegal dumping, to the system; and (4) inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste.

The illicit discharge and elimination program need only address the following categories of non-storm water discharges if the operator of the small MS4 identifies them as significant contributors of pollutants to its small MS4: water line flushing, landscape irrigation, diverted stream flows, rising ground waters, uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20)), uncontaminated pumped ground water, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, springs, water from crawl space pumps, footing drains, lawn watering, individual residential car washing, flows from riparian habitats and wetlands, dechlorinated swimming pool discharges, and street wash water (discharges or flows from fire fighting activities are excluded from the definition of illicit discharge and only need to be addressed where they are identified as significant sources of pollutants to waters of the United States). If the operator of the MS4 identifies one or more of these categories of sources to be a significant contributor of pollutants to the system, it could require specific controls for that category of discharge or prohibit the discharges completely.

Several comments were received on the mapping requirements of the proposal. Most comments said that more flexibility should be given to the MS4s to determine their mapping needs, and that resources could be better spent in addressing problems once the illicit discharges are detected. EPA reviewed the mapping requirements in the proposed rule and agrees that some of the information is not necessary in order to begin an illicit discharge detection and elimination program. Today's rule requires a map or set of maps that show the locations of all outfalls and names and locations of receiving waters. Knowing the locations of outfalls and receiving waters are necessary to be able to conduct dry weather field screening for non-storm water flows and to respond to illicit discharge reports from the public. EPA recommends that the operator collect any existing information on outfall locations (*e.g.*, review city records, drainage maps, storm drain maps), and then conduct field surveys to verify the locations. It will probably be necessary to "walk" (*i.e.* wade small receiving waters or use a boat for larger receiving waters) the streambanks and shorelines, and it may take more than one trip to locate all outfalls. A coding system should be used to mark and identify each outfall. MS4 operators have the flexibility to determine the type (*e.g.* topographic, GIS, hand or computer drafted) and size of maps which best meet their needs. The map scale should be such that the outfalls can be accurately located. Once an illicit discharge is detected at an outfall, it may be necessary to map that portion of the storm sewer system leading to the outfall in order to locate the source of the discharge.

Several comments requested clarification of the requirement to develop and implement a plan to detect and eliminate illicit discharges. EPA recommends that plans include procedures for the following: locating priority areas; tracing the source of an illicit discharge; removing the source of the discharge; and program evaluation and assessment. EPA recommends that MS4 operators identify priority areas (*i.e.*, problems areas) for more detailed screening of their system based on higher likelihood of illicit connections (*e.g.*, areas with older sanitary sewer lines), or by conducting ambient sampling to locate impacted reaches. Once priority areas are identified, EPA recommends visually screening outfalls during dry weather and conducting field tests, where flow is occurring, of selected chemical parameters as indicators of the discharge source. EPA's manual for investigation of inappropriate pollutant entries into the storm drainage system (EPA, 1993) suggests the following parameter list: specific conductivity, fluoride and/or hardness concentration, ammonia and/or potassium concentration, surfactant and/or fluorescence concentration, chlorine concentration, pH and other chemicals indicative of industrial sources. The manual explains why each parameter is a good indicator and how the information can be used to determine the type of source flow. The Agency is not recommending that fluoride and chlorine, generally used to locate potable water discharges, be addressed under this program, therefore a short list of parameters may include conductivity, ammonia, surfactant and pH. Some MS4s have found it useful to measure for fecal coliform or E. coli in their testing program. Observations of physical characteristics of the discharge are also helpful such as flow rate, temperature, odor, color, turbidity, floatable matter, deposits and stains, and vegetation.

The implementation plan should also include procedures for tracing the source of an illicit discharge. Once an illicit discharge is detected and field tests provide source characteristics, the next step is to determine the actual location of the source. Techniques for tracing the discharge to its place of origin may include: following the flow up the storm drainage system via observations and/or chemical testing in manholes or in open channels; televising storm sewers; using infrared and thermal photography; conducting smoke or dye tests.

The implementation plan should also include procedures for removing the source of the illicit discharge. The first step may be to notify the property owner and specify a length of time for eliminating the discharge. Additional notifications and escalating legal actions should also be described in this part of the plan.

Finally, the implementation plan should include procedures for program evaluation and assessment. Procedures could include documentation of actions taken to locate and eliminate illicit discharges such as: number of outfalls screened, complaints received and corrected, feet of storm sewers televised, numbers of discharges and quantities of flow eliminated, number of dye or smoke tests conducted. Appropriate records of such actions should be kept and should be submitted as part of the annual reports for the first permit term, as specified by the permitting authority (reports only need to be submitted in years 2 and 4 in later permits). For more on reporting requirements, see § 122.34(g).

EPA received comments regarding an MS4's legal authority beyond its jurisdictional boundaries to inspect or take enforcement against illicit discharges. EPA recognizes that illicit flows may originate in one jurisdiction and cross into one or more jurisdictions before being discharged at an outfall. In such instances, EPA expects the MS4 that detects the illicit flow to trace it to the point where it leaves their jurisdiction and notify the adjoining MS4 of the flow, and any other physical or chemical information. The adjoining MS4 should then trace it to the source or to the location where it enters their jurisdiction. The process of notifying the adjoining MS4 should continue until the source is located and eliminated. In addition, because any non-storm water discharge to waters of the U.S. through an MS4 is subject to the prohibition against unpermitted discharges pursuant to CWA section 301 (a), remedies are available under the federal enforcement provisions of CWA sections 309 and 505.

EPA requested and received comments regarding the prohibition and enforcement provision for this minimum measure. Commenters specifically questioned the proposal that the operator only has to implement the appropriate prohibition and enforcement procedures "to the extent allowable under State or Tribal law." They raised concerns that by qualifying prohibition and enforcement procedures in this manner, the operator could altogether ignore this minimum measure where affirmative legal authority did not exist. Comments suggested that EPA require States to grant authority to those municipalities where it did not exist. Other comments, however, stated that municipalities cannot exercise legal authority not granted to them under State law, which varies considerably from one State to another. EPA has no intention of directing State legislatures on how to allocate authority and responsibility under State law. As noted above, there is at least one remedy (the federal CWA) to control non-storm water discharges through MS4s. If State law prevents political subdivisions from controlling discharges through storm sewers, EPA anticipates common sense will prevail to provide those MS4 operators with the ability to meet the requirements applicable for their discharges.

One comment reinforced the importance of public information and education to the success of this measure. EPA agrees and suggests that MS4 operators consider a variety of ways to inform and educate the public which could include storm drain stenciling; a program to promote, publicize, and facilitate public reporting of illicit connections or discharges; and distribution of visual and/or printed outreach materials. Recycling and other public outreach programs could be developed to address potential sources of illicit discharges, including used motor oil, antifreeze, pesticides, herbicides, and fertilizers.

EPA received comments that State DOT's lack authority to implement this measure. EPA believes that most DOTs can implement most parts of this measure. If a DOT does not have the necessary legal authority to implement any part of this measure, EPA encourages them to coordinate their storm water management efforts with the surrounding MS4s and other State agencies. Many DOTs that are regulated under Phase I of this program are co-permittees with the local regulated MS4. Under today's rule, DOTs can use any of the options of § 122.35 to share their storm water management responsibilities.

EPA received comments requesting clarification of various terms such as "outfall" and "illicit discharge." One comment asked EPA to reinforce the point that a "ditch" could be considered an outfall. The term "outfall" is defined at 40 CFR 122.26(b)(9) as "a point source at the point where a municipal separate storm sewer discharges to waters of the United States * * *". The term municipal separate storm sewer is defined at 40 CFR § 122.26(b)(8) as "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) * * *". Following the logic of these definitions, a "ditch" may be part of the municipal separate storm sewer, and at the point where the ditch discharges to waters of the United States, it would be an outfall. As with any determination about jurisdictional provisions of the CWA, however, final decisions require case specific evaluations of fact.

One commenter specifically requested clarification on the relationship between the term "illicit discharge" and non-storm water discharges from fire fighting. The comment suggested that it would be impractical to attempt to determine whether the flow from a specific fire (*i.e.*, during a fire) is a significant source of pollution. EPA intends that MS4s will address all allowable non-storm water flows categorically rather than individually. If an MS4 is concerned that flows from fire fighting are, as a category, contributing substantial amounts of pollutants to their system, they could develop a program to address those flows prospectively. The program may include an analysis of the flow from several sources, steps to minimize the pollutant contribution, and a plan to work with the sources of the discharge to minimize any adverse impact on water quality. During the development of such a program, the MS4 may determine that only certain types of flows within a particular category are a concern, for example, fire fighting flows at industrial sites where large quantities of chemicals are present. In this example, a review of existing procedures with the fire department and/or hazardous materials team may reveal weaknesses or strengths previously unknown to the MS4 operator.

EPA received comments requesting modifications to the rule to include on-site sewage disposal systems (i.e., septic systems) in the scope of the illicit discharge program. On-site sewage disposal systems that flow into storm drainage systems are within the definition of illicit discharge as defined by the regulations. Where they are found to be the source of an illicit discharge, they need to be eliminated similar to any other illicit discharge source. Today's rule was not modified to include discharges from on-site sewage disposal systems specifically because those sources are already within the scope of the existing definition of illicit discharge.

iv. Construction Site Storm Water Runoff Control. Over a short period of time, storm water runoff from construction site activity can contribute more pollutants, including sediment, to a receiving stream than had been deposited over several decades (see section I.B.3). Storm water runoff from construction sites can include pollutants other than sediment, such as phosphorus and nitrogen, pesticides, petroleum derivatives, construction chemicals, and solid wastes that may become mobilized when land surfaces are disturbed. Generally, properly implemented and enforced construction site ordinances effectively reduce these pollutants. In many areas, however, the effectiveness of ordinances in reducing pollutants is limited due to inadequate enforcement or incomplete compliance with such local ordinances by construction site operators (Paterson, R.G. 1994. "Construction Practices: The Good, the Bad, and the Ugly." *Watershed Protection Techniques* 1(2)).

Today's rule requires operators of regulated small MS4s to develop, implement, and enforce a pollutant control program to reduce pollutants in any storm water runoff from construction activities that result in land disturbance of 1 or more acres (see § 122.34(b)(4)). Construction activity on sites disturbing less than one acre must be included in the program if the construction activity is part of a larger common plan of development or sale that would disturb one acre or more.

The construction runoff control program of the regulated small MS4 must include an ordinance or other regulatory mechanism to require erosion and sediment controls to the extent practicable and allowable under State, Tribal or local law. The program also must include sanctions to ensure compliance (for example, non-monetary penalties, fines, bonding requirements, and/or permit denials for non-compliance). The program must also include, at a minimum: requirements for construction site operators to implement appropriate erosion and sediment control BMPS, such as silt fences, temporary detention ponds and diversions; procedures for site plan review by the small MS4 which incorporate consideration of potential water quality impacts; requirements to control other waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste at the construction site that may adversely impact water quality; procedures for receipt and consideration of information submitted by the public to the MS4; and procedures for site inspection and enforcement of control measures by the small MS4.

Today's rule provides flexibility for regulated small MS4s by allowing them to exclude from their construction pollutant control program runoff from those construction sites for which the NPDES permitting authority has waived NPDES storm water small construction permit requirements. For example, if the NPDES permitting authority waives permit coverage for storm water discharges from construction sites less than 5 acres in areas where the rainfall erosivity factor is less than 5, then the regulated small MS4 does not have to include these sites in its storm water management program. Even if requirements for a discharge from a given construction site are waived by the NPDES permitting authority, however, the regulated small MS4 may still chose to control those discharges under the MS4's construction pollutant control program, particularly where such discharges may cause siltation problems in storm sewers. See Section II.I.1.b for more information on construction waivers by the permitting authority.

Some commenters suggested that the proposed construction minimum measure requirements went beyond the permit application requirements concerning construction for medium and large MS4s. In response, EPA has made changes to the proposed measure so that it more closely resembles the MS4 permit application requirements in existing regulations. For example, as described below, the Agency revised the proposed requirements for "pre-construction review of site management plans" to require "procedures for site plan review."

One commenter expressed concerns that addressing runoff from construction sites within urbanized areas (through the small MS4 program) differently from construction sites outside urbanized areas (which will not be covered by the small MS4 program) will encourage urban sprawl. Today's rule, together with the existing requirements, requires all construction greater than or equal to 1 acre, unless waived, to be covered by an NPDES permit whether it is located inside or outside of an urbanized area (see § 122.26(b)(15)). Today's rule does not require small MS4s to control runoff from construction sites more stringently or prescriptively than is required for construction site runoff outside urbanized areas. Therefore, today's rule imposes no substantively different onsite controls on runoff of storm water from construction sites in urbanized areas than from construction sites outside of urbanized areas.

One commenter recommended that the small MS4 construction site storm water runoff control program address all storm water runoff from construction sites, not just the runoff into the MS4. The commenter also believed that MS4s should provide clear, objective standards for all construction sites. EPA agrees. Because today's rule only regulates discharges from the MS4, the construction pollutant control measure only requires small MS4 operators to control runoff into its system. As a practical matter, however, EPA anticipates that MS4 operators will find that regulation of all construction site

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runoff, whether they runoff into the MS4 or not, will prove to be the most simple and efficient program. The Agency may provide more specific criteria for construction site BMPs in the forthcoming rule being developed under CWA section 402(m). See section II.D.1 of today's rule.

One commenter stated that there is no need for penalties at the local level by the small MS4 because the CWA already imposes sufficient penalties to ensure compliance. EPA disagrees and believes that enforcement and compliance at the local level is both necessary and preferable. Examples of sanctions, some not available under the CWA, include non-monetary penalties, monetary fines, bonding requirements, and denial of future or other local permits.

One commenter recommended that EPA should not include the requirement to control pollutants other than sediment from construction sites in this measure. EPA disagrees with this comment. The requirement is to control waste that "may cause adverse impacts on water quality." Such wastes may include discarded building materials, concrete truck washout, chemicals, pesticides, herbicides, litter, and sanitary waste. These wastes, when exposed to and mobilized by storm water, can contribute to water quality impairment.

The proposed rule required "procedures for pre-construction review of site management plans." EPA requested comment on expanding this provision to require both review and approval of construction site storm water plans. Many commenters expressed the concern that review and approval of site plans is not only costly and time intensive, but may unnecessarily delay construction projects and unduly burden staff who administer the local program. In addition, some commenters expressed confusion whether EPA proposed pre-construction review for all site management plans or only higher priority sites. To address these comments, and be consistent with the permit application requirements for larger MS4s, EPA changed "procedures for pre-construction review of site management plans" to "procedures for site plan review." Today's rule requires the small MS4 to develop procedures for site plan review so as to incorporate consideration of adverse potential water quality impacts. Procedures should include review of site erosion and sediment control plans, preferably before construction activity begins on a site. The objective is for the small MS4 operator and the construction site operator to address storm water runoff from construction activity early in the project design process so that potential consequences to the aquatic environment can be assessed and adverse water quality impacts can be minimized or eliminated.

One commenter requested that EPA delete the requirement for "procedures for receipt and consideration of information submitted by the public" because it went beyond existing storm water requirements. Another commenter stated that establishing a separate process to respond to public inquiries on a project is a burden to small communities, especially if the project has gone through an environmental review. One commenter requested clarification of this provision. EPA has retained this requirement in today's final rule to require some formality in the process for addressing public inquiries regarding storm water runoff from construction activities. EPA does not intend that small MS4s develop a separate, burdensome process to respond to every public inquiry. A small MS4 could, for example, simply log public complaints on existing storm water runoff problems from construction sites and pass that information on to local inspectors. The inspectors could then investigate complaints based on the severity of the violation and/or priority area.

One commenter believed that the proposed requirement of "regular inspections during construction" would require every construction project to be inspected more than once by the small MS4 during the term of a construction project. EPA has deleted the reference to "regular inspections." Instead, the small MS4 will be required to "develop procedures for site inspection and enforcement of control measures." Procedures could include steps to identify priority sites for inspection and enforcement based on the nature and extent of the construction activity, topography, and the characteristics of soils and receiving water quality.

In order to avoid duplication of small MS4 construction requirements with NPDES construction permit requirements, today's rule adds § 122.44(s) to recognize that the NPDES permitting authority can incorporate qualifying State, Tribal, or local erosion and sediment control requirements in NPDES permits for construction site discharges. For example, a construction site operator who complies with MS4 construction pollutant control programs that are referenced in the NPDES construction permit would satisfy the requirements of the NPDES permit. See section II.I.1.d for more information on incorporating qualifying programs by reference into NPDES construction permits. This provision has no impact on, or direct relation to, the small MS4 operator's responsibilities under the construction site storm water runoff control minimum measure. Conversely, under § 122.35(b), the permitting authority may recognize in the MS4's permit that another governmental entity, or the permitting authority itself, is responsible for implementing one or more of the minimum measures (including construction site storm water runoff control), and not include this measure in the small MS4's permit. In this case, the other governmental entity's program must satisfy all of the requirements of the omitted measure.

v. Post-Construction Storm Water Management in New Development and Redevelopment. The NURP study and more recent investigations indicate that prior planning and designing for the minimization of pollutants in storm water discharges is the most cost-effective approach to storm water quality management. Reducing pollutant concentrations in storm water after the discharge enters a storm sewer system is often more expensive and less efficient than preventing or reducing pollutants at the source. Increased human activity associated with development often results in increased pollutant loading from storm water discharges. If potential adverse water quality impacts are considered from the beginning stages of a project, new development and redevelopment provides more opportunities for water quality protection. For example, minimization of impervious areas, maintenance or restoration of natural infiltration, wetland protection, use of vegetated drainage ways, and use of riparian buffers have been shown to reduce pollutant loadings in storm water runoff from developed areas. EPA encourages operators of regulated small MS4s to identify specific problem areas within their jurisdictions and initiate innovative solutions and designs to focus attention on those areas through local planning.

In today's rule at § 122.34(b)(5), NPDES permits issued to an operator of a regulated small MS4 will require the operator to develop, implement, and enforce a program to address storm water runoff from new development and redevelopment projects that result in land disturbance of greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, that discharge into the MS4. Specifically, the NPDES permit will require the operator of a regulated small MS4 to: (1) Develop and implement

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strategies which include a combination of structural and/or non-structural best management practices (BMPs) appropriate for the community; (2) use an ordinance, or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects to the extent allowable under State, Tribal or local law; (3) ensure adequate long-term operation and maintenance of BMPs; and (4) ensure that controls are in place that would minimize water quality impacts. EPA intends the term "redevelopment" to refer to alterations of a property that change the "footprint" of a site or building in such a way that results in the disturbance of equal to or greater than 1 acre of land. The term is not intended to include such activities as exterior remodeling, which would not be expected to cause adverse storm water quality impacts and offer no new opportunity for storm water controls.

EPA received comments requesting guidance and clarification of the rule requirements. The scope of the comments ranged from general requests for more details on how MS4 operators should accomplish the four requirements listed above, to specific requests for information regarding transfer of ownership for structural controls, as well as ongoing responsibility for operation and maintenance. By the term "combination" of BMPs, EPA intends a combination of structural and/or non-structural BMPs. For this requirement, the term "combination" is meant to emphasize that multiple BMPs should be considered and adopted for use in the community. A single BMP generally cannot significantly reduce pollutant loads because pollutants come from many sources within a community. The BMPs chosen should: (1) Be appropriate for the local community; (2) minimize water quality impacts; and (3) attempt to maintain pre-development runoff conditions. In choosing appropriate BMPs, EPA encourages small MS4 operators to participate in locally-based watershed planning efforts which attempt to involve a diverse group of stakeholders. Each new development and redevelopment project should have a BMP component. If an approach is chosen that primarily focuses on regional or non-structural BMPs, however, then the BMPs may be located away from the actual development site (*e.g.*, a regional water quality pond).

Non-structural BMPs are preventative actions that involve management and source controls such as: (1) Policies and ordinances that provide requirements and standards to direct growth to identified areas, protect sensitive areas such as wetlands and riparian areas, maintain and/or increase open space (including a dedicated funding source for open space acquisition), provide buffers along sensitive water bodies, minimize impervious surfaces, and minimize disturbance of soils and vegetation; (2) policies or ordinances that encourage infill development in higher density urban areas, and areas with existing storm sewer infrastructure; (3) education programs for developers and the public about project designs that minimize water quality impacts; and (4) other measures such as minimization of the percentage of impervious area after development, use of measures to minimize directly connected impervious areas, and source control measures often thought of as good housekeeping, preventive maintenance and spill prevention. Detailed examples of non-structural BMPs follow.

Preserving open space may help to protect water quality as well as provide other benefits such as recharging groundwater supplies, detaining storm water, supporting wildlife and providing recreational opportunities. Although securing funding for open space acquisition may be difficult, various funding mechanisms have been used. New Jersey uses a portion of their State sales tax (voter approved for a ten year period) as a stable source of funding to finance the preservation of historic sites, open space and farmland. Colorado uses part of the proceeds from the State lottery to acquire and manage open space. Some local municipalities use a percentage of the local sales tax revenue to pay for open space acquisition (*e.g.*, Jefferson County, CO has had an open space program in place since 1977 funded by a 0.50 percent sales tax). Open space can be acquired in the form of: fee simple purchase; easements; development rights; purchase and sellback or leaseback arrangements; purchase options; private land trusts; impact fees; and land dedication requirements. Generally, fee simple purchases provide the highest level of development control and certainty of preservation, whereas the other forms of acquisition may provide less control, though they would also generally be less costly.

Cluster development, while allowing housing densities comparable to conventional zoning practice, concentrates housing units in a portion of the total site area which provides for greater open space, recreation, stream protection and storm water control. This type of development, by reducing lot sizes, can protect sensitive areas and result in less impervious surface, as well as reduce the cost for roads and other infrastructure.

Minimizing directly connected impervious areas (DCIAs) is a drainage strategy that seeks to reduce paved areas and directs storm water runoff to landscaped areas or to structural controls such as grass swales or buffer strips. This strategy can slow the rate of runoff, reduce runoff volumes, attenuate peak flows, and encourage filtering and infiltration of storm water. It can be made an integral part of drainage planning for any development (Urban Drainage and Flood Control District, Denver, CO. 1992. *Urban Storm Drainage Criteria Manual, Volume 3—Best Management Practices).* The Urban Drainage and Flood Control District manual describes three levels for minimizing DCIAs. At Level 1 all impervious surfaces are made to drain over grass-covered areas before reaching a storm water conveyance system. Level 2 adds to Level 1 and replaces street curb and gutter systems with low-velocity grass-lined swales and pervious street shoulders. In addition to Levels 1 and 2, Level 3 over-sizes swales and configures driveway and street crossing culverts to use grass-lined swales as elongated detention basins.

Structural BMPs include: (1) Storage practices such as wet ponds and extended-detention outlet structures; (2) filtration practices such as grassed swales, sand filters and filter strips; and (3) infiltration practices such as infiltration basins and infiltration trenches.

EPA recommends that small MS4 operators ensure the appropriate implementation of the structural BMPs by considering some or all of the following: (1) Pre-construction review of BMP designs; (2) inspections during construction to verify BMPs are built as designed; (3) post-construction inspection and maintenance of BMPs; and (4) sanctions to ensure compliance with design, construction or operation and maintenance (O&M) requirements of the program.

EPA cautions that certain infiltration systems such as dry wells, bored wells or tile drainage fields may be subject to Underground Injection Control (UIC) program requirements (see 40 CFR Part 144.12.). To find out more about these requirements, contact your state UIC Program, or call EPA's Safe Drinking Water Hotline at 1–800–426–4791.

In order to meet the third post-construction requirement (ensuring adequate long-term O&M of BMPs), EPA recommends that small MS4 operators evaluate various O&M management agreement options. The most common options are agreements between the

MS4 operator and another party such as post-development landowners (*e.g.*, homeowners' associations, office park owners, other government departments or entities), or regional authorities (*e.g.*, flood control districts, councils of government). These agreements typically require the post-construction property owner to be responsible for the O&M and may include conditions which: allow the MS4 operator to be reimbursed for O&M performed by the MS4 operator that is the responsibility of the property owner but is not performed; allow the MS4 operator to enter the property for inspection purposes; and in some cases specify that the property owner submit periodic reports.

In providing the guidance above, EPA intends the requirements in today's rule to be consistent with the permit application requirements for large MS4s for post-construction controls for new development and redevelopment. MS4 operators have significant flexibility both to develop this measure as appropriate to address local concerns, and to apply new control technologies as they become available. Storm water pollution control technologies are constantly being improved. EPA recommends that MS4s be responsive to these changes, developments or improvements in control technologies. EPA will provide more detailed guidance addressing the responsibility for long-term O&M of storm water controls in guidance materials. The guidance will also provide information on appropriate planning considerations, structural controls and non-structural controls. EPA also intends to develop a broad menu of BMPs as guidance to ensure flexibility to accommodate local conditions.

EPA received comments suggesting that requirements for new development be treated separately from redevelopment in the rule. The comment stressed that new development on raw land presents fewer obstacles and more opportunities to incorporate elements for preventing water quality impacts, whereas redevelopment projects are constrained by space limitations and existing infrastructure. Another comment suggested allowing waivers from the redevelopment requirements if the redevelopment does not result in additional adverse water quality impacts, and where BMPs are not technologically or economically feasible. EPA recognizes that redevelopment projects may have more site constraints which narrow the range of appropriate BMPs. Today's rule provides small MS4 operators with the flexibility to develop requirements that may be different for redevelopment projects, and may also include allowances for alternate or off-site BMPs at certain redevelopment projects. Non-structural BMPs may be the most appropriate approach for smaller redevelopment projects.

EPA received comments requesting clarification on what is meant by "pre-development" conditions within the context of redevelopment. Pre-development refers to runoff conditions that exist onsite immediately before the planned development activities occur. Pre-development is not intended to be interpreted as that period before any human-induced land disturbance activity has occurred.

EPA received comments on the guidance language in the proposed rule and preamble which suggest that implementation of this measure should "attempt to maintain pre-development runoff conditions" and that "post-development conditions should not be different than pre-development conditions in a way that adversely affects water quality." Many comments expressed concern that maintaining pre-development runoff conditions is impossible and cost-prohibitive, and objected to any reference to "flow" or increase in volume of runoff. Other comments support the inclusion of this language in the final rule. Similar references in today's rule relating to pre-development runoff conditions are intended as *recommendations* to *attempt* to maintain pre-development runoff conditions. With these recommendations, EPA intends to prevent water quality impacts resulting from increased discharges of pollutants, which may result from increased volume of runoff. In many cases, consideration of the increased flow rate, velocity and energy of storm water discharges following development unavoidably must be taken into consideration in order to reduce the discharge of pollutants, to meet water quality standards and to prevent degradation of receiving streams. EPA recommends that municipalities consider these factors when developing their post-construction storm water management program.

Some comments said that the quoted phrases in the paragraph above are directives that imply federal land use control, which they argue is beyond the authority of the CWA. EPA recognizes that land use planning is within the authority of local governments.

EPA disagrees, however, with the implication that today's rule dictates any such land use decisions. The requirement for small MS4 operators to develop a program to address discharges resulting from new development and redevelopment is essentially a pollution prevention measure. The Rule provides the MS4 operator with flexibility to determine the appropriate BMPs to address local water quality concerns. EPA recognizes that these program goals may not be applied to every site, and expects that MS4s will develop an appropriate combination of BMPs to be applied on a site-by-site, regional or watershed basis.

vi. Pollution Prevention/Good Housekeeping for Municipal Operations. Under today's final rule, operators of MS4s must develop and implement an operation and maintenance program ("program") that includes a training component and has the ultimate goal of preventing or reducing storm water from municipal operations (in addition to those that constitute storm water discharges associated with industrial activity). This measure's emphasis on proper O&M of MS4s and employee training, as opposed to requiring the MS4 to undertake major new activities, is meant to ensure that municipal activities are performed in the most efficient way to minimize contamination of storm water discharges.

The program must include government employee training that addresses prevention measures pertaining to municipal operations such as: parks, golf courses and open space maintenance; fleet maintenance; new construction or land disturbance; building oversight; planning; and storm water system maintenance. The program can use existing storm water pollution prevention training materials provided by the State, Tribe, EPA, or environmental, public interest, or trade organizations.

EPA also encourages operators of MS4s to consider the following in developing a program: (1) Implement maintenance activities, maintenance schedules, and long-term inspection procedures for structural and non-structural storm water controls to reduce floatables and other pollutants discharged from the separate storm sewers; (2) implement controls for reducing or eliminating the discharge of pollutants from streets, roads, highways, municipal parking lots, maintenance and storage yards, waste transfer stations, fleet or maintenance shops with outdoor storage areas, and salt/sand storage locations and snow disposal areas operated by the MS4; (3) adopt procedures for the proper disposal of waste removed from the separate storm sewer systems and areas listed above in (2), including dredge

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spoil, accumulated sediments, floatables, and other debris; and (4) adopt procedures to ensure that new flood management projects are assessed for impacts on water quality and existing projects are assessed for incorporation of additional water quality protection devices or practices. Ultimately, the effective performance of the program measure depends on the proper maintenance of the BMPs, both structural and non-structural. Without proper maintenance, BMP performance declines significantly over time. Additionally, BMP neglect may produce health and safety threats, such as structural failure leading to flooding, undesirable animal and insect breeding, and odors. Maintenance of structural BMPs could include: replacing upper levels of gravel; dredging of detention ponds; and repairing of retention basin outlet structure integrity. Maintenance of non-structural BMPs could include updating educational materials periodically.

EPA emphasizes that programs should identify and incorporate existing storm water practices and training, as well as non-storm water practices or programs that have storm water pollution prevention benefits, as a means to avoid duplication of efforts and reduce overall costs. EPA recommends that MS4s incorporate these new obligations into their existing programs to the greatest extent feasible and urges States to evaluate MS4 programs with programmatic efficiency in mind. EPA designed this minimum control measure as a modified version of the permit application requirements for medium and large MS4s described at 40 CFR 122.26(d)(2)(iv), in order to provide more flexibility for these smaller MS4s. Today's requirements provide for a consistent approach to control pollutants from O&M among medium, large, and regulated small MS4s.

By properly implementing a program, operators of MS4s serve as a model for the rest of the regulated community. Furthermore, the establishment of a long-term program could result in cost savings by minimizing possible damage to the system from floatables and other debris and, consequently, reducing the need for repairs.

EPA received comments requesting clarification of what this measure requires. Certain municipalities expressed concern that the measure has the potential to impose significant costs associated with EPA's requirement that operators of MS4s consider implementing controls for reducing or eliminating the discharge of pollutants from streets, roads, highways, municipal parking lots, and salt/sand storage locations and snow disposal areas operated by the municipality. EPA disagrees that a requirement to *consider* such controls will impose considerable costs.

One commenter objected to the preamble language from the proposal suggesting that EPA does not expect the MS4 to undertake new activity. While it remains the Agency's expectation that major new activity will not be required, the MEP process should drive MS4s to incorporate the measure's obligations into their existing programs to achieve the pollutant reductions to the maximum extent practicable.

Certain commenters requested a definition for "municipal operations." EPA has revised the language to more clearly define municipal operations. Questions may remain concerning whether discharges from specific municipal activities constitute discharges associated with industrial activities (requiring NPDES permit authorization according to the requirements for industrial storm water that apply in that State) or from municipal operations (subject only to the controls developed in the MS4 control program). Even though there may be different substantive requirements that apply depending on the source of the discharge, EPA has modified the deadlines for permit coverage so that all the regulated municipally owned and operated sources become subject to permit requirements on the same date. The deadline is the same for permit coverage for this minimum measure as for permit coverage for municipally owned/operated industrial sources.

c. Application Requirements

An NPDES permit that authorizes the discharge from a regulated small MS4 may take the form of either an individual permit issued to one or more facilities as co-permittees or a general permit that applies to a group of MS4s. For reasons of administrative efficiency and to reduce the paperwork burden on permittees, EPA expects that most discharges from regulated small MS4s will be authorized under general permits. These NPDES general permits will provide specific instructions on how to obtain coverage, including application requirements. Typically, such application requirements will be satisfied by the submission of a Notice of Intent (NOI) to be covered by the general permit. In this section, EPA explains the small MS4 operator's application requirements for obtaining coverage under a NPDES permit for storm water.

i. Best Management Practices and Measurable Goals. Section 122.34(d) of today's rule requires the operator of a regulated small MS4 that wishes to implement a program under § 122.34 to identify and submit to the NPDES permitting authority a list of the best management practices ("BMPs") that will be implemented for each minimum control measure in their storm water management program. They also must submit measurable goals for the development and implementation of each BMP. The BMPs and the measurable goals must be included either in an NOI to be covered under a general permit or in an individual permit application.

The operator's submission must identify, as appropriate, the months and years in which the operator will undertake actions required to implement each of the minimum control measures, including interim milestones and the frequency of periodic actions. The Agency revised references to "starting and completing" actions from the proposed rule because many actions will be repetitive or ongoing. The submission also must identify the person or persons responsible for implementing or coordinating the small MS4 storm water program. See § 122.34(d). The submitted BMPs and measurable goals become enforceable according to the terms of the permit. The first permit can allow the permittee up to five years to fully implement the storm water management program.

Several commenters opposed making the measurable goals enforceable permit conditions. Some suggested that a permittee should be able to change its goals so that BMPs that are not functioning as intended can be replaced. EPA agrees that a permittee should be free to switch its BMPs and corresponding goals to others that accomplish the minimum measure or measures. The permittee is required to implement BMPs that address the minimum measures in § 122.34(b). If the permittee determines that its original combination of BMPs are not adequate to achieve the objectives of the municipal program, the MS4 should revise its program to implement BMPs that are adequate and submit to the permitting authority a revised list of BMPs and measurable goals. EPA suggests that permits describe the process for revising BMPs and measurable goals, such as whether the permittee should follow the same procedures as were required for the submission of the original NOI and whether the permitting authority's approval is necessary prior to the permittee implementing the revised

BMPs. The permittee should indicate on its periodic report whether any BMPs and measurable goals have been revised since the last periodic report.

Some commenters expressed concern that making the measurable goals enforceable would encourage the development of easily attained goals and, conversely, discourage the setting of ambitious goals. Others noted that it is often difficult to determine the pollutant reduction that can be achieved by BMPs until several years after implementation. Much of the opposition to the enforceability of measurable goals appears to have been based on a mistaken understanding that measurable goals must consist of pollutant reduction targets to be achieved by the corresponding BMPs.

Today's rule requires the operator to submit either measurable goals that serve as BMP design objectives or goals that quantify the progress of implementation of the actions or performance of the permittee's BMPs. At a minimum, the required measurable goals should describe specific actions taken by the permittee to implement each BMP and the frequency and the dates for such actions. Although the operator may choose to do so, it is not required to submit goals that measure whether a BMP or combination of BMPs is effective in achieving a specific result in terms of storm water discharge quality. For example, a measurable goal might involve a commitment to inspect a given number of drainage areas of the collection system for illicit connections by a certain date. The measurable goal need not commit to achieving a specific amount of pollutant reduction through the elimination of illicit connections. Other measurable goals could include the date by which public education materials would be developed, a certain percentage of the community participating in a clean-up campaign, the development of a mechanism to address construction site runoff, and a reduction in the percentage of imperviousness associated with new development projects.

To reduce the risk that permittees will develop inadequate BMPs, EPA intends to develop a menu of BMPs to assist the operators of regulated small MS4s with the development of municipal programs. States may also develop a menu of BMPs. Today's rule provides that the measurable goals that demonstrate compliance with the minimum control measures in §§ 122.34 (b)(3) through (b)(6) do not have to be met if the State or EPA has not issued a menu of BMPs at the time the MS4 submits its NOI. Commenters pointed out that the proposed rule would have made the measurable goals unenforceable if the menu of BMPs was not available, but the proposal was silent as to the enforceability of the implementation of BMPs. Today's rule clarifies that the operators are not free to do nothing prior to the issuance of a menu of BMPs; they still must make a good faith effort to implement the BMPs designed to comply with each measure. See § 122.34(d)(2). The operators would not, however, be liable for failure to meet its measurable goals if a menu of BMPs was not available at the time they submit their NOI.

The proposed rule provision in § 123.35 stated that the "[f]ailure to issue the menu of BMPs would not affect the legal status of the general permit." This concept is included in the final rule in § 122.34(d)(2)'s clarification that the permittee still must comply with other requirements of the general permit.

Unlike the proposed rule, today's rule does not require that each BMP in the menu developed by the State or EPA be regionally appropriate, cost-effective and field-tested. Various commenters criticized those criteria as unworkable, and one described them as "ripe for ambiguity and abuse." Other commenters feared that the operators of regulated small MS4s would never be required to achieve their goals until menus were developed that were cost-effective, field-tested and appropriate for every conceivable subregion.

While some municipal commenters supported the requirement that a menu of BMPs be made available that included BMPs that had been determined to be regionally appropriate, field-tested and cost-effective, others raised concerns that they would be restricted to a limited menu. Some commenters supported such a detailed menu because they thought they would only be able to select BMPs that were on the menu, while others thought that it was the permitting authority's responsibility to develop BMPs narrowly tailored to their situation. In response, EPA notes that the operators will not be restricted to implementing only, or all of, the BMPs included on the menu. Since the menu does not require permittees to implement the BMPs included on the menu, it is also not necessary to apply the public notice and other procedures that some commenters thought should be applied to the development of the menu of BMPs.

The purpose of the BMP menu is to provide guidance to assist the operators of regulated small MS4s with the development and refinement of their local program, not to limit their options. Permittees may implement BMPs other than those on the menu unless a State restricts its permittees to specific BMPs. To the extent possible, EPA will develop a menu of BMPs that describes the appropriateness of BMPs to specific regions, whether the BMPs have been field-tested, and their approximate costs. The menu, however, is not intended to relieve permittees of the need to implement BMPs that are appropriate for their specific circumstances.

If there are no known relevant BMPs for a specific circumstance, a permittee has the option of developing and implementing pilot BMPs that may be better suited to their circumstances. Where BMPs are experimental, the permittee should consider committing to measurable goals that address its schedule for implementing its selected BMPs rather than goals of achieving specific pollutant reductions. If the BMPs implemented by the permittee do not achieve the desired objective, the permittee may be required to commit to different or revised BMPs.

As stated in § 123.35(g), EPA is committed to issuing a menu of BMPs prior to the deadline for the issuance of permits. This menu would serve as guidance for all operators of regulated small MS4s nationwide. After developing the initial menu of BMPs, EPA intends to periodically modify, update, and supplement the menu of BMPs based on the assessments of the MS4 storm water program and research. States may rely on EPA's menu of BMPs or issue their own. If States develop their own menus, they would constitute additional guidance (or perhaps requirements in some States) for the operators to follow. Several commenters were confused by the proposed rule language that stated that States must provide or issue a menu of BMPs and, if they fail to do so, EPA "may" do so. Some read this language as not requiring either EPA or the State to develop the menu. EPA had intended that it would develop a menu and that States could either provide the EPA developed menu or one developed by the State.

EPA has dropped the proposed language that States "must" develop the menu of BMPs. Some commenters thought that it was inappropriate to require States to issue guidance. A menu of BMPs issued by either EPA or a permittee's State will satisfy the condition in § 122.34(d) that a regulatory authority provide a menu of BMPs. A State could require its permittees to follow its menu of BMPs provided that they are adequate to implement § 122.34(b).

Several commenters raised concerns that operators of small MS4s could be required to submit their BMPs and measurable goals before EPA or the State has issued a menu of BMPs. EPA has assumed primary responsibility for developing a menu of BMPs to minimize the possibility of this occurring. Should a general permit be issued before a menu of BMPs is available, the permit writer would have the option of delaying the date by which the identification of the BMPs and measurable goals must be submitted to the permitting authority until some time after a menu of BMPs is available.

Several municipal commenters raised concerns that they would begin to develop a program only to be later told by the permitting authority or challenged in a citizen suit that their BMPs were inadequate. They expressed a need for certainty regarding what their permit required. Several commenters suggested that EPA require permitting authorities to approve or disapprove the submitted BMPs and measurable goals. EPA disagrees that formal approval or disapproval by the permitting authority is needed.

EPA acknowledges that the lack of a formal approval process does place on the permittee some responsibility for designing and determining the adequacy of its BMPs. Once the permittee has submitted its BMPs to the permitting authority as part of its NOI, it must implement them in order to achieve the corresponding measurable goals. EPA does not believe that this results in the uncertainty to the extent expressed by some commenters or unduly expose the permittee to the risk of citizen suit. If the permit is very specific regarding what the permittee must do, then the uncertainty is eliminated. If the permit is less prescriptive, the permittee has greater latitude in determining for itself what constitutes an adequate program. A citizen suit could impose liability on the permittee only if the program that it develops and implements clearly does not satisfy the requirements of the general permit. EPA believes today's approach strikes a balance between the competing goals of providing certainty as to what constitutes an adequate program and providing flexibility to the permittees.

Commenters were divided on whether five years was a reasonable and expeditious schedule for a MS4 to implement its program. Some thought that it was an appropriate amount of time to allow for the development and implementation of adequate programs. One questioned whether the permittee had to be implementing all of its program within that time, and suggested that there may be cases where a permitting authority would need flexibility to allow more time. One commenter suggested that five years is too long and would amount to a relaxation of implementation in their area. EPA believes it will take considerable time to complete the tasks of initially developing a program, commencing to implement it, and achieving results. EPA notes, however, that full implementation of an appropriate program must occur as expeditiously as possible, and not later than five years.

EPA solicited comment on how an NOI form might best be formatted to allow for measurable goal information (*e.g.*, through the use of check boxes or narrative descriptions) while taking into account the Agency's intention to facilitate computer tracking. All commenters supported the development of a checklist NOI, but most noted that there would need to be room for additional information to cover unusual situations. One noted that, while a summary of measurable goals might be reduced to one sheet, attachments that more fully described the program and the planned BMPs would be necessary. EPA agrees that in most cases a "checklist" will not be able to capture the information on what BMPs a permittee intends to implement and its measurable goals for their implementation. EPA will continue to consider whether to develop a model NOI form and make it available for permitting authorities that choose to use it. What will be required on an MS4's NOI, however, is more extensive than what is usually required on an NOI, so a "form" NOI for MS4s may be impractical.

ii. Individual Permit Application for a § 122.34(b) program. In some cases, an operator of a regulated small MS4s may seek coverage under an individual NPDES permit, either because it chooses to do so or because the NPDES permitting authority has not made the general permit option available to that source. For small MS4s that are to implement a § 122.34(b) program in today's rule, EPA is promulgating simplified individual permit application requirements at § 122.33(b)(2)(i). Under the simplified individual permit application requirements, the operator submits an application to the NPDES permitting authority that includes the information required under § 122.21(f) and an estimate of square mileage served by the small MS4. They are also required to supply the BMP and measurable goal information required under § 122.34(d). Consistent with CWA section 308 and analogous State law, the permitting authority could request any additional information to gain a better understanding of the system and the areas draining into the system.

Commenters suggested that the requirements of § 122.21(f) are not necessarily applicable to a small MS4. One suggested that it was not appropriate to require the following information: a description of the activities conducted by the applicant which require it to obtain an NPDES permit; the name, mailing address, and location of the facility; and up to four Standard Industrial Classification ("SIC") codes which best reflect the principal products or services provided by the facility. In response, EPA notes that the requirements in § 122.21(f) are generic application requirements applicable to NPDES applicants. With the exception of the SIC code requirement, EPA believes that they are applicable to MS4s. In the SIC code portion of the standard application, the applicant may simply put "not applicable."

One commenter asked that EPA clarify whether § 122.21(f)(5)'s requirement to indicate "whether the facility is located on Indian lands," referred to tribal lands, Indian country, or Indian reservations. For some local governments this is a complex issue with no easy "yes" or "no" answer. See the discussion in the Section II.F in the proposal to today's rule regarding what tribal lands are subject to the federal trust responsibility for purposes of the NPDES program.

One commenter suggested that the application should not have to list the permits and approvals required under § 122.21(f)(6). EPA notes that the applicant must only list the environmental permits that the applicant has received that cover the small MS4. The applicant is not required to list permits for other operations conducted by the small MS4 operator (*e.g.*, for an operation of an airport or landfill). Again, in most cases the applicant could respond "not applicable" to this portion of the application.

One commenter suggested that the topographic map requirement of § 122.21(f)(7) was completely different from, and significantly more onerous than, the mapping requirement outlined in the proposed rule at § 122.34(b)(3)(i). EPA agrees and has modified the final rule to clarify that a map that satisfies the requirements of § 122.34(b)(3)(i) also satisfies the map requirements for MS4 applicants seeking individual permits under § 122.33(b)(2)(i).

EPA is adding a new paragraph to § 122.44(k) to clarify that requirements to implement BMPs developed pursuant to CWA 402(p) are appropriate permit

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conditions. While such conditions could be included under the existing provision in § 122.44(k)(3) for "practices reasonably necessary to achieve effluent limitations and standards or to carry out the purposes and intent of the CWA," EPA believes it is clearer to specifically list in § 122.44(k) BMPs that implement storm water programs in light of the frequency with which they are used as effluent limitations.

iii. Alternative Permit Options/Tenth Amendment. As an alternative to implementing a program that addresses each of the six minimum measures according to the requirements of § 122.34(b), today's rule provides the operators of regulated small MS4s with the option of applying for an individual permit under existing § 122.26(d). *See* § 122.33(b)(2)(ii). If a system operator does not want to be held accountable for implementation of each of the minimum measures, an individual permit option under § 122.33(b)(2)(ii) remains available. (As explained in the next section of this preamble, § 122.35(b) also provides an opportunity for relief from permit obligations for some of the minimum measures, but that relief exists within the framework of the minimum measures.)

EPA originally drafted the individual permit application requirements in § 122.26(d) to apply to medium and large MS4s. Today's rule abbreviates the individual permit application requirements for small MS4s. Although EPA believes that the storm water management program requirements of § 122.34, including the minimum measures, provide the most appropriate means to control pollutants from most small MS4s, the Agency does recognize that the operators of some small MS4s may prefer more individualized permit requirements. Among other possible reasons, an operator may seek to avoid having to "regulate" third parties discharging into the separate storm sewer system. Alternatively, an operator may determine that structural controls, such as constructed wetlands, are more appropriate or effective to address the discharges that would otherwise be addressed under the construction and/or development/redevelopment measures.

Some MS4s commenters alleged that an absolute requirement to implement the minimum measures violates the Tenth Amendment to the U.S. Constitution. While EPA disagrees that requiring MS4s to implement the minimum measures would violate the Constitution, today's rule does provide small MS4s with the option of developing more individualized measures to reduce the pollutants and pollution associated with urban storm water that will be regulated under today's rule.

Some commenters specifically objected that § 122.34's minimum measures for small MS4s violate the Tenth Amendment insofar as they require the operators of MS4s to regulate third parties. The minimum measures include requirements for small MS4 operators to prohibit certain non-storm water discharges, control storm water discharges from construction greater than one acre, and take other actions to control third party sources of storm water discharges into their MS4s. Commenters also argued that it was inappropriate for EPA to require local governments to enact ordinances that will consume local revenues and put local governments in the position of bearing the political responsibility for implementing the program. One commenter argued that EPA was prohibited from conditioning the issuance of an NPDES permit upon the small MS4 operators waiving their constitutional right to be free from such requirements to regulate third parties. The Agency replies to each comment in turn.

Because the rule does rely on local governments—who operate municipal separate storm sewer systems—to regulate discharges from third parties into storm sewers, EPA acknowledges that the rule implicates the Tenth Amendment and constitutional principles of federalism. EPA disagrees, however, that today's rule is inconsistent with federalism principles. [As political subdivisions of States, municipalities enjoy the same protections as States under the Tenth Amendment.]

The Supreme Court has interpreted the Tenth Amendment to preclude federal actions that compel States or their political subdivisions to enact or administer a federal regulatory program. *See New York* v. *United States,* 505 U.S. 144 (1992); *Printz* v. *United States,* 117 S.Ct. 2365 (1997). The *Printz* case, however, did acknowledge that the restriction does not apply when federal requirements of general applicability—requirements that regulate all parties engaging in a particular activity—do not excessively interfere with the functioning of State governments when those requirements are applied to States (or their political subdivisions). *See Printz,* 117 S.Ct. at 2383.

Today's rule imposes a federal requirement of general applicability, namely, the requirement to obtain and comply with an NPDES permit, on municipalities that operate a municipal separate storm sewer system. By virtue of this rule, the permit will require the municipality/storm sewer operator to develop a storm water control program. The rule specifies the components of the control program, which are primarily "management"-type controls, for example, municipal regulation of third party storm water discharges associated with construction, as well as development and redevelopment, when those discharges would enter the municipal system.

Unlike the circumstances reviewed in the *New York* and *Printz* cases, today's rule merely applies a generally applicable requirement (the CWA permit requirement) to municipal point sources. The CWA establishes a generally applicable requirement to obtain an NPDES permit to authorize point source discharge to waters of the United States. Because municipalities own and operate separate storm sewers, including storm sewers into which third parties may discharge pollutants, NPDES permits may require municipalities to control the discharge of pollutants into the storm sewers in the first instance. Because NPDES permits can impose end-of-pipe numeric effluent limits, narrative effluent limits in the form of "management" program requirements are also within the scope of Clean Water Act authority. As noted above, however, EPA believes that such narrative limitations are the most appropriate form of effluent limitation for these types of permits. For municipal separate storm sewer permits, CWA section 402(p)(3)(B)(iii) specifically authorizes "controls to reduce pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants."

The Agency did not design the minimum measures in § 122.34 to "commandeer" state regulatory mechanisms, but rather to reduce pollutant discharges from small MS4s. The permit requirement in CWA section 402 is a requirement of general applicability. The operator of a small MS4 that does not prohibit and/or control discharges into its system essentially accepts "title" for those discharges. At a minimum, by providing free and open access to the MS4s that convey discharges to the waters of the United States, the municipal storm sewer system enables water quality impairment by third parties. Section 122.34 requires the operator of a regulated small MS4 to control a third party only to the extent that the MS4 collection system receives pollutants from that third party and discharges it to the waters of the United States. The operators of regulated small MS4s cannot passively receive and discharge pollutants from third parties. The Agency concedes that administration of a municipal program will consume limited local revenues for implementation; but those consequences stem from the municipal operator's identity as a permitted sewer system operator. The Tenth Amendment does not create a blanket municipal immunity from generally applicable requirements. Development of a program based on the minimum measures and implementation of that program should not "excessively interfere" with the functioning of municipal government, especially given the "practicability" threshold under CWA section 402(p)(3)(B)(iii).

As noted above, today's rule also allows regulated small MS4s to opt out of the minimum measures approach. The individual permit option provides for greater flexibility in program implementation and also responds to the comment about requiring a municipal permit applicant's waiver of any arguable constitutional rights. The individual permit option responds to questions about the rule's alleged unconstitutionality by more specifically focusing on the pollutants discharged from municipal point sources. Today's rule gives operators of MS4s the option to seek an individual permit that varies from the minimum measures/ management approach that is otherwise specified in today's rule. Even if the minimum measures approach was constitutionally suspect, a requirement that standing alone would violate constitutional principles of federalism does not raise concerns if the entity subject to the requirement may opt for an alternative action that does not raise a federalism issue.

For municipal system operators who seek to avoid third party regulation according to all or some of the minimum measures, § 122.26(d) requires the operator to submit a narrative description of its storm water sewer system and any existing storm water control program, as well as the monitoring data to enable the permit writer to develop appropriate permit conditions. The permit writer can then develop permit conditions and limitations that vary from the six minimum measures prescribed in today's rule. The information will enable the permit writer to develop an NPDES permit that will result in pollutant reduction to the maximum extent practicable. *See NRDC* v. *EPA*, 966 F.2d at 1308, n17. If determined appropriate under CWA section 402(p)(3)(B)(iii), for example BMPs to meet water quality standards, the permit could also incorporate any more stringent or prescriptive effluent limits based on the individual permit application information.

For small MS4 operators seeking an individual permit, both Part 1 and Part 2 of the application requirements in § 122.26(d)(1) and (2) are required to be submitted within 3 years and 90 days of the date of publication of this **Federal Register** notice. Some of the information required in Part 1 will necessarily have to be developed by the permit applicant prior to the development of Part 2 of the application. The permit applicant should coordinate with its permitting authority regarding the timing of review of the information.

The operators of regulated small MS4s that apply under § 122.26(d) may apply to implement certain of the § 122.34(b) minimum control measures, and thereby focus the necessary evaluation for additional limitations on alternative controls to the § 122.34(b) measures that the small MS4 will not implement. The permit writer may determine "equivalency" for some or all of the minimum measures by developing a rough estimate of the pollutant reduction that would be achieved if the MS4 implemented the § 122.34 minimum measure and to incorporate that pollutant reduction estimate in the small MS4's individual permit as an effluent limitation. The Agency recognizes that, based on current information, any such estimates will probably have a wide range. Anticipation of this wide range is one of the reasons EPA believes MS4 operators need flexibility in determining the mix of BMPs (under the minimum measures) to achieve water quality objectives. Therefore, for example, if a system operator seeks to employ an alternative that involves structural controls, wide ranges will probably be associated with gross pollutant reduction estimates. Permit writers will undoubtedly develop other ways to ensure that permit limits ensure reduction of pollutants to the maximum extent practicable.

Small MS4 operators that pursue this individual permit option do not need to submit details about their future program requirements (*e.g.*, the MS4's future plans to obtain legal authority required by §§ 122.26(d)(1)(ii) and (d)(2)). A small MS4 operator might elect to supply such information if it intends for the permit writer to take those plans into account when developing the small MS4's permit conditions.

Several operators of small MS4s commented that they currently lacked the authority they would need to implement one or more of the minimum measures in § 122.34(b). Today's rule recognizes that the operators of some small MS4s might not have the authority under State law to implement one or more of the measures using, for example, an ordinance or other regulatory mechanism. To address these situations, each minimum measure in § 122.34(b) that would require the small MS4 operator to develop an ordinance or other regulatory mechanism states that the operator is only required to implement that requirement to "the extent allowable under State, Tribal or local law." See § 122.34(b)(3)(ii) (illicit discharge elimination), § 122.34(b)(4)(ii) (construction runoff control) and § 122.34(b)(5)(ii) (post-construction storm water management). This regulatory language does not mean that a operator of a small MS4 with ordinance making authority can simply fail to pass an ordinance necessary for a § 122.34(b) program. The reference to "the extent allowable under * * * local law" refers to the local laws of *other* political subdivisions to which the MS4 operator is subject. Rather, a small MS4 operator that seeks to implement a program under section § 122.34(b) may omit a requirement to develop an ordinance or other regulatory mechanism only to the extent its municipal charter, State constitution or other legal authority prevents the operator from exercising the necessary authority. Where the operator cannot obtain the authority to implement any activity that is only required to "the extent allowable under State, Tribal or local law," the operator may satisfy today's rule by administering the remaining § 122.34(b) requirements.

Finally, although today's rule provides operators of small MS4s with an option of applying for a permit under § 122.26(d), States authorized to administer the NPDES program are not required to provide this option. NPDES-authorized States could require all regulated small MS4s to be permitted under the minimum measures management approach in § 122.34 as a matter of State law. Such an approach would be deemed to be equally or more stringent than what is required by today's rule. *See* 40 CFR 123.2(i). The federalism concerns discussed above do not apply to requirements imposed by a State on its political subdivisions.

iv. Satisfaction of Minimum Measure Obligations by Another Entity. An operator of a regulated small MS4 may satisfy the requirement to implement one or more of the six minimum measures in § 122.34(b) by having a third party implement the measure or measures. Today's rule provides a variety of means for small MS4 operators to share responsibility for different aspects of their storm water management program. The means by which the operators of various MS4s share responsibility may affect who is ultimately responsible for performance of the minimum measure and who files the periodic reports on the implementation of the minimum measure. Section 122.35 addresses these issues. The rule describes two different variants on third party implementation with different consequences if the third party fails to implement the measure.

If the permit covering the discharge from a regulated small MS4 identifies the operator as the entity responsible for a particular minimum control measure, then the operator-permittee remains responsible for the implementation of that measure even if another entity has agreed to implement the control measure. Section 122.35(a). Another party may satisfy the operator-permittee's responsibility by implementing the minimum control measure in a manner at least as stringent or prescriptive as the corresponding NPDES permit requirement. If the third party fails to do so, the operator-permittee remains responsible for its performance. The operator of the MS4 should consider entering into an agreement with the third party that acknowledges the responsibility to implement the minimum measure. The operator-permittee's NOI and its annual § 122.34(f)(3) reports submitted to the NPDES permitting authority must identify the third party that is satisfying one or more of the permit obligations. This requirement ensures that the permitting authority is aware which entity is supposed to implement which minimum measures.

If, on the other hand, the regulated small MS4's permit recognizes that an NPDES permittee other than the operator-permittee is responsible for a particular minimum control measure, then the operator-permittee is relieved from the responsibility for implementing that measure. The operator-permittee is also relieved from the responsibility for implementing any measure that the operator's permit indicates will be performed by the NPDES permitting authority. Section 122.35(b). The MS4 operator-permittee would be responsible for implementing the remaining minimum measures.

Today's final rule differs from the proposed version of § 122.35(b), which stated that, even if the third party's responsibility is recognized in the permit, the MS4 operator-permittee remained responsible for performance if the third party failed to perform the measure consistent with § 122.34(b). Under today's rule, the operator-permittee is relieved from responsibility for performance of a measure if the third party is an NPDES permittee whose permit makes it responsible for performance of the measure (including, for example, a State agency other than the State agency that issues NPDES permits) or if the third party is the NPDES permitting authority itself. Because the permitting authority is acknowledging the third party's responsibility in the permit, commenters thought that the MS4 operator-permittee should not be responsible for ensuring that the other entity is implementing the control measure properly. EPA agrees that the operator-permittee should not be conditionally responsible when the requirements are enforceable against some other NPDES permittee. If the third party fails to perform the minimum measure, the requirements will be enforceable against the third party. In addition, the NPDES permitting authority could reopen the operator-permittee's permit under § 122.62 and modify the permit to make the operator responsible for implementing the measure. A new paragraph has been added to § 122.62 to clarify that the permit may be reopened in such circumstances.

Today's rule also provides that the operator-permittee is not conditionally responsible where it is the State NPDES permitting authority itself that fails to implement the measure. The permitting authority does not need to issue a permit to itself (i.e., to the same State agency that issues the permit) for the sole purpose of relieving the small MS4 from responsibility in the event the State agency does not satisfy its obligation to implement a measure. EPA does not believe that the small MS4 should be responsible in the situation where the NPDES permit issued to the small MS4 operator recognizes that the State agency that issues the permit is responsible for implementing a measure. If the State does fail to implement the measure, the State agency could be held accountable for its commitment in the permit to implement the measure. Where the State does not fulfill its responsibility to implement a measure, a citizen also could petition for withdrawal of the State's NPDES program or it could petition to have the MS4's permit reopened to require the MS4 operator to implement the measure.

EPA notes that not every State program that addresses erosion and sediment control from construction sites will be adequate to satisfy the requirement that each regulated small MS4 have a program to the extent required by § 122.34(b)(4). For example, although all NPDES States are required to issue NPDES permits for construction activity that disturbs greater than one acre, the State's NPDES permit program will not necessarily be extensive enough to satisfy a regulated small MS4's obligation under § 122.34(b)(4). NPDES States will not necessarily be implementing all of the required elements of that minimum measure, such as procedures for site plan review in each jurisdiction required to develop a program and procedures for receipt and consideration of information submitted by the public on individual construction sites. In order for a State erosion and sediment control program to satisfy a small MS4 operator's obligation to implement § 122.34(b)(4), the State program would have to include all of the elements of that minimum measure.

Where the operator-permittee is itself performing one or more of the minimum measures, the operator-permittee remains responsible for all of the reporting requirements under § 122.34(f)(3). The operator-permittee's reports should identify each entity that is performing the control measures within the geographic jurisdiction of the regulated small MS4. If the other entity also operates a regulated MS4 and files reports on the progress of implementation of the measures within the geographic jurisdiction of the MS4, then the operator-permittee need not include that same information in its own reports.

If the other entity operates a regulated MS4 and is performing all of the minimum measures for the permittee, the permittee is not required to file the reports required by § 122.34(f)(3). This relief from reporting is specified in § 122.35(a).

Section 122.35 addresses the concerns of some commenters who sought relief for governmental facilities that are classified as small MS4s under today's rule. These facilities frequently discharge storm water through another regulated MS4 and could be regulated by that MS4's program. For example, a State owned office complex that operates its storm sewer system in an urbanized area will be regulated as an MS4 under today's rule even though its system may be subject to the storm water controls of the municipality in

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which it is located. Today's rule specifically revised the definition of MS4 to recognize that different levels of government often operate MS4s and that each such separate entity (including the federal government) should be responsible for its discharges. If both MS4s agree, the downstream MS4 can develop a storm water management program that regulates the discharge from both MS4s. The upstream small MS4 operator still must submit an NOI that identifies the entity on which the upstream small MS4 operator is relying to satisfy its permit obligations. No reports are required from the upstream small MS4 operator, but the upstream operator must remain in compliance with the downstream MS4 operator's storm water management program. This option allows small MS4s to work together to develop one storm water management program that satisfies the permit obligations of both. If they cannot agree, the upstream small MS4 operator must develop its own program.

As mentioned previously, comments from federal facilities and State organizations that operate MS4s requested that their permit requirements differ from those of MS4s that are political subdivisions of States (cities, towns, counties, etc.). EPA acknowledges that there are differences; e.g., many federal and State facilities do not serve a resident population and thus might require a different approach to public education. EPA believes, however, that MS4s owned by State and federal governments can develop storm water management plans that address the minimum measures. Federal and State owned small MS4s may choose to work with adjacent municipally owned MS4s to develop a unified plan that addresses all of the required measures within the jurisdiction of all of the contiguous MS4s. The options in § 122.35 minimize the burden on small MS4s that are covered by another MS4's program.

One commenter recommended that if one MS4 discharges into a second MS4, the operator of the upstream MS4 should have to provide a copy of its NOI or permit application to the operator of the receiving MS4. EPA did not adopt this recommendation because the NOI and permit application will be publicly available; but EPA does recommend that NPDES permitting authorities consider it as a possible permit requirement. The commenter also suggested that monitoring data should be collected by the upstream MS4 and provided to the downstream MS4. EPA is not adopting such a uniform monitoring requirement because EPA believes it is more appropriate to let the MS4 operators work out the need for such data. If necessary, the downstream MS4s might want to make such data a condition to allowing the upstream MS4 to connect to its system.

v. Joint Permit Programs. Many commenters supported allowing the operators of small MS4s to apply as co-permittees so they each would not have to develop their own storm water management program. Today's rule specifically allows regulated small MS4s to join with either other small MS4s regulated under § 122.34(d) or with medium and large MS4s regulated under § 122.26(d).

As is discussed in the previous section, regulated small MS4s may indicate in their NOIs that another entity is performing one or more of its required minimum control measures. Today's rule under § 122.33(b)(1) also specifically allows the operators of regulated small MS4s to jointly submit an NOI. The joint NOI must clearly indicate which entity is required to implement which control measure in each geographic jurisdiction within the service area of the entire small MS4. The operator of each regulated small MS4 remains responsible for the implementation of each minimum measure for its MS4 (unless, as is discussed in the previous section above, the permit recognizes that another entity is responsible for completing the measure.) The joint NOI, therefore, is legally equivalent to each entity submitting its own NOI. EPA is, however, revising the rule language to specifically authorize the joint submission of NOIs in response to comments that suggested that such explicit authorization might encourage programs to be coordinated on a watershed basis.

Section 122.33(b)(2)(iii) authorizes regulated small MS4s to jointly apply for an individual permit to implement today's rule, where allowed by an NPDES permitting authority. The permit application should contain sufficient information to allow the permitting authority to allocate responsibility among the parties under one of the two permitting options in §§ 122.33(b)(2)(i) and (ii).

Section 122.33(b)(3) of today's rule also allows an operator of a regulated small MS4 to join as a co-permittee in an existing NPDES permit issued to an adjoining medium or large MS4 or source designated under the existing storm water program. This co-permittee option applies only with the agreement of all co-permittees. Under this co-permittee arrangement, the operator of the regulated small MS4 must comply with the terms and conditions of the applicable permit rather than the permit condition requirements of § 122.34 of today's rule. The regulated small MS4 that wishes to be a co-permittee must comply with the applicable requirements of § 122.26(d), but would not be required to fulfill all the permit application requirements applicable to medium and large MS4s. Specifically, the regulated small MS4 is not required to comply with the application requirements of § 122.26(d)(1)(iii) (Part 1 source identification), § 122.26 (d)(1)(iv) (Part 1 discharge characterization), and § 122.26(d)(2)(iii) (Part 2 discharge characterization data). Furthermore, the regulated small MS4 operator could satisfy the requirements in § 122.26(d)(1)(v) (Part 1 management programs) and § 122.26(d)(2)(iv) (Part 2 proposed management program) by referring to the adjoining MS4 operator's existing plan. An operator pursuing this option must describe in the permit modification request how the adjoining MS4's storm water program addresses or needs to be supplemented in order to adequately address discharges from the MS4. The request must also explain the role of the small MS4 operator in coordinating local storm water activities and describe the resources available to accomplish the storm water management plan.

EPA sought comments regarding the appropriateness of the application requirements in these subsections of § 122.26(d). One commenter stated that newly regulated smaller MS4s should not be required to meet the existing regulations' Part II application requirements under § 122.26(d) regarding the control of storm water discharges from industrial activity. EPA disagrees. The smaller MS4 operators designated for regulation in today's rule may satisfy this requirement by referencing the legal authority of the already regulated MS4 program to the extent the newly regulated MS4 will rely on such legal authority to satisfy its permit requirements. If the smaller MS4 operator plans to rely on its own legal authorities, it must identify it in the application. If the smaller MS4 operator does not elect to use its own legal authority, they may file an individual permit application for an alternate program under § 122.33(b)(2)(ii).

The explanatory language in § 122.33(b)(3) recommends that the smaller MS4s designated under today's rule identify how an existing plan "would need to be supplemented in order to adequately address your discharges." One commenter suggested that this must be regulatory language and not guidance. EPA disagrees that this needs to be mandatory language.

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Since many of the smaller MS4s designated today are "donut holes" within the geographic jurisdiction of an already regulated MS4, the larger MS4's program generally will be adequate to address the newly regulated MS4's discharges. The small MS4 applicant should consider the adequacy of the existing MS4's program to address the smaller MS4's water quality needs, but EPA is not imposing specific requirements. Where circumstances suggest that the existing program is inadequate with respect to the newly designated MS4 and the applicant does not address the issue, the NPDES permitting authority must require that the existing program be supplemented.

Commenters recommended that the application deadline for smaller MS4s designated today be extended so that existing regulated MS4s would not have to modify their permit in the middle of their permit term, provided that permit renewal would occur within a reasonable time (12 to 18 months) of the deadline. In response, EPA notes that today's rule allows operators of newly designated small MS4s up to three years and 90 days from the promulgation of today's rule to submit an application to be covered under the permit issued to an already regulated MS4. The permitting authority has a reasonable time after receipt of the application to modify the existing permit to include the newly designated source. If an existing MS4's permit is up for renewal in the near future, the operator of a newly designated small MS4 may take that into account when timing its application and the NPDES permitting authority may take that into account when processing the application.

Another commenter suggested that the rule should include a provision to allow permit application requirements for smaller MS4s designated today to be determined by the permitting authority to account for the particular needs/wants of an already regulated MS4 operator. EPA does not believe that the regulations should specifically require this approach. When negotiating whether to include a newly designated MS4 in its program, the already regulated MS4 operator may require the newly designated MS4's operator to provide any information that is necessary.

The co-permitting approach allows small MS4s to take advantage of existing programs to ease the burden of creating their own programs. The operators of regulated small MS4s, however, may find it simpler to apply for a program under today's rule, and to identify the medium or large MS4 operator that is implementing portions of its § 122.34(b) minimum measures.

d. Evaluation and Assessment

Under today's rule, operators of regulated small MS4s are required to evaluate the appropriateness of their identified BMPs and progress toward achieving their identified measurable goals. The purpose of this evaluation is to determine whether or not the MS4 is meeting the requirements of the minimum control measures. The NPDES permitting authority is responsible for determining whether and what types of monitoring needs to be conducted and may require monitoring in accordance with State/Tribe monitoring plans appropriate to the watershed. EPA does not encourage requirements for "end-of-pipe" monitoring for regulated small MS4s. Rather, EPA encourages permitting authorities to carefully examine existing ambient water quality and assess data needs. Permitting authorities should consider a combination of physical, chemical, and biological monitoring or the use of other environmental indicators such as exceedance frequencies of water quality standards, impacted dry weather flows, and increased flooding frequency. (Claytor, R. and W. Brown. 1996. *Environmental Indicators to Assess Storm Water Control Programs and Practices.* Center for Watershed Protection, Silver Spring, MD.) Section II.L., Water Quality Issues, discusses monitoring in greater detail.

As recommended by the Intergovernmental Task Force on Monitoring Water Quality (ITFM), the NPDES permitting authority is encouraged to consider the following watershed objectives in determining monitoring requirements: (1) To characterize water quality and ecosystem health in a watershed over time, (2) to determine causes of existing and future water quality and ecosystem health problems in a watershed and develop a watershed management program, (3) to assess progress of watershed management program or effectiveness of pollution prevention and control practices, and (4) to support documentation of compliance with permit conditions and/or water quality standards. With these objectives in mind, the Agency encourages participation in group monitoring programs that can take advantage of existing monitoring programs undertaken by a variety of governmental and nongovernmental entities. Many States may already have a monitoring program in effect on a watershed basis. The ITFM report is included in the docket for today's rule (Intergovernmental Task Force on Monitoring Water Quality. 1995. *The Strategy for Improving Water-Quality Monitoring in the United States: Final Report of the Intergovernmental Task Force on Monitoring Water Quality.* Copies can be obtained from: U.S. Geological Survey, Reston, VA.).

EPA expects that many types of entities will have a role in supporting group monitoring activities—including federal agencies, State agencies, the public, and various classes or categories of point source dischargers. Some regulated small MS4s might be required to contribute to such monitoring efforts. EPA expects, however, that their participation in monitoring activities will be relatively limited. For purposes of today's rule, EPA recommends that, in general, NPDES permits for small MS4s should not require the conduct of any additional monitoring beyond monitoring that the small MS4 may be already performing. In the second and subsequent permit terms, EPA expects that some limited ambient monitoring might be appropriately required for perhaps half of the regulated small MS4s. EPA expects that such monitoring will only be done in identified locations for relatively few pollutants of concern. EPA does not anticipate "end-of-pipe" monitoring requirements for regulated small MS4s.

EPA received a wide range of comments on this section of the rule. Some commenters believe that EPA should require monitoring; others want a strong statement that the newly regulated small MS4s should not be required to monitor. Many commenters raised questions about exactly what EPA expects MS4s to do to evaluate and assess their BMPs. EPA has intentionally written today's rule to provide flexibility to both MS4s and permitting authorities regarding appropriate evaluation and assessment. Permitting authorities can specify monitoring or other means of evaluation when writing permits. If additional requirements are not specified, MS4s can decide what they believe is the most appropriate way to evaluate their storm water management program. As mentioned above, EPA expects that the necessity for monitoring and its extent may change from permit cycle to permit cycle. This is another reason for making the evaluation and assessment rule requirements very flexible.

i. Recordkeeping. The NPDES permitting authority is required to include at least the minimum appropriate recordkeeping conditions in each permit. Additionally, the NPDES permitting authority can specify that permittees develop, maintain, and/or

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submit other records to determine compliance with permit conditions. The MS4 operator must keep these records for at least 3 years but is not required to submit records to the NPDES permitting authority unless specifically directed to do so. The MS4 operator must make the records, including the storm water management program, available to the public at reasonable times during regular business hours (see 40 CFR 122.7 for confidentiality provision). The MS4 operator is also able to assess a reasonable charge for copying and to establish advance notice requirements for members of the public.

EPA received a comment that questioned EPA's authority to require MS4s to make their records available to the public. EPA disagrees with the commenter and believes that the CWA does give EPA the authority to require that MS4 records be available. It is also more practical for the public to request records directly from the MS4 than to request them from EPA who would then make the request to the MS4. Based on comments, EPA revised the proposed rule so as not to limit the time for advance notice requirements to 2 business days.

ii. Reporting. Under today's rule, the operator of a regulated small MS4 is required to submit annual reports to the NPDES permitting authority for the first permit term. For subsequent permit terms, the MS4 operator must submit reports in years 2 and 4 unless the NPDES permitting authority requires more frequent reports. EPA received several comments supporting this timing for report submittal. Other commenters suggested that annual reports during the first permit cycle are too burdensome and not necessary. EPA believes that annual reports are needed during the first 5-year permit term to help permitting authorities track and assess the development of MS4 programs, which should be established by the end of the initial term. Information contained in these reports can also be used to respond to public inquiries.

The report must include (1) the status of compliance with permit conditions, an assessment of the appropriateness of identified BMPs and progress toward achieving measurable goals for each of the minimum control measures, (2) results of information collected and analyzed, including monitoring data, if any, during the reporting period, (3) a summary of what storm water activities the permittee plans to undertake during the next reporting cycle, and (4) a change in any identified measurable goal(s) that apply to the program elements.

The NPDES permitting authority is encouraged to provide a brief two-page reporting format to facilitate compiling and analyzing the data from submitted reports. EPA does not believe that submittal of a brief annual report of this nature is overly burdensome, and has not changed the required reporting time frame from the proposal. The permitting authority will use the reports in evaluating compliance with permit conditions and, where necessary, will modify the permit conditions to address changed conditions.

iii. Permit-As-A-Shield. Section 122.36 describes the scope of authorization (i.e. "permit-as-a-shield") under an NPDES permit as provided by section 402(k) of the CWA. Section 402(k) provides that compliance with an NPDES permit is deemed compliance, for purposes of enforcement under CWA sections 309 and 505, with CWA sections 301, 302, 306, 307, and 403, except for any standard imposed under section 307 for toxic pollutants injurious to human health.

EPA's Policy Statement on Scope of Discharge Authorization and Shield Associated with NPDES Permits, originally issued on July 1, 1994, and revised on April 11, 1995, provides additional information on this matter.

e. Other Applicable NPDES Requirements

Any NPDES permit issued to an operator of a regulated small MS4 must also include other applicable NPDES permit requirements and standard conditions, specifically the applicable requirements and conditions at 40 CFR 122.41 through 122.49. Reporting requirements for regulated small MS4s are governed by § 122.34 and not the existing requirements for medium and large MS4s at § 122.42(c). In addition, the NPDES permitting authority is encouraged to consult the Interim Permitting Approach, issued on August 1, 1996. The discussion on the Interim Permitting Approach in Section II.L.1, Water Quality Based Effluent Limits, provides more information. The provisions of §§ 122.41 through 122.49 establish permit conditions and limitations that are broadly applicable to the entire range of NPDES permits. These provisions should be interpreted in a manner that is consistent with provisions that address specific classes or categories of discharges. For example, § 122.44(d) is a general requirement that each NPDES permit shall include conditions to meet water quality standards. This requirement will be met by the specific approach outlined in today's rule for the implementation of BMPs. BMPs are the most appropriate form of effluent limitations to satisfy technology requirements and water quality-based requirements in MS4 permits (see the introduction to Section II.H.3, Municipal Permit Requirements, Section II.H.3.h, Reevaluation of Rule, and the discussion of the Interim Permitting Policy in Section II.L.1. below).

f. Enforceability

NPDES permits are federally enforceable. Violators may be subject to the enforcement actions and penalties described in CWA sections 309, 504, and 505 or under similar water pollution enforcement provisions of State, tribal or local law. Compliance with a permit issued pursuant to section 402 of the Clean Water Act is deemed compliance, for purposes of sections 309 and 505, with sections 301, 302, 306, 307, and 403 (except any standard imposed under section 307 for toxic pollutants injurious to human health).

g. Deadlines

Today's final rule includes "expeditious deadlines" as directed by CWA section 402(p)(6). In proposed § 122.26(e), the permit application for the "ISTEA" facilities was maintained as August 7, 2001 and the permit application deadline for storm water discharges associated with other construction activity was established as 3 years and 90 days from the final rule date. In proposed § 122.33(c)(1), operators of regulated small MS4s were required to seek permit coverage within 3 years and 90 days from the date of publication of the final rule. In proposed § 122.33(c)(2), operators of regulated small MS4s designated by the NPDES permitting authority on a local basis under § 122.32(a)(2) must seek coverage under an NPDES permit within 60 days of notice, unless the NPDES permitting authority specifies a later date.

In order to increase the clarity of today's final rule, EPA has changed the location of some of the above requirements. All application deadlines for both Phase I and Phase II are now listed or referenced in § 122.26(e). Section 122.26(e)(1) contains the deadlines for storm water associated with industrial activity. Paragraph (i) has been changed to correct a typographical error. Paragraph (ii) has been revised to reflect the changed application date for "ISTEA" facilities. (See discussion in section I.3, ISTEA Sources). The application deadline for storm water discharges associated with other construction activity is now in a new § 122.26(e)(8). The application deadline for regulated small MS4s remains in § 122.33(c) because this section is written in "readable regulation" format, but it is also described in a new § 122.26(e)(9).

Under today's rule, permitting authorities are allowed up to 3 years to issue a general permit and MS4s designated under § 122.32(a)(1) are allowed up to 3 years and 90 days to submit a permit application. Operators of regulated small MS4s that choose to be a co-permittee with an adjoining MS4 with an existing NPDES storm water permit must apply for a modification of that permit within the same time frame. Several commenters stated that 90 days was not adequate time to submit an NOI. This might be true if facilities did not start developing their storm water program until publication of their general permit. In fact, municipalities should start developing their storm water program upon publication of today's final rule, if they have not already done so. Municipalities that are uncertain if they fall within the urbanized area should ask their permitting authority. EPA believes that municipalities should not automatically take three years and 90 days to develop a program and submit their NOI. Three years is the maximum amount of time to issue a general permit. MS4s that are automatically designated under today's rule may have less than 3 years and 90 days if the permitting authority issues a permit that requires submission of NOIs before that time. EPA encourages States to modify their NPDES program to include storm water and issue their permits as soon as possible. It is important for permitting authorities to keep their municipalities informed of their progress in developing or modifying their NPDES storm water requirements.

EPA recognizes that MS4s brought into the program due to the 2000 Census calculations do not have as much time to develop a program as those already designated from the 1990 Census. However, the official Bureau of the Census urbanized area calculation for the 2000 Census is expected to be published in the **Federal Register** in the spring of 2002, which should give the potentially affected MS4s adequate time to prepare for compliance under the applicable permit. However, if the publication of this information is delayed, MS4s in newly designated urbanized areas will have 180 days from the time the new designations are published to submit an NOI, consistent with the time frame for other regulated 1S4s that are designated after promulgation of the rule.

The proposed application deadline for MS4s designated under § 122.32(a)(2) was within 60 days of notice. Many commenters stated that 60 days does not provide adequate time for the preparation of an NOI or permit application. EPA agrees that newly designated MS4s may not be aware that they might be designated since the permitting authority could take several years to develop designation criteria. EPA has decided that the application time frame for these facilities should be consistent with the 180 days allowed for facilities designated under §§ 122.26(a)(9)(i)(C) and (D). Section 122.33(c)(2) of today's final rule contains the modified time frame of 180 days to apply for coverage.

h. Reevaluation of Rule

The municipal caucus of the Storm Water Phase II FACA Subcommittee asked EPA to demonstrate its commitment to revisit the municipal requirements of today's rule and make changes where necessary after evaluating the storm water program and researching the effectiveness of municipal BMPs. In § 122.37 of today's final rule, EPA commits to revisiting the regulations for the municipal storm water discharge control program after completion of the first two permit terms. EPA intends to use this time to work closely with stakeholders on research efforts. Gathering and analyzing data related to the storm water program, including data regarding the effectiveness of BMPs, is critical to EPA's storm water program evaluation. EPA does not intend to change today's NPDES municipal storm water program until the end of this period, except under the following circumstances: a court decision requires changes; a technical change is necessary for implementation; or the CWA is modified, thereby requiring changes. After careful analysis, EPA might also consider changes from consensus-based stakeholder requests regarding requirements applicable to newly regulated MS4s. EPA will apply the August 1, 1996, Interim Permitting Approach to today's program during this interim period and encourages all permitting authorities to use this approach in municipal storm water permits for newly regulated MS4s and in determining MS4 permit requirements under a TMDL approach. After careful consideration of the data, EPA will make modifications as necessary.

EPA received comments that supported waiting two permit cycles before re-evaluating the rule and other comments that requested re-evaluation much sooner. EPA anticipates two full permit cycles are necessary to obtain enough data to significantly evaluate the rule. The re-evaluation time frame of 13 years from today remains as proposed.

I. Other Designated Storm Water Discharges

1. Discharges Associated with Small Construction Activity

Section 122.26(b)(15) of today's rule designates certain construction activities for regulation as "storm water discharges associated with small construction activity." Specifically, storm water discharges from construction activity equal to or greater than 1 acre and less than 5 acres are automatically designated except in those circumstances where the operator (i.e., person responsible for discharges that might occur) certifies to the permitting authority that one of two specific waiver circumstances (described in section b. below) applies. Sites below one acre may be designated under § 122.26(b)(15)(ii) where necessary to protect water quality.

Today's rule regulates these construction-related storm water sources under CWA section 402(p)(6) to protect water quality rather than under CWA section 402(p)(2). Designation under 402(p)(6) gives States and EPA the flexibility to waive the permit requirement for construction activity that is not likely to impair water quality, and to designate additional sources below one acre that are likely to cause water quality impairment. Thus, the one acre threshold of today's rule is not an absolute threshold like the five acre threshold that applies under the existing storm water rule.

Today's rule regulating certain storm water discharges from construction activity disturbing less than 5 acres is consistent with the 9th Circuit remand in *NRDC* v. *EPA*, 966 F.2d 1292 (9th Cir. 1992). In that case, the court remanded portions of the existing storm water regulations related to discharges from construction sites. The existing Phase I regulations define "storm water discharges associated with industrial activity" to include storm water discharges from construction sites disturbing 5 acres or more of total land area (see 40 CFR 122.26(b)(14)(x)). In its decision, the court concluded that the 5-acre threshold was improper because the Agency had failed to identify information "to support its perception that construction activities on less than 5 acres are non-industrial in nature" (966 F.2d at 1306). The court remanded the exemption to EPA for further proceedings (966 F.2d at 1310). EPA's objectives in today's action include an effort to (1) address the 9th Circuit

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remand to reconsider regulation of storm water discharges from construction activities that disturb less than 5 acres of land, (2) address water quality concerns associated with such activities, and (3) balance conflicting recommendations and concerns of stakeholders in the regulation of additional construction activity.

EPA responded to the Ninth Circuit's decision by designating discharges from construction activities that disturb between 1 and 5 acres as "discharges associated with small construction activity" under CWA section 402(p)(6), rather than as "discharges associated with industrial activity" under CWA section 402(p)(2)(B). Although a size criterion alone may be an indicator of whether runoff from construction sites between 1 and 5 acres is "associated with industrial activity," the Agency is instead relying on a size threshold in tandem with provisions that allow for designations and waivers based on potential for "predicted water quality impairments" to regulate construction sites between 1 and 5 acres under CWA section 402(p)(6). This approach was chosen by the Agency for the sake of simplicity and certainty and, most importantly, to protect water quality consistent with the mandate of CWA section 402(p)(6). Today's rule also includes extended application deadlines for this new category of dischargers under the authority of CWA section 402(p)(6) (see § 122.26(e)(8) of today's rule).

In today's rule, EPA is regulating storm water discharges from additional construction sites to better protect the Nation's waters, while remaining sensitive to a concern that the Agency should not regulate discharges from construction sites that might not or do not have adverse water quality impacts. EPA believes that today's rule will successfully accomplish this objective by establishing a 1-acre threshold nationwide that includes the flexibility to allow the permitting authority to both waive requirements for discharges from sites that are not expected to cause adverse water quality impacts and to designate discharges from sites below 1-acre based on adverse water quality impacts.

In addition to the diminishing water quality benefits of regulating all sites below one acre, the Agency relied on practical considerations in establishing a one acre threshold and not setting a lower threshold. Regardless of the threshold established by EPA, a NPDES permit can only be required if a construction site has a point source discharge. A point source discharge means that pollutants are added to waters of the United States through a discernible, confined, discrete conveyance. "Sheet flow" runoff from a small construction site would not result in a point source discharge unless and until it channelized. As the amount of disturbed land surface decreases, precipitation is less likely to channelize and create a "point source" discharge (assuming the absence of steep slopes or other factors that lead to increased channelization). Categorical designation of very small sites may create confusion about applicability of the NPDES permitting program to those sites. EPA's one acre threshold reflects, in part, the need to recognize that smaller sites are less likely to result in point source discharges. Of course, the NPDES permitting authority could designate smaller sites (below one acre, assuming point source discharges occur from the smaller designated sites) for regulation if a watershed or other local assessment indicated the need to do so. The Phase II rule includes this designation authority at 40 CFR 122.26(a)(9)(i)(D) and (b)(15)(ii).

The one acre threshold also provides an administrative tool for more easily identifying those sites that are identified for coverage by the rule (but may receive a waiver) and those that are not automatically covered (but may be designated for inclusion). Although all construction sites less than five acres could have a significant water quality impact cumulatively, EPA is automatically designating for permit coverage only those storm water discharges from construction sites that disturb land equal to or greater than one acre. Categorical regulation of discharges from construction below this one acre threshold would overwhelm the resources of permitting authorities and might not yield corresponding water quality benefits. Construction activities that disturb less than one acre make up, in total, a very small percentage of the total land disturbance from construction nationwide. The one acre threshold is reasonable for accomplishing the water quality goals of CWA section 402(p)(6) because it results in 97.5% of the total acreage disturbed by construction being designated for coverage by the NPDES storm water program, while excluding from automatic coverage the numerous smaller sites that represent 24.7% of the total number of construction sites.

Some commenters believed that EPA has not adequately identified water quality problems associated with storm water discharges from construction activity disturbing less than five acres. Other commenters believed that storm water discharges from small construction activity is a significant water quality problem nationwide. Section I.B.3, Construction Site Runoff provides a detailed discussion of adverse water quality impacts resulting from construction site storm water discharges. EPA is regulating storm water discharges from construction activity disturbing between 1 and 5 acres because the cumulative impact of many sources, and not just a single identified source, is typically the cause for water quality impairments, particularly for sediment-related water quality standards.

Several commenters requested that EPA regulate discharges from small construction activity as "discharges associated with industrial activity" under CWA 402(p)(4) and not, as proposed, as "storm water discharges associated with other activity" under CWA 402(p)(6). EPA is regulating discharges from small construction sites as "small construction activity" under the authority of CWA section 402(p)(6), rather than section 402(p)(4), to ensure that regulation of these sources is water quality-sensitive. CWA section 402(p)(6) affords the opportunity for designations and waivers of sources based on potential for "predicted water quality impairments." Regulation of storm water "associated with industrial activity" does not necessarily focus regulation to protect water quality.

a. Scope

The definition of "storm water discharges associated with small construction activity" includes discharges from construction activities, such as clearing, grading, and excavating activities, that result in the disturbance of equal to or greater than 1 acre and less than 5 acres (see § 122.26(b)(15)(i)). Such activities could include: road building; construction of residential houses, office buildings, or industrial buildings; or demolition activity. The definition of "storm water discharges associated with small construction activity" also includes any other construction activity, regardless of size, designated based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants to waters of the United States (§ 122.26(b)(15)(ii)). This designation is made by the Director, or in States with approved NPDES programs, either the Director or the EPA Regional Administrator.

For the purposes of today's rule, the definition of "storm water discharges associated with small construction activity" includes discharges from activities disturbing less than 1 acre if that construction activity is part of a

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"larger common plan of development or sale" with a planned disturbance of equal to or greater than 1 acre of land. A "larger common plan of development or sale" means a contiguous area where multiple separate and distinct construction activities are planned to occur at different times on different schedules under one plan, *e.g.*, a housing development of five ¼ acre lots (§ 122.26(b)(15)(i)).

In addition to the regulatory text for smaller construction, the Agency is also revising the existing text of § 122.26(b)(14)(x) to clarify EPA's intention regarding construction projects involving a larger common plan of development or sale ultimately disturbing 5 or more acres. Operators of such sites are required to seek coverage under an NPDES permit regardless of the number of lots in the larger plan because designation for permit coverage is based on the total amount of land area to be disturbed under the common plan. This designation attempts to address the potential cumulative effects of numerous construction activities concentrated in a given area.

Several commenters asked that EPA allow the permitting authority to set the appropriate size threshold based on water quality studies. While EPA agrees that location-specific water quality studies provide an ideal information base from which to make regulatory decisions, today's rule establishes a default standard for regulation in the absence of location-specific studies. The rule does allow for deviation from the default standard through additional designations and waivers, however, when supported by location-specific water quality information. The rule codifies the ability of permitting authorities to provide waivers for sites greater than or equal to one acre (the default standard) and designate additional discharges from small sites below one acre when location-specific information suggests that the default 1 acre standard is either unnecessary (waivers) or too limited (designations) to protect water quality.

Some commenters wanted EPA to base the regulation of storm water discharges from construction sites not only on size, but also on the duration and intensity of activity occurring on the site. EPA believes that a national 1-acre threshold, in combination with waivers and additional designations, is the most effective and simplest way to address adverse water quality impacts from storm water from small construction sites. Moreover, as discussed below, the waiver for rainfall erosivity does account for projects of limited duration. EPA believes, however, that the intensity of activity occurring on-site would be a very difficult condition to quantify.

Many commenters requested that EPA maintain the 5 acre threshold from the existing regulations, which include opportunities for site-specific designation, as the regulatory scope for regulating storm water from construction sites, *i.e.*, that the Agency not automatically regulate storm water discharges from sites less than 5 acres. Several commenters wanted construction requirements to be applied to sites smaller than 1 acre, while some commenters suggested alternative thresholds of 2 or 3 acres. The rest of the commenters supported the 1 acre threshold. None of the commenters presented any data or rationales to support a specific size threshold.

EPA examined alternative size thresholds, including 0.5 acre, 1 acre, 2 acres and 5 acres. EPA had difficulty evaluating the alternative size thresholds because, while directly proportional to the size of the disturbed site, the water quality threat posed by discharges from construction sites of differing sizes varies nationwide, depending on the local climatological, geological, geographical, and hydrological influences. In order to ensure improvements in water quality nationwide, however, today's rule does not allow various permitting authorities to establish different size thresholds except based on the waiver and designation provisions of the rule. EPA believes that the water quality impact from small construction sites is as high as or higher than the impact from larger sites on a per acre basis. By selecting the 1 acre size threshold and coupling it with waivers and additional designations, EPA is seeking to standardize improvement of water quality on a national basis while providing permitting authorities with the opportunity to designate those unregulated activities causing water quality impairments regardless of site size, as well as to waive requirements when information demonstrates that regulation is unnecessary.

EPA recognizes that the size criterion alone may not be the most ideal predictor of the need for regulation, but effective protection of water quality depends as much on simplicity in implementation as it does on the scientific information underlying the regulatory criteria. The default size criterion of 1 acre will ensure protection against adverse water quality impacts from storm water from small construction sites while not overburdening the resources of permitting authorities and the construction industry to implement the program to protect water quality in the first place.

One commenter stated a need to clarify whether routine road maintenance is considered construction activity for the purpose of today's rule. The NPDES general permit for discharges from construction sites larger than 5 acres defined "commencement of construction" as the *initial* disturbance of soils associated with clearing, grading, or excavating activities or other construction activities (63 FR 7913). For construction sites disturbing less than 5 acres, EPA does not consider construction activity to include *routine* maintenance performed to maintain the *original* line and grade, hydraulic capacity, or original purpose of the facility.

Two commenters believed that the Multi-Sector General Permit for storm water discharges from industrial activities (MSGP) (60 FR 50804) already applies to storm water discharges from construction activities at oil and gas exploration and production sites and asked for a clarification on this issue. Commenters also requested a single general permit to authorize both industrial storm water discharges and construction site discharges which occur at the same industrial site.

Currently, when construction activity disturbing more than 5 acres occurs on an industrial site covered by the MSGP, authorization under a separate NPDES construction permit is needed because the MSGP does not include the "construction" industrial sector. While the MSGP does address sediment and erosion control, it is not as specific as the NPDES general permit for storm water discharges from construction activities disturbing more than 5 acres. Though permitting authorities could conceivably develop a single general permit to authorize storm water discharges associated with construction activity at these industrial facilities, the commenter's request is not addressed by today's rulemaking. When today's rule is implemented through general permits (to be issued later), the permitting authority will have discretion whether or not to incorporate the permit requirements for both the industrial storm water discharges and construction site storm water discharges into a single general permit. This type of request should be addressed to the permitting authority.

One commenter suggested that discharges from small construction sites should be regulated through a "self-implementing rule" approach. While today's rule is not a self-implementing rule, it does add § 122.28(b)(2)(v), which

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gives the permitting authority the discretion to authorize a construction general permit for sites less than 5 acres without submitting a notice of intent. Such non-registration general permits function similarly to self-implementing rules, but are, in fact, permits. Today's rule will be implemented through NPDES permits rather than self-implementing regulations to capitalize on the compliance, tracking, enforcement, and public participation associated with NPDES permits (see discussion in section II.C).

Other commenters believed that only the permitting authority should regulate construction site storm water discharges (under a NPDES permit) and that a small MS4 operator's regulation of storm water discharges associated with construction (under the small MS4 NPDES storm water program) is redundant. EPA disagrees that control measure implementation by the NPDES authority and the small MS4 operator is redundant. To the extent the two efforts overlap, today's rule provides for consolidation and coordination of substantive requirements via incorporation by reference permitting. Small MS4s operators may choose to impose more prescriptive requirements than an NPDES permitting authority based on localized water quality needs. In those cases, EPA intends that the substantive requirements from the small MS4 program should apply as the NPDES permit requirements for the construction site discharger. In cases where a small MS4 program does not prioritize and focus on storm water from construction sites (beyond the small MS4 minimum control measure in today's rule, which does not require the small MS4 operator to control construction site discharges in a manner as prescriptive as is expected for discharges regulated under NPDES permits), the Agency intends that the NPDES general permit will provide the substantive standards applicable to the construction site discharge. EPA does anticipate, however, that implementation of MS4 programs to address construction site runoff within their jurisdiction will enhance overall NPDES compliance by construction site dischargers. EPA also notes that under § 122.35(b), the permitting authority may recognize its own program to control storm water discharges from construction sites in lieu of requiring such a program in an MS4's NPDES permit, provided that the permitting authority's program satisfies the requirements of § 122.34(b)(4), including, for example, procedures for site plan reviews and consideration of information submitted by the public on individual construction sites in each jurisdiction required to be covered by the program.

b. Waivers

Under § 122.26(b)(15)(i) of today's rule, NPDES permitting authorities may waive today's requirement for construction site operators to obtain a permit in two circumstances. The first waiver is intended to apply where little or no rainfall is expected during the period of construction. The second waiver may be granted when a TMDL or equivalent analysis indicates that controls on construction site discharges are not needed to protect water quality.

The first waiver is based on "low predicted rainfall erosivity" which can be found using tables of rainfall-runoff erosivity (R) values published for each region in the U.S. R factors are published in the U.S. Department of Agriculture (USDA) Agricultural Handbook 703 (Renard, K.G., Foster, G.R., Weesies, G.A., McCool, D.K., and D.C. Yoder. 1997. *Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE).* U.S. Department of Agriculture Handbook 703). The R factor varies based on the time during the year when construction activity occurs, where in the country it occurs, and how long the construction activity lasts. The permitting authority may determine, using Handbook 703, which times of year, if any, the waiver opportunity is available for construction activity. EPA will provide assistance either through computer programs or the World Wide Web on how to determine whether this waiver applies for a particular geographic area and time period. Application of this waiver for regulatory purposes will be determined by the authorized NPDES authority. This waiver is discussed further in the following section titled Rainfall-Erosivity Waiver.

The second waiver is based on a consideration of ambient water quality. This waiver is available after a State or EPA develops and implements TMDLs for the pollutant(s) of concern from storm water discharges associated with construction activity. This waiver is also available for sites discharging to non-impaired waters that do not require TMDLs, when an equivalent analysis has determined allocations for small construction sites for the pollutant(s) of concern or determined that such allocations are not needed to protect water quality based on consideration of existing in-stream concentrations, expected growth in pollutant contributions from all sources, and a margin of safety. The Agency envision an equivalent analysis that would demonstrate that water quality is *not* threatened by storm water discharges from small construction activity. This waiver is discussed further below in the sections titled TMDL Waiver and Water Quality Issues.

The proposed rule included a waiver based on "low predicted soil loss." This waiver provision would have been applicable on a case-by-case basis where the annual soil loss rate for the period of construction for a site, using the Revised Universal Soil Loss Equation (RUSLE), would be less than 2 tons/acre/year. The annual soil loss rate of less than 2 tons/acre/year would be calculated through the use of the RUSLE equation, assuming the constants of no ground cover and no runoff controls in place.

Several commenters found the low soil loss waiver too complex and impractical, and stated that expertise is not available at the local level to prepare and evaluate eligibility for the waiver. Another commenter questioned whether two tons/acre/year was an appropriate threshold for predicting adverse water quality impacts. Two other commenters said that RUSLE was never intended to predict off-site impacts and is not an indicator of potential harm to water quality. EPA agrees with the commenters on the difficulty associated with determining and implementing this waiver. Most construction site operators are not familiar with the RUSLE program, and the potential burden on the permitting authority, construction industry, USDA's Natural Resources Conservation Service and conservation districts probably would have been significant. The Agency has not included this waiver in the final rule.

Two commenters asked that EPA allow States the flexibility to develop their own waiver criteria but did not suggest how the Agency (or affected stakeholders) could evaluate the acceptability of alternative State waiver criteria. Therefore, the final rule does not provide for any such alternative waivers. If a State does seek to develop alternate waiver criteria, then EPA procedures afford the opportunity for subsequent actions, for example, under the Project XL Program in EPA's Office of Reinvention, which seeks cleaner, smarter, and cheaper solutions to environmental problems. Many commenters suggested that EPA extend these waivers to existing industrial storm water regulations for construction activity greater than 5 acres. These construction site discharges are regulated as industrial storm water discharges under CWA 402(p)(2) and are not eligible for such water quality-based waivers.

Two commenters were concerned that waivers would create a potential for significant degradation of small streams. EPA disagrees. If small streams are threatened, the permitting authority would choose not to provide any waivers. In addition, permitting authorities may protect small streams by designating discharges from small construction activity based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants to waters of the U.S.

Two commenters asked that the waiver options be eliminated. They felt it would create a gross inequity within the construction community if some projects will not be subject to the requirements of today's rule. While the comments may be valid, EPA disagrees that waivers should be disallowed on this basis. Construction site discharges that qualify for a waiver from permitting requirements are not expected to present a threat to water quality, which is the basis for designation and regulation under today's rule.

A number of commenters suggested additional waivers in cases where new development will result in no additional adverse impacts to water quality as compared to the existing development it replaces. EPA believes these waivers are either unworkable or unnecessary. It would be very difficult for most construction operators to determine, as well as for other stakeholders to verify, on a site-by-site basis, that there is no potential for adverse impact to water quality compared to the replaced development.

Other commenters proposed waivers in cases where a local erosion and sediment control program covers the project or a separate waiver for small linear utility projects. Instead of waivers, today's rule addresses the first suggestion through the qualifying program provision described in the section titled Cross-Referencing State/Local Erosion and Sediment Control Programs below. Today's rule provides waivers for small linear projects in so far as they satisfy conditions for low rainfall erosivity. (See § 122.26(b)(15)(i)(A).)

Other commenters suggested waivers based on distance to water body, existence of vegetated buffer around water body, slope of disturbed land, or if discharging to very large bodies of water. As a result of public outreach, EPA believes that these proposed waivers would be generally unworkable for construction site dischargers and permitting authorities because of the difficulty in applying them to all small sites.

One commenter mentioned that waivers for the R factor (rainfall-erosivity) and soil loss are effluent standards that have not been developed in accordance with sections 301 and 304 of the CWA. EPA disagrees that these sections are relevant to the designation of sources in today's rule. The waiver provisions in this section of the rule are jurisdictional because they affect the scope of the universe of entities subject to the NPDES program. Therefore, the waiver provisions are not themselves substantive control standards implemented through NPDES permits, and thus, not subject to the statutory criteria in sections 301 and 304.

Another commenter stated that waivers would allow exemptions to the technology based requirements and would thus be inconsistent with the two-fold approach of the CWA (a technology based minimum and a water quality based overlay). EPA acknowledges that the CWA does not generally provide for waivers for the Act's technology-based requirements. The waiver provisions do not create exemptions from technology-based standards that apply to NPDES dischargers; they provide exemption from the underlying requirement for an NPDES permit in the first place. Protection of water quality is the reason these smaller sites are designated for regulation under NPDES. The Act's two fold approach imposes more stringent water quality based effluent limitations when technology-based limitations applicable to regulated dischargers are insufficient to meet water quality standards. Under today's rule, water quality protection is the basis for determining which of the unregulated sources should be regulated at all. Thus, today's rule is entirely consistent with the Act's two fold approach.

i. Rainfall-Erosivity Waiver. The rainfall-erosivity waiver under § 122.26(b)(15)(i)(A) is intended to exempt the requirements for a permit when and where negligible rainfall/runoff-erosivity is expected. In the development of the Universal Soil Loss Equation, analysis of data indicated that when factors other than rainfall are held constant, soil loss is directly proportional to a rainfall factor composed of total storm kinetic energy times the maximum 30 minute intensity. The average annual sum of the storm energy and intensity values for an area comprise the R factor—the rainfall erosivity index. A detailed explanation of the R factor can be found in *Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE)* (USDA, 1997).

This waiver is time-sensitive and is dependent on when during the year a construction activity takes place, how long it lasts, and the expected rainfall and intensity during that time. R factors vary based on location. EPA anticipates that this waiver opportunity responds to concerns about the requirement for a permit when it is not expected to rain, especially in the arid areas of the U.S. Under today's rule, the permitting authority could waive the requirements for a permit for time periods when the rainfall-erosivity factor ("R" in RUSLE) is less than *five* during the period of construction. For the purposes of calculating this waiver, the period of construction activity starts at the time of initial disturbance and ends with the time of final stabilization. The operator must submit a written certification to the Director in order to apply for such a waiver. EPA believes that those areas receiving negligible rainfall during certain times of the year are unlikely to have storm events causing discharges that could adversely impact receiving streams. Consequently, BMPs would not be necessary on those smaller sites. This waiver is most applicable to projects of short duration and to the arid regions of the country where the occurrence of rainfall follows a cyclic pattern—between no rain and extremely heavy rain. EPA review of rainfall records for these areas indicates that, during periods of the year when the number of events and quantity of rain are low, storm water discharges from the smaller construction sites regulated under today's rule should be minimal.

Some commenters supported the use of the R factor as a waiver, while others felt that a waiver based on rainfall statistics ignores the fact that it may rain on any given day and it is the cumulative effect of wet weather discharges which cause water quality impairments. A commenter also asked what happens in "El Nino" years when significantly more rainfall than normal occurs. Another commenter also expressed concern that this waiver was not based on a measured water quality impact, but instead on an indicator of potential impact. In response to the previous comments, EPA notes that, under CWA 402(p)(6), sources are designated on their *potential* for adverse impact. Designation under the section is prospective, not retrospective or remedial only. For that reason, the waivers under today's rule also operate prospectively. EPA wanted to waive requirements for sites with little potential to impair water quality, and the R factor is the most straightforward way to do this. The permitting authority, if electing to use waivers, could always suspend the use of waivers in certain areas or during certain times. In addition, the permitting authority may choose to use a lower R factor threshold than the one set by EPA. Application of this waiver is at the discretion of the permitting authority, subject only to the limitation that R factors cannot exceed 5.

One commenter expressed the need for EPA to provide a justification for the threshold value used for the R factor. None of the commenters included any data to show that EPA's proposed R factor of 2 was either too high or too low. EPA is using the R factor as an indicator of the potential to impact water quality. In an effort to determine which R threshold should be used, EPA conducted additional analysis of the rainfall/runoff erosivity factor for 134 sites across the country. For an R factor threshold of 5, approximately 12% of sites would be waived if the project period lasted 6 months, 27% for 3 months, 47% for 1 month, and 60% of sites would be waived if the project lasted for only 15 days. None of the 134 sites would be waived if the project lasted an entire year. For an R factor threshold of 2, approximately 9% of sites would be waived if the project period lasted 6 months, 15% for 3 months, 31% for 1 month, and 43% for 15 days. For an R factor threshold of 10, approximately 22% of sites would be waived if the project period lasted 6 months, 37% for 3 months, 60% for 1 month, and 78% for 15 days. EPA believes that an R factor of 5 is an adequate threshold to waive requirements for sites because they would not reasonably be expected to impair water quality.

EPA will develop, as part of the tool box described in section II.A.5, guidance materials and computer or web-accessible programs to assist permitting authorities and construction site discharges in determining if any resulting storm water discharges from specific projects are eligible for this waiver.

ii. Water Quality Waiver. The water quality waiver under § 122.26(b)(15)(i)(B) is available where storm water controls are not needed based on a comprehensive, location-specific evaluation of water quality needs. The waiver is available based on either an EPA-approved "total maximum daily load" (TMDL) under section 303(d) of the CWA that addresses the pollutant(s) of concern or, for sites discharging to non-impaired waters that do not require TMDLs, an equivalent analysis that has either determined allocations for small construction sites for the pollutant(s) of concern or determined that such allocations are not needed to protect water quality based on consideration of existing in-stream concentrations, expected growth in pollutant contributions from all sources, and a margin of safety. The pollutants of concern that must be addressed include sediment or a parameter that addresses sediment (such as total suspended solids (TSS), turbidity or siltation) and any other pollutant that has been identified as a cause of impairment of any water body that will receive a discharge from the construction activity. The operator must certify to the NPDES permitting authority that the construction activity will take place, and storm water discharges will occur, within the applicable drainage area evaluated in the TMDLs or equivalent analyses.

Today's rule modifies the approach in the proposed rule. EPA proposed to allow a waiver of permit requirements for small construction if storm water controls were determined to be unnecessary based on "wasteload allocations that are part of 'total maximum daily loads' (TMDLs) that address the pollutants of concern," or "a comprehensive watershed plan, implemented for the water body, that includes the equivalents of TMDLs, and addresses the pollutants of concern."

Commenters asked for clarification of the terms "comprehensive watershed plans" and "equivalent of TMDLs." EPA intended that both terms would include a comprehensive analysis that determines that controls on small construction sites are not needed based on consideration of existing in-stream concentrations, expected growth in pollutant contributions from all sources, and a margin of safety. Today's rule makes this clarification.

One commenter pointed out that there are no water quality standards for suspended solids, the major pollutant expected in discharges from construction activity. The commenter asserted that no waiver would ever be available. Another commenter noted that there are no sediment criteria developed for streams, also making this waiver useless. EPA notes that a number of States and Tribes have water quality standards that address TSS, which are narrative in form, and that may serve as a basis for water quality-based effluent limits. As efforts to identify impairments and improve water quality progress, some States may yet develop water quality standards for suspended solids. Although several TMDLs for sediment and related parameters have been established, EPA does recognize that currently it is extremely difficult to develop TMDLs for sediment. EPA is partially addressing this concern by clarifying in today's rule that the waivers may be based on a TMDL or equivalent analyses for sediment or one of the various pollutant parameters that are a proxy for sediment. These include TSS, turbidity and siltation.

Other commenters noted that this waiver was unattainable if a TMDL or equivalent analysis must be available for every pollutant that could possibly be present in any amount in discharges from small construction sites regardless of whether the pollutant is causing water quality impairment. Commenters asked that EPA identify what constitutes the "pollutants of concern" for which a TMDL or its equivalent must be developed. EPA has revised the proposed rule in response to these concerns.

In order for discharges from construction sites under five acres to qualify for the water quality waiver of today's rule, the construction site operator must demonstrate that storm water controls are not necessary for sediment or a parameter that addresses sediment (such as TSS, turbidity or siltation) and any other pollutant that has been identified as a cause of impairment of any water body that will receive a discharge from the construction activity. Even if the water body is not currently impaired for sediment, today's rule requires an analysis of the potential impacts of sediment because the storm water discharges from the construction activity will be a new source of loading to the water body that could constitute a new impairment. Because the water body will not necessarily have been included on a "303(d) list" and a TMDL will not necessarily be required, the rule continues to allow an analysis that is the equivalent of a TMDL. The designation of storm water discharges from small construction activity for regulation in today's rule is intended to control pollutants other than sediment. This waiver provision requires a TMDL or equivalent analysis for a pollutant other than gross particulates (*i.e.*, sediment and other particulate-focused pollutant parameters) only if the receiving water is currently impaired for that pollutant.

One commenter expressed the concern that construction operators will not know if they are in a watershed covered by a TMDL. To the extent this is an operator's concern, he or she could contact their NPDES permitting authority before applying for permit coverage to determine if receiving water is subject to a TMDL. Alternatively, the permitting authority could identify the TMDL (or equivalent analysis) areas in the general permit or another operator-accessible information source.

Another commenter expressed the concern that a TMDL waiver is likely to be ineffective because the TMDL list is submitted only once every 2 years. By the time a water is listed, the activity may have been completed and stabilized. The commenter argued that, if a watershed is impaired due to sediment from construction, then storm water controls will still be needed, because small construction can only be waived when it is not identified as a source of impairment. In response, EPA notes that an analysis that is the equivalent of a TMDL (specifically, equivalent to the component of a TMDL that comprehensively analyses existing ambient conditions against the applicable water quality standards) may also provide a basis for waiver from the default 1 acre designation. Also, even if a water has been identified as impaired for sediment, it is possible that a site or category of sites may receive an allocation that is sufficiently high enough to allow discharges without storm water controls.

c. Permit Process and Administration

The operator of the construction site, as with any operator of a point source discharge, is responsible for obtaining coverage under a NPDES permit as required by § 122.21(b). The "operator" of the construction site, as explained in the current NPDES construction general permit, is typically the party or parties that either individually or collectively meet the following two criteria: (1) Operational control over the site specifications, including the ability to make modifications in the specifications; and (2) day-to-day operational control of those activities at the site necessary to ensure compliance with permit conditions (63 FR 7859). If more than one party meets these criteria, then each party involved would typically be a co-permittee with any other operators. The operator could be the owner, the developer, the general contractor, or individual contractor. When responsibility for operational control is shared, all operators must apply.

In today's rule, EPA is not requiring an NOI for NPDES general permits for storm water discharges from construction activities regulated by § 122.26(b)(15) if the NPDES permitting authority finds that the use of NOIs would be inappropriate (see § 122.28(b)(2)(v)). Under this approach, the NPDES permitting authority will have the discretion to decide whether or not to require NOIs for discharges from construction activity less than 5 acres. Compared to the existing storm water regulation, the permitting authority thus has increased flexibility in program implementation. EPA does recommend the use of NOIs, however because NOIs track permit coverage and provide a useful information source to prioritize inspections or enforcement. Requiring an NOI allows for greater accountability by, and tracking of, dischargers. This simple permit application and reporting mechanism also allows for better outreach to the regulated community, uses an existing and familiar mechanism, and is consistent with the existing requirements for storm water discharges from larger construction activities. Today's rule does not amend the requirement for NOIs in general permits for storm water discharges from construction activity disturbing 5 acres for more. See § 122.28(b)(2)(v).

EPA expects that the vast majority of discharges of storm water associated with small construction activity identified in § 122.26(b)(15) will be regulated through general permits. In the event that an NPDES permitting authority decides to issue an individual construction permit, however, individual application requirements for these construction site discharges are found at § 122.26(c)(1)(ii). For any discharges of storm water associated with small construction activity identified in § 122.26(b)(15) that are not authorized by a general permit, a permit application made pursuant to § 122.26(c) must be submitted to the Director by 3 years and 90 days after publication of the final rule.

Some commenters expressed concern that linear construction projects (*e.g.*, roads, highways, pipelines) that cross several jurisdictions will have to comply with multiple sets of requirements from various jurisdictions, including multiple local governments and States. EPA is limited in its options to address these concerns because the Agency cannot issue NPDES permits in States authorized to implement the NPDES program nor preempt other more stringent local and State requirements. EPA believes, however, that the option for incorporating by reference the State, Tribal or local requirements (see discussion in Section II.I.2.d., Cross-Referencing State/Local Erosion and Sediment Control Programs) should limit the administrative burden on the operator responsible for discharges from linear construction projects. If the operator were to implement the most comprehensive of the various requirements for the whole project, it could avoid confusion due to differing requirements for different sections of the project. In addition, linear utility projects, which usually have a shorter project period, are more likely to be eligible for the rainfall erosivity waiver.

One commenter stated there was no reason to delay the application period for regulated storm water discharges from small construction activities. The commenter requested that the newly regulated construction site discharges should be required to seek permit coverage within 90 days, as opposed to 3 years, of the effective date of the rule. The Agency does not accept this request. EPA anticipates that NPDES permitting authorities will need one to two years to develop adequate legal authority to implement a program to address this new category of discharges, as well as to develop and issue general permits. Moreover, to ensure effective implementation to protect water quality, regulatory authorities will need additional time to inform small construction site operators of requirements and provide guidance and training on these requirements.

Finally, EPA received a comment requesting that the three year file retention requirement be deleted for discharges from small construction sites. While EPA recognizes that the three year record retention schedule may be unnecessary for certain construction projects, the Agency has determined it is necessary to retain files after the completion of the project to ensure permit compliance, including applicable construction site stabilization enabling permit termination for such sites.

d. Cross-Referencing State, Tribal or Local Erosion and Sediment Control Programs

In developing the NPDES permit requirements for construction sites less than 5 acres, members of the Storm Water Phase II FACA Subcommittee asked EPA to try to minimize redundancy in the construction permit requirements. In response, today's rule at § 122.44(s) provides for incorporation of qualifying State, Tribal or local erosion and sediment control program requirements by reference into the NPDES permit authorizing storm water discharges from construction sites (described under §§ 122.26(b)(15) and (b)(14)(x)). The incorporation by reference approach applies not only to the newly regulated storm water discharges (from construction activity disturbing between 1 and 5 acres, including designated sites, but excluding waived sites) but also to discharges from construction activity disturbing 5 or more acres already covered by the existing storm water regulations. For this latter category of discharges from construction activity disturbing 5 or more acres, the incorporation by reference approach requires that the pollutant control requirements from the incorporated program also satisfy the statutory standard for limitations representing application of the best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT).

For permits issued for discharges from small construction activity defined under § 122.26(b)(15), a qualifying State, Tribal, or local erosion and sediment control program is one that includes the program elements described under § 122.44(s)(1). These elements include requirements for construction site operators to implement appropriate erosion and sediment control BMPs, requirements to control waste, a requirement to develop a storm water pollution prevention plan, and requirements to submit a site plan for review. A storm water pollution prevention plan includes site descriptions, descriptions of appropriate control measures, copies of approved State, Tribal or local requirements, maintenance procedures, inspection procedures, and identification of non-storm water discharges. The construction site's permit would require it to follow the requirements of the qualifying local program rather than require it to follow two different sets of requirements. If a partially-qualifying program does not have all of the elements described under § 122.44(s)(1), then the NPDES permitting authority may still incorporate language in the small construction site discharge's permit that requires the construction site operator to follow the program, but the construction site discharge permit also must incorporate the missing required elements in order to satisfy CWA requirements.

The term "local" refers to the geographic area of applicability, not the form of government that develops and administers the program. Thus, a qualifying federal erosion and control program, such as certain programs developed and administered by the federal Bureau of Land Management, could be a qualifying local program.

As a result of this provision, local requirements will, in effect, provide the substantive construction site erosion and sediment control requirements for the NPDES permit authorization. Therefore, by following one set of erosion and sediment control requirements, construction site operators satisfy both local and NPDES permit requirements without duplicative effort. At the same time, noncompliance with the referenced local requirements will be considered noncompliance with the NPDES permit which is federally enforceable. The NPDES permitting authority will, of course, retain the discretion to decide whether to include the alternative requirements in the general permit. EPA believes that this approach will best balance the need for consideration of specific local requirements and local implementation with the need for federal and citizen oversight, and will extend supplemental NPDES requirements to control storm water discharges from construction sites.

EPA developed the "incorporation by reference" approach based on implementation efforts designed by the State of Michigan. Michigan relies on localities to develop substantive controls for storm water discharges associated with construction activities on a localized basis. Localities, however, are not required to do so. In areas where the local authority does not choose to participate, the State administers the sedimentation and erosion control requirements. The State agency, as the NPDES permitting authority, receives an NOI (termed "notice of coverage" by Michigan) under the general permit and tracks and exercises oversight, as appropriate, over the activity causing the storm water discharge. Michigan's goal under these procedures is to utilize the existing erosion and sediment control program infrastructure authorized under State law for storm water discharge regulation. (See U.S. Environmental Protection Agency, Office of Water. January 7, 1994. Memo: From Michael B. Cook, Director OWEC, to Water Management Division Directors, Regarding the "Approach Taken by Michigan to Regulate Storm Water Discharges from Construction Activities.")

Most commenters supported the general concept of incorporating by reference qualifying programs. Two commenters expressed concern that different local construction requirements will create an impossible regulatory scheme for builders who work in different localities. EPA believes that allowing States to incorporate qualifying programs by reference will minimize the differences for builders who work in different areas of the State. These differences already exist, however, not only for erosion and sediment controls, but also other aspects of construction. In any event, the criteria for qualification for localized programs should provide a certain degree of standardization for various localities' requirements. EPA expects that the new rule for construction and post-construction BMPs being developed under CWA section 304(m) will also encourage standardization of local requirements. (See discussion of this new rulemaking in section II.D.1, Federal Role of this preamble).

Two commenters requested that an "incorporation by reference" should include permission, in writing, from the qualifying local program administrator because of a perceived extra burden on the referenced program. Any program requirements incorporated by reference in NPDES permits should already apply to construction site dischargers in the applicable area and therefore should not add any additional burden to the referenced program. EPA has left to the discretion of the permitting authority the decision on whether to seek permission from the qualifying program before cross-referencing it in an NPDES permit.

One commenter stated that a qualifying local program should require a SWPPP. The proposed rule defined the qualifying local program as a program the meets the minimum program requirements established in the proposed construction minimum control measure for small MS4s. To ensure consistency in the controls for storm water discharges between the larger, already regulated construction sites and the discharges from smaller sites that will be regulated as a result of today's rule, EPA has made a change to define a qualifying local program as one that includes the elements described in § 122.44(s)(1). Section 122.44(s)(1) requires the development and implementation of a storm water pollution prevention plan as a criterion for qualification of local programs for incorporation by reference. As noted above, if a qualifying program does not include all the elements in § 122.44(s)(1) then the permitting authority will need to specify the missing elements in order to rely on the incorporation by reference approach.

One commenter asked what happens in regard to the use of qualifying programs when a construction site operator is also the qualifying local program operator. The provision for incorporation by reference applies in this situation also. The local program operator will be required to comply with requirements it has established for others.

e. Alternative Approaches

EPA received a number of comments on alternative permitting approaches. Several commenters supported regulating discharges only from those construction sites within urbanized areas. Other commenters opposed this approach. EPA chose to address storm water discharges from construction sites located both within and outside urbanized areas because of the potential for adverse water quality impact from storm water discharges from smaller sites in all areas. Regulating only those sites within urbanized areas would have excluded a large number of potential contributors to water quality impairment and would not address large areas of new development occurring on the outer fringes of urbanized areas. In fact, designating only small construction discharges within urbanized areas might create a perverse incentive for building only outside urbanized areas. Such an incentive would be inconsistent with the Agency's intention behind designating to protect water quality. The Agency intends that designation to protect water quality in today's rule should be both remedial and preventive.

A number of commenters encouraged EPA to cover municipal construction activities under the small MS4 general permit, instead of issuing a separate NPDES construction permit to these municipal construction projects. Similarly, a number of commenters supported EPA giving industrial facilities the option of having storm water from construction activities on the site covered by the industrial storm water permit. Several other commenters found that combining multiple permit types under one general permit introduced a degree of complexity which was confusing to permittees. Permitting authorities have the option of combining MS4 and construction permits or industrial and construction permits, however, specific requirements for each would still need to be included in the permit issued. EPA agrees that this would probably result in a more complex and confusing permit compared to the existing component permits.

Several commenters supported an alternative for regulated small MS4s where a local qualified program alone, without an NPDES permit, is sufficient to enforce compliance with construction site discharge requirements. On the other hand, one commenter stated that linking the local construction erosion and sediment control program to the existing NPDES program for storm water from larger construction has driven improvements in many local programs. Another commenter stated that the potential fines under the NPDES program will encourage compliance and will be much stronger than any fines a local program may have. EPA agrees that the NPDES program is the best approach to address water quality impacts from construction sites and provides benefits such as accountability and federal enforcement.

A number of commenters supported issuing one permit for each construction company, instead of a permit for each individual construction activity (also requested for storm water discharges from the larger, already regulated construction sites). Other commenters found that a 'licensing' program for construction site operators would have many problems, including identifying who to permit and tracking information on active sites. EPA is regulating only the storm water discharges associated with construction activity from small sites, not the construction activity itself. Separate NPDES permits (either individual or general permit coverage) for construction site discharges avoid potential problems in tracking sites and operator accountability. Section 122.28(b)(2)(v) gives permitting authorities the option to issue a general permit without requiring an NOI. If an NOI is not required for each activity, permitting authorities could pursue other options such as a company-wide NOI, license instead of an NOI, or another mechanism.

2. Other Sources

In the *Storm Water Discharges Potentially Addressed by Phase II of the National Pollutant Discharge Elimination System Storm Water Program*, Report to Congress, March 1995, ("Report") submitted by EPA pursuant to CWA section 402(p)(5), EPA examined the remaining unregulated point sources of storm water for the potential to adversely affect water quality. Due to very limited national data on which to estimate pollutant loadings on the basis of discharge categories, the discussion of the extent of unregulated storm water discharges is limited to an analysis of the number and geographic distribution of the unregulated storm water discharges. Therefore, EPA is not designating any additional unregulated point sources of storm water on a nationwide, categorical basis. Instead, the remainder of the sources will be regulated based on case-by-case post-promulgation designations by the NPDES permitting authority.

EPA did, however, evaluate a variety of categories of discharges for potential designation in the Report. EPA's efforts to identify sources and categories of unregulated storm water discharges for potential designation for regulation in today's rule started with an examination of approximately 7.7 million commercial, retail, industrial, and institutional facilities identified as "unregulated." In general, the distribution of these facilities follows the distribution of population, with a large percentage of facilities concentrated within urbanized areas (see page 4-35 of the Report). This examination resulted in identification of two general classes of facilities with the potential for discharging pollutants to waters of the United States through storm water point sources.

The first group (Group A) included sources that are very similar, or identical, to regulated "storm water discharges associated with industrial activity" but that were not included in the existing storm water regulations because EPA used SIC codes in defining the universe of regulated industrial activities. By relying on SIC codes, a classification system created to identify industries rather than environmental impacts from these industries discharges, some types of storm water discharges that might otherwise be considered "industrial" were not included in the existing NPDES storm water program. The second general class of facilities (Group B) was identified on the basis of potential for activities and pollutants that could contribute to storm water contamination.

EPA estimates that Group A has approximately 100,000 facilities. Discharges from facilities in this group, which may be of high priority due to their similarity to regulated storm water discharges from industrial facilities, include, for example, auxiliary facilities or secondary activities (*e.g.*, maintenance of construction equipment and vehicles, local trucking for an unregulated facility such as a grocery store) and facilities intentionally omitted from existing storm water regulations (*e.g.*, publicly owned treatment works with a design flow of less than 1 million gallons per day, landfills that have not received industrial waste).

Group B consists of nearly one million facilities. EPA organized Group B sources into 18 sectors for the purposes of the Report. The automobile service sector (*e.g.*, gas/service stations, general automobile repair, new and used car dealerships, car and truck rental) makes up more than one-third of the total number of facilities identified in all 18 sectors.

EPA conducted a geographical analysis of the industrial and commercial facilities in Groups A and

B. The geographical analysis shows that the majority are located in urbanized areas (see Section 4.2.2, Geographic Extent of Facilities, in the Report). In general, about 61 percent of Group A facilities and 56 percent of Group B facilities are located in urbanized areas. The analysis also showed that nearly twice as many industrial facilities are found in all urbanized areas as are found in large and medium municipalities alone. Notable exceptions to this generalization included lawn/garden establishments, small unregulated animal feedlots, wholesale livestock, farm and garden machinery repair, bulk petroleum wholesale, farm supplies, lumber and building materials, agricultural chemical dealers, and petroleum pipelines, which can frequently be located in smaller municipalities or rural areas.

In identifying potential categories of sources for designation in today's notice, EPA considered designation of discharges from Group A and Group B facilities. EPA applied three criteria to each potential category in both groups to determine the need for designation: (1) The likelihood for exposure of pollutant sources included in that category, (2) whether such sources were adequately addressed by other environmental programs, and (3) whether sufficient data were available at this time on which to make a determination of potential adverse water quality impacts for the category of sources. As discussed previously, EPA searched for applicable nationwide data on the water quality impacts of such categories of facilities.

By application of the first criterion, the likelihood for exposure, EPA considered the nature of potential pollutant sources in exposed portions of such sites. As precipitation contacts industrial materials or activities, the resultant runoff is likely to mobilize and become contaminated by pollutants. As the size of these exposed areas increases, EPA expects a proportional increase in the pollutant loadings leaving the site. If EPA concluded that a category of sources has a high potential for exposure of raw materials, intermediate products, final products, waste materials, byproducts, industrial machinery, or industrial activity to rainfall, the Agency rated that category of sources as having "high" potential for adverse water quality impact. EPA's application of the first criterion showed that a number of Group A and B sources have a high likelihood of exposure of pollutants.

Through application of the second criterion, EPA assessed the likelihood that pollutant sources are regulated in a comprehensive fashion under other environmental protection programs, such as programs under the Resource Conservation and Recovery Act (RCRA) or the Occupational Health and Safety Act (OSHA). If EPA concluded that the category of sources was sufficiently addressed under another program, the Agency rated that source category as having "low" potential for adverse water quality impact. Application of the second criterion showed that some categories were likely to be adequately addressed by other programs.

After application of the third criterion, availability of nationwide data on the various storm water discharge categories, EPA concluded that available data would not support any such nationwide designations. While such data could exist on a regional or local basis, EPA believes that permitting authorities should have flexibility to regulate only those categories of sources contributing to localized water quality impairments.

EPA received comments requesting designation of additional industrial, commercial and retail sources (*e.g.* industrial activity "look-alikes", roads, commercial facilities and institutions, and vehicle maintenance facilities) in the final rule, because the commenters believe that the data exist to support national designation of some of these sources. Other comments were received opposing designation of any additional sources. Today's rule does not designate any additional industrial or commercial category of sources either because EPA currently lacks information indicating a consistent potential for adverse water quality impact or because of EPA's belief that the likelihood of adverse impacts on water quality is low, with some possible exceptions on a more local basis. Since the time the Agency submitted the Report, EPA has continued to seek additional data and has requested available data from the FACA members. If sufficient regional or nationwide data become available in the future, the permitting authority could at that time designate a category of sources or individual sources on a case-by-case basis. Therefore, today's rule encourages control of storm water discharges from Groups A and B through self-initiated, voluntary BMPs, unless the discharge (or category of discharges) is designated for permitting by the permitting authority. See discussion in section I.D., EPA's Reports to Congress.

3. ISTEA Sources

Provisions within the Intermodal Surface Transportation and Efficiency Act (ISTEA) of 1991 temporarily exempted storm water discharges associated with industrial activity that are owned or operated by municipalities serving populations less than 100,000 people (except for airports, power plants, and uncontrolled sanitary landfills) from the need to apply for or obtain a storm water discharge permit (section 1068(c) of ISTEA). Congress extended the NPDES permitting moratorium for these facilities to allow small municipalities additional time to comply with NPDES requirements for certain sources of industrial storm water. The August 7, 1995 storm water final rule (60 FR 40230) further extended this moratorium until August 7, 2001. However, today's rule changes this deadline so that previously exempted industrial facilities owned or operated by municipalities serving populations less than 100,000 people, must now submit an application for a permit within 3 years and 90 days from date of publication of today's rule.

EPA received comments recommending that permit requirements for municipally owned or operated industrial storm water discharges, including those previously exempt under ISTEA, be included in a single NPDES permit for all MS4 storm water discharges. The existing NPDES regulations already provide permitting authorities the ability to issue a single "combination" permit for MS4 discharges. However, if the permitting authorities chose to issue this type of permit, they must make sure that in doing so, they are not creating a double standard for industrial facilities covered under the combination permit versus those covered under separate general or individual permits. In order to avoid this double standard, combination permits would have to contain requirements that are the same or very similar to the requirements found in separate MS4 and industrial permits, *i.e.*, the minimum measures and other necessary requirements of an MS4 permit, and the SWPPP, monitoring and reporting requirements, and other necessary requirements of an industrial permit. If such a combined MS4 general permit were issued, the regulations require that each discharger submit NOIs for their respective discharges, except for discharges from small construction activities. Flexibility exists in developing a combination NOI which could reduce the need to submit duplicative information, *e.g.* owner/operator name and address. The combination NOI would still need to require specific information for each separate municipally owned or operated industrial location, including

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construction projects disturbing 5 or more acres. The regulations at § 122.28(b)(2)(ii) list the necessary contents of an NOI, which require: the facility name, facility address, type of facility or discharge and receiving stream for each industrial discharge location. When viewed in its entirety, a combination permit, which by necessity would need to contain all elements of otherwise separate industrial and MS4 permit requirements, and require NOI information for each separate industrial activity, may have few advantages when compared to obtaining separate MS4 and industrial general permit coverage.

In order to allow the permitting authority to issue a single storm water permit for the MS4 and all municipally owned or operated industrial facilities, including those previously exempt under ISTEA, today's rule requires applications for ISTEA sources within 3 yrs and 90 days from date of publication of today's rule. The permitting authority has the ultimate decision to determine whether or not a single all-encompassing MS4 permit is appropriate.

4. Residual Designation Authority

The NPDES permitting authority's existing designation authority, as well as the petition provisions are being retained. Today's rule contains two provisions related to designation authority at §§ 122.26(a)(9)(i)(C) and (D). Subsection (C) adds designation authority where storm water controls are needed for the discharge based upon wasteload allocations that are part of TMDLs that address the pollutant(s) of concern. EPA intends that the NPDES permitting authority have discretion in the matter of designations based on TMDLs under subsection (C). Subsection (D) carries forward residual designation authority under former § 122.26(g), and has been modified to provide clarification on categorical designation. Under today's rule, EPA and authorized States continue to exercise the authority to designate remaining unregulated discharges composed entirely of storm water for regulation on a case-by-case basis (including § 123.35). Individual sources are subject to regulation if EPA or the State, as the case may be, determines that the storm water discharge from the source contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States. This standard is based on the text of section CWA 402(p). In today's rule, EPA believes, as Congress did in drafting section CWA 402(p)(2)(E), that individual instances of storm water discharge might warrant special regulatory attention, but do not fall neatly into a discrete, predetermined category. Today's rule preserves the regulatory authority to subsequently address a source (or category of sources) of storm water discharges of concern on a localized or regional basis. For example, as States and EPA implement TMDLs, permitting authorities may need to designate some point source discharges of storm water on a categorical basis either locally or regionally in order to assure progress toward compliance with water quality standards in the watershed.

EPA received comments asking that § 122.26(a)(9)(i)(D) as proposed be modified to include specific language clarifying the permitting authority's ability to designate additional sources on a categorical basis as explained in the preamble to the proposed rule. One comment requested that the designation language include "categories of sources on a Statewide basis." EPA agrees that the intent of the language may not have been clear regarding categorical designation. Today's rule modifies subsection (D) to clarify that the designation authority can be applied within different geographic areas to any single discharge (i.e., a specific facility), or category of discharges that are contributing to a violation of a water quality standard or are significant contributors of pollutants to waters of the United States. The added term "within a geographic area" allows "State-wide" or "watershed-wide" designation within the meaning of the terms.

One commenter questioned the Agency's legal authority to provide for such residual designation authority. The stakeholder argued that the lapse of the October 1, 1994, permitting moratorium under CWA section 402(p)(1) eliminated the significance of the CWA section 402(p)(2) exceptions to the moratorium, including the exception for discharges of storm water determined to be contributing to a violation of a water quality standard or a significant contributor of pollutants under CWA section 402(p)(2)(E). The stakeholder further argued that EPA's authority to designate sources for regulation under CWA section 402(p)(6) is limited to storm water discharges other than those described under CWA section 402(p)(2). Because CWA section 402(p)(2)(E) describes individually designated discharges, the stakeholder concluded that regulations under CWA section 402(p)(6) cannot provide for post-promulgation designation of individual sources. EPA disagrees.

First, as explained previously, EPA anticipates that NPDES permitting authorities may yet determine that individual unregulated point sources of storm water discharges require regulation on a case-by-case basis. This conclusion is consistent with the Congress' recognition of the potential need for such designation under the first phase of storm water regulation as described in CWA section 402(p)(2)(E). Under CWA section 402(p)(2)(E), Congress recognized the need for both EPA and the State to retain authority to regulate unregulated point sources of storm water under the NPDES permit program. Second, to the extent that CWA section 402(p)(6) requires designation of a "category" of sources, the permitting authority may designate such (as yet unidentified) sources as a category that should be regulated to protect water quality. Though such sources may exist and discharge today, if neither EPA nor the State/Tribal NPDES permitting authority has designated the source for regulation under CWA section 402(p)(2)(E) to date, then CWA section 402(p)(6) provides the authority to designate such sources.

The Agency can designate a category of "not yet identified" sources to be regulated, based on local concerns, even if data do not exist to support nationwide regulation of such sources. EPA does not interpret the language in CWA section 402(p) to preclude States from exercising designation authority under these provisions because such designation (and subsequent regulation of designated sources) is within the "scope" of the NPDES program.

EPA also believes that sources regulated pursuant to a State designation are part of (and regulated under) a federally approved State NPDES program, and thus subject to enforcement under CWA sections 309 and 505. Under existing NPDES State program regulations, State programs that are "greater in scope of coverage" are not part of the federally-approved program. By contrast, any such State regulation of sources in this "reserved category" will be within the scope of the federal program because today's rule recognizes the need for such post promulgation designations of unregulated point sources of storm water. Such regulation will be "more stringent" than the federal program rather than "greater in scope of coverage" (40 CFR 123.1(h)).

EPA does not interpret the congressional direction in CWA section 402(p)(6) to preclude regulation of point sources of storm water that should be regulated to protect water quality. Under CWA section 510, Congress expressly recognized and preserved the authority of States to adopt and enforce more stringent regulation of point sources, as well as any requirement respecting the control or abatement of pollution. Section 510 applies, "except as expressly provided" in the CWA. CWA section 502(14) does expressly provide affirmative limitations on the regulation of certain pollutant sources through the point source control program, the NPDES permitting program. Section 502(14) excludes agricultural storm water and return flows from irrigated agriculture from the definition of point source, and section 402(l) limits applicability of the section 402 permit program for return flows from irrigated agriculture, as well as for storm water runoff from certain oil, gas, and mining operations. Unlike sections 502(14) and 402(l), EPA does not interpret CWA section 402(p)(6) as an express provision limiting the authority to designate point sources of storm water for regulation on a case-by-case basis after the promulgation of final regulations. Any source of storm water discharge is encouraged to assess its potential for storm water contamination and take preventive measures against contamination. Such proactive actions could result in the avoidance of future regulation.

One comment was received requesting clarification of the term "non-municipal" in § 122.26(a)(9)(ii). The commenter is concerned that the term "non-municipal," in this context, implies that municipally owned or operated facilities cannot be designated. The term "non-municipal" in this context refers to the universe of unregulated industrial and commercial facilities that could potentially be designated according to § 122.26(a)(9)(i) authority. There is no exemption for municipally owned or operated facilities under these designation provisions.

Finally, EPA received comments and evaluated the proposal under which operators of regulated small, medium, and large MS4s would be responsible for controlling discharges from industrial and other facilities into their systems in lieu of requiring NPDES permit coverage for such facilities. EPA did not adopt this framework due to concerns with administrative and technical burden on the MS4 operators, as well as concerns about such an intergovernmental mandate.

J. Conditional Exclusion for "No Exposure" of Industrial Activities and Materials to Storm Water

1. Background

In 1992, the Ninth Circuit court remanded to EPA for further rulemaking, a portion of the definition of "storm water discharge associated with industrial activity" that excluded the category of industrial activity identified as "light industry" when industrial materials and/or activities were not exposed to storm water. See *NRDC* v. *EPA*, 966 F.2d 1292, 1305 (9th Cir. 1992). Today's final rule responds to that remand. In the 1990 storm water regulations, EPA excluded the light industry category from the requirement for an NPDES permit if the industrial materials and/or activities were not "exposed" to storm water (see § 122.26(b)(14)). The Agency had reasoned that most of the activity at these types of facilities takes place indoors and that emissions from stacks, use of unhoused manufacturing equipment, outside material storage or disposal, and generation of large amounts of dust or particles would be atypical (55 FR 48008, November 16, 1990).

The Ninth Circuit determined that the exemption was arbitrary and capricious for two reasons. First, the court found that EPA had not established a record to support its assumption that light industry that was not exposed to storm water was not "associated with industrial activity," particularly when other types of industrial activity not exposed to storm water remained "associated with industrial activity." The court specifically found that "[t]o exempt these industries from the normal permitting process based on an unsubstantiated assumption about this group of facilities is arbitrary and capricious." Second, the court concluded that the exemption impermissibly "altered the statutory scheme" for permitting because the exemption relied on the unverified judgment of the light industrial facility operator to determine non-applicability of the permit application requirements. In other words, the court was critical that the operator would determine for itself that there was "no exposure" and then simply not apply for a permit without any further action. Without a basis for ensuring the effective operation of the permitting scheme—either that facilities would self-report actual exposure or that EPA would be required to inspect and monitor such facilities—the court vacated and remanded the rule to EPA for further rulemaking.

One of the major concerns expressed by the FACA Committee, was that EPA streamline and reinvent certain troublesome or problematic aspects of the existing permitting program for storm water discharges. One area identified was the mandatory applicability of the permitting program to all industrial facilities, even those "light industrial" activities that are of very low risk or of no risk to storm water contamination. Such dischargers may not have any industrial sources of storm water contamination on the plant site, yet they are still required to apply for an NPDES storm water permit and meet all permitting requirements. Examples of such facilities are a soap manufacturing plant (SIC Code 28) or hazardous waste treatment and disposal facility, where all industrial activities, even loading docks, are inside a building or under a roof.

Although they did not provide a written report, the FACA Committee members advised EPA that the existing storm water program should be revised to allow such facilities to seek an exclusion from the NPDES storm water permitting requirements. The Committee agreed that such an exclusion should also provide a strong incentive for other industrial facilities that conduct industrial activities outdoors to move the activities under cover or into buildings to prevent contamination of rainfall and storm water runoff. The committee believed that such a "no exposure" permit exclusion could be a valuable incentive for storm water pollution prevention.

In today's final rule, the Agency responds to both of the bases for the court's remand. The exclusion from permitting based on "no exposure" applies to all industrial categories listed in the existing storm water regulations except construction. The court's opinion rejected EPA's distinction between light industry and other industry, but it did not preclude an interpretation that treats all "non-exposed" industrial facilities in the same fashion. Presuming that an industrial facility adequately prevents exposure of industrial materials and activities to storm water, today's rule treats discharges from "non-exposed" industrial facilities in a manner similar to the way Congress intended for discharges from administrative buildings and parking lots. Specifically, permits will not be required for storm water discharges from these facilities on a categorical basis.

To assure that discharges from industrial facilities really are similar to discharges from administrative buildings and parking lots, and to respond to the second basis for the court's remand, the permitting exclusion is "conditional". The person responsible for a point source discharge from a "no exposure" industrial source must meet the conditions of the exclusion, and complete, sign and submit the certification to the permitting authority for tracking and

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accountability purposes. EPA believes today's rule, therefore, is fully consistent with the direction provided by the court.

EPA relied upon the "no exposure" concept discussed by the FACA Committee in developing the "no exposure" provisions of today's rule. EPA is deleting the sentence regarding "no exposure" for the facilities in § 122.26(b)(14)(xi) and adding a new § 122.26(g) titled "Conditional Exclusion for No Exposure of Industrial Activities to Storm Water." The "no exposure" provision will make storm water discharges from all classes of industrial facilities eligible for exclusion, except storm water discharges from regulated construction activities. Regulated construction activities cannot claim "no exposure" because the main pollutants of concern (*e.g.*, sediment) generally cannot entirely be sheltered from storm water.

Today's rule represents a significant expansion in the scope of the "no exposure" provision originally promulgated in the 1990 rule, which was only for storm water discharges from light industry. The intent of today's "no exposure" provision is to provide a simplified method for complying with the CWA to all industrial facilities that are entirely indoors. This includes facilities that are located within a large office building, or at which the only items permanently exposed to precipitation are roofs, parking lots, vegetated areas, and other non-industrial areas or activities.

EPA received several comments related to storm water runoff from parking lots, roof tops, lawns, and other non-industrial areas of an industrial facility. Storm water discharges from these areas, which may contain pollutants or which may result in additional storm water flows, are not directly regulated under the existing storm water permitting program because they are not "storm water discharges associated with industrial activity". Many comments on this issue supported maintaining the exclusion from the existing regulations for storm water permitting for discharges from administrative buildings, parking lots, and other non-industrial areas. Other comments opposed allowing the continued exclusion for discharges from non-industrial areas of the site because discharges from these areas are potentially a significant cause of receiving water impairment. These comments urged that such discharges should not be excluded from NPDES permit coverage. Today's rule does not require permit coverage for discharges from a facility's exposed areas that are separate from industrial activities such as runoff from office buildings and accompanying parking lots, lawns and other non-industrial areas. This approach is consistent with the existing storm water rules which were based on Congress's intent to exclude non-industrial areas such as "parking lots and administrative and employee buildings." 133 Cong. Rec. 985 (1987). EPA also lacks data indicating that discharges from these areas at an industrial facility cause significant receiving water impairments. Therefore, the non-industrial areas at a facility do not need to be assessed as part of the "no exposure" certification.

EPA received comments related to industrial facilities that achieve "no exposure" by constructing large amounts of impervious surfaces, such as roofs, where previously there were pervious or porous surfaces into which storm water could infiltrate. Some commenters made the point that large amounts of impervious area may cause a significant increase in storm water volume flowing off the industrial facility, and thus may cause adverse receiving water impacts simply due to the increased quantity of storm water flow. Some commenters said that storm water discharges from impervious areas at an industrial facility are generally more frequent, and often larger, than discharges from the pre-existing natural surfaces. They believe that these discharges will contain pollutants typical of commercial areas and roads and are an equal threat to direct human uses of the water and can cause equal damage to aquatic life and its habitat. Other commenters believe that if Congress or EPA addresses the issue of flow, it should be addressed on a broader scale than merely through the "no exposure" exclusion, and that EPA has no authority under any existing legal framework to regulate flow directly. Some commenters stated that developing federal parameters for the control of water quantity, *i.e.* flow, would result in federal intrusion into land use planning, an authority that they claim is solely within the purview of State governments and their political subdivisions.

EPA is not attempting to regulate flow via the "no exposure" provisions. EPA does agree, however, that increases in impervious surfaces can result in increased runoff volumes from the site which in turn may increase pollutant loading. In addition, the Agency notes that in some States water quality standards include water quality criteria for flow or turbidity. Therefore, in order to provide a minimal amount of information on possible impacts from increased pollutant loading and runoff volume, EPA's "no exposure" certification form (see Appendix 4) asks the discharger to indicate if they have paved or roofed over a formerly exposed, pervious area in order to qualify for the "no exposure" exclusion. If the answer is yes, the discharger must indicate, by choosing from three possible responses, approximately how much impervious area was created to achieve "no exposure". The choices are: (1) less than 1 acre, (2) 1 to 5 acres, and (3) more than 5 acres. This requirement provides additional information that will aid in determining if discharges from the facility are causing adverse receiving water impacts. EPA intends to prevent water quality impacts resulting from increased discharges of pollutants, which may result from increased volume of runoff. In many cases, consideration of the increased flow rate, velocity and energy of storm water discharges, following construction of large amounts of impervious surfaces, must be taken into consideration in order to reduce the discharge of pollutants, to meet water quality standards and to prevent degradation of receiving streams. EPA recommends that dischargers consider these factors when making modifications to their site in order to qualify for the "no exposure" exclusion.

2. Today's Rule

In order to claim relief under the "no exposure" provision, the discharger of an otherwise regulated facility must submit a no exposure certification that incorporates the questions of § 122.26(g)(4)(iii) to the NPDES permitting authority once every 5 years. This provision applies across all categories of industrial activity covered by the existing program, except discharges from construction activities.

In addition to submitting a "no exposure" certification every 5 years, the facility must allow the NPDES permitting authority or operator of an MS4 (where there is a storm water discharge to the MS4) to inspect the facility and to make such inspection reports publicly available upon request. Also, upon request, the facility must submit a copy of the "no exposure" certification to the operator of the MS4 into which the facility discharges (if applicable). All "no exposure" certifications must be signed in accordance with the signatory requirements of § 122.22. The "no exposure" certification is non-transferable. In the event that the facility operator changes, the new discharger must submit a new "no exposure" certification.

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Members of the FACA Committee urged that EPA not allow dischargers certifying "no exposure" to take actions to qualify for this provision that result in a net environmental detriment. In developing a regulatory implementation mechanism, however, EPA found that the phrase "no net environmental detriment," was too imprecise to use within this context. Therefore, today's rule addresses this issue by requiring information that should help the permitting authority to determine whether actions taken to qualify for the exclusion interfere with the attainment or maintenance of water quality standards, including designated uses. Permitting authorities will be able, where necessary, to make a determination by evaluating the activities that changed at the industrial site to achieve "no exposure", and assess whether these changes cause an adverse impact on, or have the reasonable potential to cause an instream excursion of, water quality standards, including designated uses. EPA anticipates that many efforts to achieve "no exposure" will employ simple good housekeeping and contaminant cleanup activities. Other efforts may involve moving materials and industrial activities indoors into existing buildings or structures.

In very limited cases, industrial operators may make major changes at a site to achieve "no exposure". These efforts may include constructing a new building or cover to eliminate exposure or constructing structures to prevent run-on and storm water contact with industrial materials or activities. Where major changes to achieve "no exposure" increase the impervious area of the site, the facility operator must provide this information on the "no exposure" certification form as discussed above. Using this and other available data and information, permitting authorities should be able to assess whether any major change has resulted in increased pollutant concentrations or loadings, toxicity of the storm water runoff, or a change in natural hydrological patterns that would interfere with the attainment and maintenance of water quality standards, including designated uses or appropriate narrative, chemical, biological, or habitat criteria where such State or Tribal water quality standards exist. In these instances, the facility operator and their NPDES permitting authority should take appropriate actions to ensure that attainment or maintenance of water quality standards can be achieved. The NPDES permitting authority should decide if the facility must obtain coverage under an individual or general permit to ensure that appropriate actions are taken to address adverse water quality impacts.

While the intent of today's "no exposure" provision is to reduce the regulatory burdens on industrial facilities and government agencies, the FACA Committee suggested that the NPDES permitting authority consider a compliance assessment program to ensure that facilities that have availed themselves of this "no exposure" option meet the applicable requirements. Inspections could be conducted at the discretion of the NPDES authority and be coordinated with other facility inspections. EPA expects, however, that the permitting authority will conduct inspections when it becomes aware of potential water quality impacts possibly caused by the facility's storm water discharges or when requested to do so by adversely affected members of the public. The intent of this provision is that the 5 year "no exposure" certification be fully available to, and enforceable by, appropriate federal and State authorities under the CWA. Private citizens can enforce against facilities for discharges of storm water that are inconsistent with a "no exposure" certification if storm water discharges from such facilities are not otherwise permitted and in compliance with applicable requirements.

EPA received comments from owners, operators and representatives of Phase I facilities classified as "light industry" as defined by the regulations at § 122.26(b)(14)(xi). The comments recommended maintaining the approach of the existing regulations which does not require the discharger to submit any supporting documentation to the permitting authority in order to claim the "no exposure" exclusion from permitting. As discussed previously, the "no exposure" concept was developed in response to the Ninth Circuit court's remand of part of the existing rules back to EPA. The court found that EPA cannot rely on the "unverified judgment" of the facility. The comments opposing documentation did not address the "unverified judgment" concern.

Today's rule is a "conditional" exclusion from permitting which requires all categories, including the "light industrial" facilities that have no exposure of materials to storm water, to submit a certification to the permitting authority. Upon receipt of a complete certification, the permitting authority can review the information, or call, or inspect the facility if there are doubts about the facility's "no exposure" claim. Also, if the facility discharges into an MS4, the operator of the MS4 can request a copy of the certification, and can inspect the facility. The public can request a copy of the certification and/or inspection reports. In adopting these conditional "no exposure" provisions, the Agency addressed the Ninth Circuit court's ruling regarding the discharger's unverified judgment.

EPA received one comment requesting clarification on whether the anti-backsliding provisions in the regulations at § 122.44(l) apply to industrial facilities that are currently covered under an NPDES storm water permit, and whether such facilities could qualify for the "no exposure" exclusion under today's rule. The anti-backsliding provisions will not prevent most industrial facilities that can certify "no exposure" under today's rule from qualifying for an exclusion from permitting. The anti-backsliding provisions contain 5 exceptions that allow permits to be renewed, reissued or modified with less stringent conditions. One exception at § 122.44(l)(2)(A) allows less stringent conditions if "material and substantial alterations or additions to the permitted facility occurred after permit issuance which justify the application of a less stringent effluent limitation." Section 122.44(l)(B)(1) also allows less stringent requirements if "information is available which was not available at the time of permit issuance and which would have justified the application of less stringent effluent limitations at the time of permit issuance." Facility's operators who certify "no exposure" and submit the required information once every 5 years will have provided the permitting authority "information that was not available at the time of permit issuance." Also, some facilities may, in order to achieve "no exposure", make "material and substantial alterations or additions to the permitted facility." Therefore, most facilities covered under existing NPDES general permits for storm water (e.g., EPA's Multi-Sector General Permit) will be eligible for the conditional "no exposure" exclusion from permitting without concern about the anti-backsliding provisions. Such dischargers will have met one or both of the anti-backsliding exceptions detailed above. Facilities that are covered under individual permits containing numeric limitations for storm water should consult with their permitting authority to determine whether the anti-backsliding provisions will prevent them from qualifying for the exclusion from permitting (for that discharge point) based on a certification of "no exposure".

EPA received several comments regarding the timing of when the "no exposure" certification should be submitted. The proposed rule said that the "no exposure" certification notice must be submitted "at the beginning of each permit term or prior to commencing discharges during a permit term." Some commenters interpreted this statement to mean that existing facilities can only submit the certification at the time a permit is being issued or renewed. EPA intended the phrase "at the beginning of each permit term" to mean "once every 5 years" and today's rule reflects this clarification. EPA envisions that the NPDES storm water program will be implemented primarily through general permits which are issued for a 5 year term. Likewise the "no exposure" certification term is 5 years. The NPDES permitting authority will maintain a simple registration list that should impose only a minor administrative burden on the permitting authority. The registration list will allow for tracking of industrial facilities claiming the exclusion. This change allows a facility to submit a "no exposure" certification at any time during the term of the permit, provided that a new certification is submitted every 5 years from the time it is first submitted (assuming that the facility maintains a "no exposure" status). Once a discharger has established that the facility meets the definition of "no exposure", and submits the necessary "no exposure" certification, the discharger must maintain their "no exposure" status. Failure to maintain "no exposure" at their facility could result in the unauthorized discharge of pollutants to waters of the United States and enforcement for violation of the CWA. Where a discharger believes that exposure could occur in the future due to some anticipated change at the facility, the discharger should submit an application and obtain coverage under an NPDES permit prior to such discharge to avoid penalties.

Where EPA is the permitting authority, dischargers may submit a "no exposure" certification at any time after the effective date of today's rule. Where EPA is not the permitting authority, dischargers may not be able to submit the certification until the non-federal permitting authority completes any necessary statutory or regulatory changes to adopt this "no exposure" provision. EPA recommends that the discharger contact the permitting authority for guidance on when the "no exposure" certification should be submitted.

EPA received comments on the proposed rule requirement that the discharger "must comply immediately with all the requirements of the storm water program including applying for and obtaining coverage under an NPDES permit," if changes occur at the facility which cause exposure of industrial activities or materials to storm water. The comments expressed the difficultly of immediate compliance. EPA expects that most facility changes can be anticipated, therefore dischargers should apply for and obtain NPDES permit coverage in advance of changes that result in exposure to industrial activities or materials. Permitting authorities may grant additional time, on a case-by-case basis, for preparation and implementation of a storm water pollution prevention plan.

Finally, today's rule at § 122.26(g)(4) includes the information which must be included on the "no exposure" certification. Authorized States, Tribes or U.S. Territories may develop their own form which includes this required information, at a minimum. EPA adopted the requirements (with modification) from the draft "No Exposure Certification Form" published as an appendix to the proposed rule. Modifications were made to the draft form to address comments received and to streamline the required information. EPA included these certification requirements in today's rule in order to preserve its integrity. Dischargers in areas where EPA is the permitting authority should use the "No Exposure Certification" form included in Appendix 4.

3. Definition of "No Exposure"

For purposes of this section, "no exposure" means that all industrial materials or activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snowmelt, and/or runoff. Industrial materials or activities include, but are not limited to, material handling equipment or activities, industrial machinery, raw materials, intermediate products, by-products, final products, or waste products. Material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, final product or waste product. However, storm resistant shelter is not required for: (1) Drums, barrels, tanks, and similar containers that are tightly sealed, provided those containers are not deteriorated and do not leak; (2) adequately maintained vehicles used in material handling; and (3) final products, other than products that would be mobilized in storm water discharge (e.g., rock salt). Each of these three exceptions to the no exposure definition are discussed in more detail below.

EPA intends the term "storm resistant shelter" to include completely roofed and walled buildings or structures, as well as structures with only a top cover but no side coverings, provided material under the structure is not otherwise subject to any run-on and subsequent runoff of storm water. While the Agency intends that this provision promote permanent "no exposure", EPA understands that certain vehicles could pass between buildings and, during passage, be exposed to rain and snow. Adequately maintained vehicles such as trucks, automobiles, forklifts, or other such general purpose vehicles at the industrial site that are not industrial machinery, and that are not leaking contaminants or are not otherwise a source of industrial pollutants, could be exposed to precipitation or runoff. Such activities alone does not prevent a discharger from being able to certify no exposure under this provision. Similarly, trucks or other vehicles awaiting maintenance at vehicle maintenance facilities, as defined at § 122.26(b)(14)(viii), that are not leaking contaminants or are not otherwise a source of industrial pollutants, are not considered exposed.

In addition, EPA recognizes that there are circumstances where permanent "no exposure" of industrial activities or materials is not possible. Under such conditions, materials and activities may be sheltered with temporary covers, such as tarps, between periods of permanent enclosure. The final rule does not specify every such situation. EPA intends that permitting authorities will address this issue on a case-by-case basis. Permitting authorities can determine the circumstances under which temporary structures will or will not meet the requirements of this section. Until permitting authorities specifically determine otherwise, EPA recommends application of the "no exposure" exclusion for temporary sheltering of industrial materials or activities only during facility renovation or construction, provided that the temporary shelter achieves the intent of this section. Moreover, "exposure" that results from a leak in protective covering would only be considered "exposure" if not corrected prior to the next storm water discharge event. EPA received one comment requesting that this allowance for temporary shelter be limited to facility renovation or construction directly related to the industrial activity requiring temporary shelter, and be scheduled to minimize the use of temporary shelter. Another comment suggested placing time limits

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on the use of temporary shelter. The commenter did not recommend a specific time period, rather the comment said that renovation in some instances may take years, and that EPA should not allow temporary shelter over prolonged periods. EPA agrees that the use of temporary shelter must be related to the renovation or construction at the site, and be scheduled or designed to minimize the use of temporary shelter. Further, EPA agrees that the use of temporary shelter should be limited in duration, but does not intend to define "temporary" or "prolonged period".

Many final products are intended for outdoor use and pose little risk of storm water contamination, such as new cars. Therefore, final products, except those that can be mobilized in storm water discharge, can be "exposed" and still allow the discharge to certify "no exposure". EPA intends the term "final products" to mean those products that are not used in producing another product. Any product that can be used to make another product is considered an "intermediate product." For example, a facility that makes horse trailers can store the finished trailers outdoors as a final product. The storage of those final products does not prevent eligibility to claim "no exposure". However, any facility that makes parts for the horse trailers (e.g., metal tubing, sheet metal, paint) is not eligible for the "no exposure" exclusion from permitting if those "intermediate products" are stored outdoors (i.e., "exposed").

EPA received comments related to materials in drums, barrels, tanks and similar containers. Some comments objected to the language in the preamble to the proposed rule that would have recommended that the "exposure" determination for drums and barrels be based on the "potential to leak." Those comments said that all drums and barrels have the potential to leak, thereby making certification impossible. They recommended allowing outdoor storage of drums and barrels except for those that "are leaking" at the time of certification. Other comments suggested allowing drums and barrels to be stored outside only if the drums and barrels: are empty; have secondary containment; or there is a spill contingency plan in place. Opposing comments suggested that allowing outdoor exposure of drums and barrels, based on existing integrity and condition, is inconsistent with the "however packaged" proposed rule language, and also would not satisfy the Ninth Circuit remand. The comments point out that the former rule was invalidated by the court in part because it relied on the "unverified judgment" of the light industrial facility operator to determine the non-applicability of the permit requirements, and that allowing the facility operator to determine the condition of their drums and barrels would result in the same flaw.

In response, EPA believes that drums and barrels that are stored outdoors pose little risk of storm water contamination unless they are open, deteriorated or leaking. The Agency has modified today's rule accordingly. EPA intends the term "open" to mean any container that is not tightly sealed and "sealed" to mean banded or otherwise secured and without operational taps or valves. Drums, barrels, tanks, and similar containers may only be *stored* outdoors under this conditional exclusion. The addition of material to or withdrawing of material from these containers while outside is deemed "exposure". Moving the containers while outside does not create "exposure" provided that the containers are not open, deteriorated or leaking. In order to complete the "no exposure" certification, a facility operator must inspect all drums, barrels, tanks or other containers stored outside to ensure that they are not open, deteriorated, or leaking. EPA recommends that the discharger designate someone at the facility to conduct frequent inspections to verify that the drums, barrels, tanks or other containers remain in a condition such that they are not open, deteriorated or leaking. Drums, barrels, tanks or other containers stored outside that have valves which are used to put material in or take material out of the container, and that have dripped or may drip, are considered to be "leaking" and must be under a storm resistant shelter in order to qualify for the no exposure exclusion. Likewise, leaking pipes containing contaminants exposed to storm water are deemed "exposed." If at any time drums, barrels, tanks or similar containers are opened, deteriorated or leaking, the discharger should take immediate actions to close or replace the container. Any resulting unpermitted discharge would violate the CWA. The Director, the operator of the MS4, or the municipality may inspect the facility to verify that all of the applicable areas meet the "no exposure" conditions as specified in the rule language. In requiring submission of the conditional "no exposure" certification and allowing the permitting authority and the operator of the MS4 to inspect the facility, today's rule does not rely on the unverified judgment of the facility to determine that the no exposure provision is being met.

EPA received several comments related to trash dumpsters that are located outside. The preamble to the proposed rule listed dumpsters in the same grouping as drums and barrels, which based exposure on the "potential to leak". Today's rule distinguishes between dumpsters and drums/barrels. In the Phase I Question and Answer document (volume 1, question 52) the Agency noted that a covered dumpster containing waste material that is kept outside is not considered "exposed" as long as "the container is completely covered and nothing can drain out holes in the bottom, or is lost in loading onto a garbage truck." EPA affirms this approach today. Industrial refuse and industrial trash that is left uncovered is deemed "exposed."

For purposes of this provision, particulate matter emissions from roof stacks/vents that are regulated and in compliance under other environmental protection programs, such as air quality control programs, and that do not cause storm water contamination, are considered "not exposed." EPA received comments on the phrase in the draft "no exposure" certification form that asked whether "particulate emissions from roof stacks/vents not otherwise regulated, and in quantities detectable in the storm water outflow," are exposed to precipitation. One comment expressed concern that the phrase "in quantities detectable in the storm water outflow" implies that the facility must conduct monitoring prior to completing the checklist, and must continue to monitor after receiving the no exposure exclusion, in order to be able to verify compliance with the no exposure provision. Another comment said that current measurement technology allows detection of pollutants at levels that may not cause environmental harm. EPA does not intend to require monitoring of runoff from facilities with roof stacks/vents prior to or after completing and submitting the no exposure certification. EPA has thus replaced the phrase "in quantities detectable" with "evident" to convey the message that emissions from some roof stacks/vents have the potential to contaminate storm water discharges in quantities that are considered significant or that cause or contribute to a water quality standards violation. In those instances where the permitting authority determines that particulate emissions from facility roof stacks/vents are a significant contributor of pollutants or contributing to water quality violations, the permitting authority may require the discharger to apply for and obtain coverage under a permit. Visible deposits of residuals (*e.g.*, particulate matter) near roof or side vents are considered "exposed". Likewise, visible "track out" (*i.e.*, pollutants carried on the tires of vehicles) or windblown raw materials are deemed "exposed."

EPA received a comment requesting an allowance under the "no exposure" provision for industrial facilities with several outfalls at a site where some, but not all of the outfalls drain non-exposed areas. The commenter provided an example of an industrial facility that has 5 outfalls draining different areas of the site, where two of those outfalls drain areas where industrial activities or materials are not exposed to storm water. The comment requested that the facility in this example be allowed to submit a "no exposure" certification in order to be relieved of permitting obligations for discharges from those two outfalls.

EPA agrees, but the comment would be implemented on an outfall-by-outfall basis in the permitting process, not through the "no exposure" exclusion. The "no exposure" provision was developed to allow exclusion from permitting of discharges from entire industrial facilities (except construction), based on a claim of "no exposure" for all areas of the facility where industrial materials or activities occur. Where exposure to industrial materials or activities exist at some but not all areas of the facility, the "no exposure" exclusion from permitting is not allowed because permit coverage is still required for storm water discharges from the exposed areas. Relief from permit requirements for outfalls draining non-exposed areas should be addressed through the permit process, in coordination with the permitting authority. Most NPDES general permits for storm water discharge provide enough flexibility to allow minimal or no requirements for non-exposed areas at industrial facilities. If the permitting authority determines that additional flexibility is needed for this scenario, the permits could be modified as necessary.

K. Public Involvement/Public Role

The Phase II FACA Subcommittee discussed the appropriate role of the public in successful implementation of a municipal storm water program. EPA believes that an educated and actively involved public is essential to a successful municipal storm water program. An educated public increases program compliance from residents and businesses as they realize their individual and collective responsibility for protecting water resources (*e.g.*, the residents and businesses could be subject to a local ordinance that prohibits dumping used oil down storm sewers). Finally, the program is also more likely to receive public support and participation when the public is actively involved from the program's inception and allowed to participate in the decision making process.

In a time of limited staff and financial resources, public volunteers offer diverse backgrounds and expertise that may be used to plan, develop, and implement a program that is tailored to local needs (*e.g.*, participate in public meetings and other opportunities for input, perform lawful volunteer monitoring, assist in program coordination with other preexisting and related programs, aid in the development and distribution of educational-materials, and provide public training activities). The public's participation is also useful in the areas of information dissemination/education and reporting of violators, where large numbers of community members can be more effective than a few regulators.

The public can also petition the NPDES permitting authority to require an NPDES permit for a discharge composed entirely of storm water that contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States. In evaluating such a petition, the NPDES permitting authority is encouraged to consider the set of designation criteria developed for the evaluation of small MS4s located outside of an urbanized area in places with a population of at least 10,000 and a population density of 1,000 or more. Furthermore, any person can protect water bodies by taking civil action under section 505 of the CWA against any person who is alleged to be in violation of an effluent standard or permit condition. If civil action is taken, EPA encourages citizen plaintiffs to resolve any disagreements or concerns directly with the parties involved, either informally or through any available alternative dispute resolution process.

EPA recognizes that public involvement and participation pose challenges. It requires a substantial initial investment of staff and financial resources, which could be very limited. Even with this investment, the public might not be interested in participating. In addition, public participation could slow down the decision making process. However, the benefits are numerous.

EPA encourages members of the public to contact the NPDES permitting authority or local MS4s operator for information on the municipal storm water program and ways to participate. Such information may also be available from local environmental, nonprofit and industry groups.

Some commenters stressed the need to suggest to the public that they have a responsibility to fund the municipal storm water program. While EPA believes it is important that the program be adequately funded, today's rule does not address appropriate mechanisms or levels for such funding.

EPA received comments expressing concern that considerable public involvement requirements could result in increased litigation. EPA is not convinced there is a correlation between meaningful public education programs and any increased probability of litigation.

Finally, EPA received comments stating that the Agency should not en courage volunteer monitoring unless proper procedures are followed. EPA agrees. EPA encourages only lawful monitoring, *i.e.*, obtaining the necessary approval if there is any question about lawful access to sites. Moreover, as a matter of good practice and to enhance the validity and usefulness of the results, any party, public or private, conducting water quality monitoring is encouraged to use appropriate quality control procedures and approved sampling and analytic methods.

L. Water Quality Issues

1. Water Quality Based Effluent Limits

In addition to technology based requirements, all point source discharges of industrial storm water are subject to more stringent NPDES permitting requirements when necessary to meet water quality standards. CWA sections 402(p)(3)(A) and 301(b)(1)(C). For municipal separate storm sewers, EPA or the State may determine that other permit provisions (*e.g.* one of the minimum measures) are appropriate to protect water quality and, for discharges to impaired waters, to achieve reasonable further progress toward attainment of water quality standards pending implementation of a TMDL. CWA section 402(p)(3)(B)(iii). See *Defenders of Wildlife, et al. Browner*, No. 98–71080 (9th cir., August 11, 1999). Discharges of storm water also must comply with applicable antidegradation policies and implementation methods to maintain and protect water quality. 40 CFR 131.12. Section 122.34(a) emphasizes this point by specifically noting that a storm water management program designed to reduce the discharge of pollutants from the storm sewer system "to the maximum extent practicable" is also designed to protect water quality.

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Permits issued to non-municipal sources of storm water must include water quality-based effluent limits where necessary to meet water quality standards.

Commenters challenged EPA's interpretation of the CWA as requiring water quality-based effluent limits for MS4s when necessary to protect water quality. Commenters asserted that CWA 402(p)(3)(B), which addresses permit requirements for municipal discharges, limits the scope of municipal program requirements to an effective prohibition on non-storm water discharges to a separate storm sewer and to controls which reduce pollutants to the "maximum extent practicable, including management practices, control techniques and system design and engineering methods." They asserted that the final rule should clarify that neither numeric nor narrative water quality-based limits are appropriate or authorized for MS4s.

EPA disagrees that section 402(p)(3) divests permitting authorities of the tools necessary to issue permits to meet water quality standards. Section 402(p)(3)(B)(iii) specifically preserves the authority for EPA or the State to include other provisions determined appropriate to reduce pollutants in order to protect water quality. *Defenders of Wildlife*, slip op. at 11688. Small MS4s regulated under today's rule are designated under CWA 402(p)(6) "to protect water quality."

Commenters argued that water quality standards, particularly numeric criteria, were not designed to address storm water discharges. The episodic nature and magnitude of storm water events, they argue, make it impossible to apply the "end of pipe" compliance assessment approach, for example, in the development of water quality based effluent limits.

EPA's disagrees with the commenters arguments about the inability of water quality criteria to address high flow conditions. Today's final rule does, however, address the concern that numeric effluent limits will necessitate end of pipe treatment and the need to provide a workable alternative.

Today's rule was developed under the approach outlined in the Interim Permitting Policy for Water Quality-Based Effluent Limitations in Storm Water Permits, issued on August 1, 1996. 61 FR 43761 (November 26, 1996) (the "Interim Permitting Policy"). EPA intends to issue NPDES permits consistent with the Interim Permitting Policy, which provides as follows:

In response to recent questions regarding the type of water quality-based effluent limitations that are most appropriate for NPDES storm water permits, EPA is adopting an interim permitting approach for regulating wet weather storm water discharges. Due to the nature of storm water discharges, and the typical lack of information on which to base numeric water quality-based effluent limitations (expressed as concentration and mass), EPA will use an interim permitting approach for NPDES storm water permits.

"The interim permitting approach uses best management practices (BMPs) in first-round storm water permits, and expanded or better-tailored BMPs in subsequent permits, where necessary, to provide for the attainment of water quality standards. In cases where adequate information exists to develop more specific conditions or limitations to meet water quality standards, these conditions or limitations are to be incorporated into storm water permits, as necessary and appropriate. This interim permitting approach is not intended to affect those storm water permits that already include appropriately derived numeric water quality-based effluent limitations. Since the interim permitting approach only addresses water quality-based effluent limitations, it also does not affect technology-based effluent limitations, such as those based on effluent limitations guidelines or developed using best professional judgment, that are incorporated into storm water permits.

"Each storm water permit should include a coordinated and cost-effective monitoring program to gather necessary information to determine the extent to which the permit provides for attainment of applicable water quality standards and to determine the appropriate conditions or limitations of subsequent permits. Such a monitoring program may include ambient monitoring, receiving water assessment, discharge monitoring (as needed), or a combination of monitoring procedures designed to gather necessary information.

"This interim permitting approach applies only to EPA; however, EPA also encourages authorized States and Tribes to adopt similar policies for storm water permits. This interim permitting approach provides time, where necessary, to more fully assess the range of issues and possible options for the control of storm water discharges for the protection of water quality. This interim permitting approach may be modified as a result of the ongoing Urban Wet Weather Flows Federal Advisory Committee policy dialogue on this subject."

One commenter challenged the Interim Permitting Policy on a procedural basis, arguing that it was published without opportunity for public notice and comment. In response, EPA notes that the Policy was included verbatim and made available for public comment in the proposal to today's final rule. Prior to that proposal, the Agency defended the application of the Policy on a case-by-case basis in individual permit proceedings. Moreover, the essential elements of the Policy—that narrative effluent limitations are the most appropriate form of effluent limitations for storm water dischargers from municipal sources—was inherent in § 122.34(a) of the proposed rule, and was the subject of extensive public comment. In any event, the Policy does not constitute a binding obligation. It is policy, not regulation.

Consistent with the recognition of data needs underlying the Policy, EPA will evaluate the small MS4 storm water regulations after the second round of permit issuance. Section 122.34(e)(2) of today's rule expressly provides that for the interim ten-year period, "EPA strongly recommends that until the evaluation of the storm water program in § 122.37, no additional requirements beyond the minimum control measures be imposed on regulated small MS4s without the agreement of the operator of the affected small MS4, except where an approved TMDL or equivalent analysis provides adequate information to develop more specific measures to protect water quality." This approach addresses the concern for protecting water resources from the threat posed by storm water discharges with the important qualification that there must be adequate information on the watershed or a specific site as a basis for requiring tailored storm water controls beyond the minimum control measures. As indicated, the Interim Permitting Policy has several important limitations—it does not apply to technology-based controls or to sources that already have numeric end of pipe effluent limitations. EPA encourages authorized States and Tribes to adopt policies similar to the Interim Permitting Policy when developing storm water discharge programs. For a discussion of appropriate monitoring activities, see Section H.3.d., Evaluation and Assessment.

Where a water quality analysis indicates there is a need and basis for deriving water quality-based effluent limits in NPDES permits for storm water discharges regulated under today's rule, EPA believes that most of these cases would be satisfied by narrative effluent limitations that require the implementation of BMPs. NPDES permit limits will in most cases continue to be based on the specific approach outlined in today's rule for the implementation of BMPs as the most appropriate form of effluent limitation to satisfy technology and water quality-based requirements. See § 122.34(a). For storm water management plans with existing BMPs, this may require further tailoring of BMPs to address the pollutant(s) of concern, the nature of the discharge and the receiving water. If the permitting authority determines that, through implementation of appropriate BMPs required by the NPDES storm water permit, the discharge has the necessary controls to provide for attainment of water quality standards, additional controls are not needed in the permit. Conversely, if a discharger (MS4, industrial or construction) fails to adopt and implement adequate BMPs, the permittee and/or the permitting authority should consider a different mix of BMPs or more specific conditions to ensure water quality protection.

Some commenters observed that there was no evidence from the experience of storm water dischargers regulated under the existing NPDES storm water program, or from studies or reports that allegedly support EPA's position, that implementation of BMPs to satisfy the six minimum control measures would meet applicable water quality standards for a regulated small MS4. In response, EPA acknowledges that the six minimum measures are intended to implement the statutory requirement to control discharges to the maximum extent practicable, and they may not result in the attainment of water quality standards in all cases. The control measures do, however, focus on and address well-documented threats to water quality associated with storm water discharges. Based on the collective expertise of the FACA Subcommittee, EPA believes that implementation of the six minimum measures will, for most regulated small MS4s, be adequate to protect water quality, and for other regulated small MS4s will substantially reduce the adverse impacts of their discharges on water quality.

Some commenters asserted that analyses of existing water quality criteria suggest that numeric criteria for aquatic life may be overprotective if applied to storm water discharges. These comments maintained that an approach that prohibits exceedance of applicable water quality criteria is unworkable. Various commenters recommended wet weather specific criteria, variances to the criteria during wet weather events, and seasonal designated uses. Other commenters noted that water quality-based effluent limits in NPDES permits have traditionally been developed based on dry weather flow conditions (*e.g.*, assuming critical low-flow conditions in the receiving water to ensure protection of aquatic life and human health). Wet weather discharges, however, typically occur under high-flow conditions in the receiving water. Assumptions regarding mass balance equations and size of mixing zones may also not be pertinent during wet weather.

EPA acknowledges the need to devise a regulatory program that is both flexible enough to accommodate the episodic nature, variability and volume of wet weather discharges and prescriptive enough to ensure protection of the water resource. EPA believes that wet weather discharges can be adequately addressed in the existing regulations through refining designated uses and assigning criteria that are tailored to the level of water quality protection described by the refined designated use.

EPA believes that lack of precision in assigning designated uses and corresponding criteria by States and Tribes, in many cases may result in application of water quality criteria that may not appropriately match the intended condition of the water body. States and Tribes have frequently designated uses without regard to site-specific wet weather conditions. Because certain uses (swimming, for example) might not exist during high-intensity storm events or in the winter, States may factor such climatic conditions and seasonal uses into their use designations with appropriate analyses. This would acknowledge that a lower level of control, at lower compliance cost, would be appropriate to protect that use. Before modifying any designated use, however, States would need to evaluate the effect of less stringent water quality criteria on protecting other uses, including any threatened or endangered species, drinking water supplies and downstream uses. EPA will further evaluate these issues in the context of the Water Quality Standards Regulation; Advance Notice of Proposed Rule Making (ANPRM), 63 FR, 36742, July 7, 1998.

One of the major themes presented by EPA in the ANPRM is that refinement in use designations and tailoring of water quality criteria to match refined use designations is an important future direction of the water quality standards program. In assigning criteria to protect general use classifications, a State or Tribe must ensure that the criteria are sufficiently protective to safeguard the full range of waters of the State, *i.e.*, criteria would be based on the most sensitive use. This approach has been disputed, especially for aquatic life uses, where evidence suggests that the general use criteria will require controls more stringent than needed to protect the existing or potential aquatic life community for a specific water body. EPA recognizes that there is a growing need to more precisely tailor use descriptions and criteria to match site-specific conditions, ensuring that uses and criteria provide an appropriate level of protection, which, to the extent possible, are not overprotective. EPA is engaged in an ongoing evaluation of its regulations in this area through the ANPRM effort. At the same time, EPA continues to encourage States and Tribes to review the applicability of the designated uses and associated criteria using existing provisions in the water quality standards regulation.

2. Total Maximum Daily Loads and Analysis To Determine the Need for Water Quality-Based Limitations

The development and implementation of total maximum daily loads (TMDLs) provide a link between water quality standards and effluent limitations. CWA section 303(d) requires States to develop TMDLs to provide more stringent water quality-based controls when technology-based controls are inadequate to achieve applicable water quality standards. A TMDL is the sum of the individual wasteload allocations for point sources and load allocations for nonpoint sources, with consideration for natural background conditions. A TMDL quantifies the maximum allowable loading of a pollutant to a water body and allocates this maximum load to contributing point and nonpoint sources so that water quality criteria will not be exceeded and designated uses will be protected. A TMDL also includes a margin of safety to account for uncertainty about the relationship between pollutant loads and water quality.

Today's final rule refers to TMDLs in several provisions. For the purpose of today's rule, EPA relies on the component of the TMDL that evaluates existing conditions and allocates loads. For discharges to waters that are not impaired and for which a TMDL has not been developed, today's rule also refers to an "equivalent analysis." The discussion that follows uses the term "TMDL" for both.

Under revised § 122.26(a)(9)(i)(C), the permitting authority may designate

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storm water discharges that require NPDES permits based on TMDLs that address the pollutants of concern. For storm water discharges associated with small construction activity, § 122.26(b)(15)(i)(B) provides a waiver provision where it may be determined that storm water controls are not needed based on TMDLs that address sediment and any other pollutants of concern. The NPDES permitting authority may waive requirements under the program for certain small MS4s within urbanized areas serving less than 1,000 persons provided that, if the small MS4 discharges any pollutant that has been identified as a cause of impairment of a water body into which it discharges, the discharge is in compliance with a wasteload allocation in a TMDL for the pollutant of concern. The permitting authority may also waive requirements for MS4s in urbanized areas serving between 1,000 and 10,000 persons, if the permitting authority determines that storm water controls are not needed, as provided in § 123.35(d)(2). See § 122.32(c).

Under CWA section 303(d), States identify which of their water bodies need TMDLs and rank them in order of priority. Generally, once a TMDL has been completed for one or more pollutants in a water body, a wasteload allocation for each point source discharging the pollutant(s) is implemented as an enforceable condition in the NPDES permit. Regulated small MS4s are essentially like other point source discharges for purposes of the TMDL process.

A TMDL and the resulting wasteload allocations for pollutant(s) of concern in a water body may not be available because the water body is not on the State's 303(d) list, the TMDL has not yet been completed, or the TMDL did not include specific pollutants of concern. In these cases, the permitting authority must determine whether point sources discharge pollutant(s) in amounts that cause, have the reasonable potential to cause, or contribute to excursions above State water quality standards, including narrative water quality criteria. This so-called "reasonable potential" analysis is intended to determine whether and for what pollutants water quality based effluent limits are required. The analysis is, in effect, a substitute for a similar determination that would be made as part of a TMDL, where necessary. When "reasonable potential" exists, regulations at § 122.44(d) require a water quality-based effluent limit for the pollutant(s) of concern in NPDES permits. The water quality-based effluent limits may be narrative requirements to implement BMPs or, where necessary, may be numeric pollutant effluent limitations.

Commenters, generally from the regulated community, objected that, due to references to the need to develop a program "to protect water quality" and to additional NPDES permit requirements beyond the minimum control measures based on TMDLs or their equivalent, regulated small MS4s will be subject to uncertain permit limitations beyond the six minimum control measures. Commenters also asserted that through the imposition of a wasteload allocation under a TMDL in impaired water bodies, there is a likelihood that unattainable, yet enforceable narrative and numeric standards will be imposed on regulated small MS4s.

As is discussed in the preceding section, NPDES permits must include any more stringent limitations when necessary to meet water quality standards. However, even if a regulated small MS4 is subject to water quality based effluent limits, such limits may be in the form of narrative effluent limitations that require the implementation of BMPs. As discussed earlier, EPA has adopted the Interim Permitting Policy and incorporated it in the development of today's rule to recognize the appropriateness of BMP-based limits developed on a case-by-case basis.

EPA formed a Federal Advisory Committee to provide advice to EPA on identifying water quality-limited water bodies, establishing TMDLs for them as appropriate, and developing appropriate watershed protection programs for these impaired waters in accordance with CWA section 303(d). Operating under the auspices of the National Advisory Council for Environmental Policy and Technology (NACEPT), the committee produced its *Report of the Federal Advisory Committee on the Total Maximum Daily Load (TMDL) Program* (July 1998). EPA recently published a proposed rule to implement the Report's recommendations (64 FR 46012, August 23, 1999).

3. Anti-Backsliding

In general, the term "anti-backsliding" refers to statutory provisions at CWA sections 303(d)(4) and 402(o) and regulatory provisions at 40 CFR 122.44(l). These provisions prohibit the renewal, reissuance, or modification of an existing NPDES permit that contain effluent limits, permit terms, limitations and conditions, or standards that are less stringent than those established in the previous permit. There are also exceptions to this prohibition known as "antibacksliding exceptions."

The issue of backsliding from prior permit limits, standards, or conditions is not expected to initially apply to most storm water dischargers designated under today's proposal because they generally have not been previously authorized by an NPDES permit. However, the backsliding prohibition would apply if a storm water discharge was previously covered under another NPDES permit. Also, the backsliding prohibition could apply when an NPDES storm water permit is reissued, renewed, or modified. In most cases, however, EPA does not believe that these provisions would restrict revisions to storm water NPDES permits.

One commenter questioned whether, if BMPs implemented by a regulated small MS4 operator fail to produce results in removal of pollutants and the permittee attempts to substitute a more effective BMP, the small MS4 operator could be accused of violating the anti-backsliding provisions and also be exposed to citizen lawsuits. In response, EPA notes that in such circumstances the MS4's permit has not changed and, therefore, the prohibition against backsliding is not applicable. Further, any change in the mix of BMPs that was intended to be more effective at controlling pollutants would not be considered backsliding, even if it did not include all of the previously implemented BMPs.

4. Water Quality-Based Waivers and Designations

Several sections of today's final rule refer to water quality standards in identifying those storm water discharges that are and are not required to be permitted under today's rule. As noted in § 122.30 of today's rule, CWA section 402(p)(6) requires the designation of municipal storm water sources that need to be regulated to protect water quality and the establishment of a comprehensive storm water program to regulate these sources. Requirements applicable to certain municipal sources may be waived based on the absence of demonstrable water quality impacts. Section 122.32(c). The section 402(p)(6) mandate to protect water quality also provides the basis for regulating discharges associated with small construction. See also § 122.26(b)(15)(i). Further, today's rule carries forward the existing authority for the permitting authority to designate sources of storm water discharges based upon water quality considerations. Section 122.26(a)(9)(i)(C) and (D).

As is discussed above in sections II.H.2.e (for small MS4s) and II.I.1.b.ii

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(for small construction), the requirements of today's rule may be waived based on wasteload allocations that are part of "total maximum daily loads" (TMDLs) that address the pollutants of concern or, in the case of small construction and municipalities serving between 1,000 and 10,000 persons, the equivalents of TMDLs. One commenter stated that waivers would allow exemptions to the technology based requirements and would thus be inconsistent with the two-fold approach of the CWA (a technology based minimum and a water quality based overlay). EPA acknowledges that waivers are not allowed for other technology-based requirements under the CWA. A more flexible approach is allowed, however, for sources designated for regulation under 402(p)(6) to protect water quality. For such sources EPA may allow a waiver where it is demonstrated that an individual source does not present the threat to water quality that was the basis for EPA's designation.

III. Cost-Benefit Analysis

EPA has determined that the range of the rule's benefits exceeds the range of regulatory costs. The estimated rule costs range from $847.6 million to $981.3 million annually with corresponding estimated monetized annual benefits which range from $671.5 million to $1.628 billion, expected to exceed costs.

The rule's cost and benefit estimates are based on an annual comparison of costs and benefits for a representative year (1998) in which the rule is implemented. This differs from the approach used for the proposed rule which projected cost and benefits over three permit terms. EPA has chosen to use the current approach because it determined that the ratio of annual benefits and costs would not change significantly over time. Moreover, because there is not an initial outlay of capital costs with benefits accruing in the future (*i.e.*, benefits and costs are almost immediately at a steady state), it is not necessary to discount costs in order to account for a time differential.

EPA developed detailed estimates of the costs and benefits of complying with each of the incremental requirements imposed by the rule. The Agency used two approaches, a national water quality model and national water quality assessment, to estimate the potential benefits of the rule. Both approaches show that the benefits are likely to exceed costs.

These estimates, including descriptions of the methodology and assumptions used, are described in detail in the *Economic Analysis of the Final Phase II Rule*, which is included in the record of this rule making. Exhibit 3 summarizes costs and benefits associated with the basic elements of today's rule.

EXHIBIT 3.—COMPARISON OF ANNUAL COMPLIANCE COST AND BENEFIT ESTIMATES [1]

Monetized benefits	National water quality model (millions of 1998 dollars)	National water quality assessment (millions of 1998 dollars)
Municipal Minimum Measures		$131.0–$410.2
Controls for Construction Sites		$540.5–$686.0
Total Annual Benefits	$1,628.5	$671.5–$1,096.2

Costs	Millions of 1998 dollars [2]
Municipal Minimum Measures	$297.3
Controls/Waivers for Construction Sites	$545.0–$678.7
Federal/State Administrative Costs	$5.3
Total Annual Costs	$847.6–$981.31

[1] National level benefits are not inclusive of all categories of benefits that can be expected to result from the regulation.
[2] Total may not add due to rounding.

A. Costs

1. Municipal Costs

Initially, to determine municipal costs for the proposed rule, EPA used anticipated expenditure data included in permit applications from a sample of 21 Phase I MS4s. Certain commenters criticized the Agency for using anticipated expenditures because they could be significantly different from the actual expenditures. These commenters suggested that the Agency use the actual cost incurred by the Phase I MS4s. Other comments stated that because the Phase I MS4s, in general, are large municipalities, they may not be representative of the Phase II MS4s for estimating regulatory costs. Finally, one commenter noted that the sample of 21 municipalities used to project cost was relatively small.

To address the concerns of the commenters, EPA utilized a National Association of Flood and Stormwater Management Agencies (NAFSMA) survey of the Phase II community to obtain incremental cost estimates for Phase II municipalities. Using the list of potential Phase II designees published in the **Federal Register** (63 FR 1616), NAFSMA contacted more than 1,600 jurisdictions. The goal of the survey was to solicit information from those communities about the proposed Phase II NPDES storm water program. Several of the survey questions corresponded directly to the minimum measures required by the Phase II rule. One hundred twenty-one surveys were returned to NAFSMA and were used to develop municipal costs.

Using the NAFSMA information, EPA estimated average annual per household program costs for automatically designated municipalities. EPA also estimated an average annual per household administrative cost for municipalities to address application, record keeping, and reporting requirements of the Rule. The total average per household cost of the rule is expected to $9.16 per household.

To determine potential national level costs for municipalities, EPA multiplied the number of households (32.5 million) by the per household cost ($9.16). EPA estimates the annual cost of the Phase II municipal program at $298 million.

As an alternative method, and point of comparison, to the NAFSMA-based approach, EPA reviewed actual expenditures reported from 35 Phase I MS4s. The Agency targeted these 35 Phase I MS4s because they had participated in the NPDES program for

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nearly one permit term, were smaller in size and had detailed data reflecting their actual program implementation costs. Of the 35 MS4s, appropriate cost data was only available for 26 of those MS4s. EPA analyzed the expenditure data and identified the relevant expenditures, excluding costs presented in the annual reports unrelated to the requirements of the Rule. The cost range and annual per household program costs of $9.08 are similar to those found using the NAFSMA survey data.

2. Construction Costs

In order to estimate the rule's construction-related cost on a national level (the soil and erosion controls (SEC) requirements of the rule and the potential impacts of the post-construction municipal measure on construction), EPA estimated a per site cost for sites of one, three, and five acres and multiplied these costs by the total number of estimated Phase II construction starts across these size categories.

To estimate the percentage of starts subject to the soil and erosion control requirements between 1 and 5 acres, with respect to each category of building permits (residential, commercial, *etc.*), EPA initially used data from Prince George's County (PGC), Maryland, and applied these percentages to national totals. In the proposal, EPA recognized that the PGC data may not be representative of the entire country and requested data that could be used to develop better estimates of the number of construction sites between 1 and 5 acres. EPA did not receive any substantiated national data from commenters.

In view of the unavailability of national data from commenters, EPA made extensive efforts to collect construction site data around the country. The Agency contacted more than 75 municipalities. EPA determined that 14 of the contacted municipalities had useable construction site data. Using data from these 14 municipalities, EPA developed an estimate of the percentage of construction starts on one to five acres. EPA then multiplied this percentage by the number of building permits issued nationwide to determine the total number of construction starts occurring on one to five acres. Finally, to isolate the number of construction starts incrementally regulated by Phase II, EPA subtracted the number of activities regulated under equivalent programs (*e.g.*, areas covered by the Coastal Zone Act Reauthorization Amendments of 1990, and areas covered by equivalent State level soil and erosion control requirements). Ultimately, EPA estimated that 110,223 construction starts would be incrementally covered by the rule annually.

EPA then used standard cost estimates from *Building Construction Cost Data* and *Site Work Landscape Cost Data* (R.S. Means, 1997a and 1997b) to estimate construction BMP costs for 27 model sites in a variety of typical site conditions across the United States. The model sites included three different site sizes (one, three and five acres), three slope variations (3%, 7%, and 12%), and three soil erosivity conditions (low, medium, and high). EPA chose BMP combinations appropriate to the model site conditions. Based on the assumption that any combination of site factors is equally likely to occur in a given site, EPA developed average cost of sediment and erosion control for all model sites. EPA estimated that, on average, BMPs for a 1 acre site will cost $1,206, for a 3 acre site $4,598 and for a 5 acre site $8,709.

EPA then estimated administrative costs per construction site for the following elements required under the rule: Submittal of a notice of intent for permit coverage; notification to municipalities; development of a storm water pollution prevention plan; record retention; and submittal of a notice of termination. EPA estimated the average total administrative cost per site to be $937.

EPA also considered the cost implications of NPDES permit authorities waiving the applicability of requirements to storm water discharges from small construction sites based on two different criteria involving water quality impact and low rainfall. EPA received comments stating that a waiver would require a significant investment in training or acquisition of a consultant. Based on comments received, EPA eliminated one of the waiver conditions involving low soil loss threshold because it necessitated use of the Revised Universal Soil Loss Equation which could require extensive technical expertise.

Based on the opinions of construction industry experts, EPA estimates that 15 percent of the construction sites that would otherwise be covered by today's rule will be eligible to receive waivers. Therefore, the Agency has excluded 15 percent of the construction sites when deriving costs of sediment and erosion control. The average cost for sites to qualify for the waiver is expected to be $34 per site. The construction cost analysis for the proposed rule did not include any costs for the preparation and submission of waiver applications because EPA believed those costs would be negligible. However, in response to public comments, EPA has estimated these potential costs.

EPA has also estimated the potential costs for construction site operators to implement the post-construction minimum measure. These are costs that may be incurred by construction site operators if the MS4 chooses to meet the post-construction minimum measure by requiring on-site structural, site-by-site control of post-construction runoff. Municipalities may select from an array of structural and non-structural options in implementing this measure, so the potential costs to construction operators is uncertain. Nonetheless, EPA developed average annual BMP costs for sites of one, three, five and seven acres. EPA's analysis accounted for varying levels of imperviousness that characterize residential, commercial, and institutional land uses. Nationwide, these costs are expected to range from $44 million to $178 million annually.

Finally, to establish national incremental annual costs for Phase II construction starts, EPA multiplied the total costs of compliance for the chosen site size categories by the total number of Phase II construction starts and added post-construction costs. EPA estimates the annual compliance cost to range from $545 million to $678.7 million.

B. Quantitative Benefits

In the Economic Analysis for the proposed rule, a "top-down" approach was used to estimate economic benefits. Under this approach, the combined economic benefits for wet weather programs were estimated first, and then were divided among various water programs on the basis of expert opinion. As a result, the benefits estimates for an individual program were rather uncertain. Moreover, this approach was inconsistent with the approach used to estimate the cost of the proposed storm water rule, which was developed using municipal-based and cost-based data to develop "bottom-up" costs. Therefore, EPA decided to use a "bottom-up" approach for estimating benefits of the Phase II rule. To adequately reflect the quantifiable benefits of the rule, EPA used two different methods: (1) National Water Quality Model and (2) National Water Quality Assessment.

To monetize benefits in both approaches, the Agency applied Carson and Mitchell's (1993) estimates of household willingness-to-pay (WTP) for water quality improvement to estimates of waters impaired by storm water discharges. Carson and Mitchell's 1993 study reports the results of their 1983 national survey of WTP for incremental improvements in fresh water quality. Carson and Mitchell estimate the WTP for three minimum levels of fresh water quality: boatable, fishable, and sizable. EPA adjusted the WTP amounts to account for inflation, growth in real per capita income, and increased attitudes towards pollution control. The adjusted WTP amounts for improvements in fresh water quality are $210 for boatable, $158 for fishable, and $177 for sizable. A brief summary of the national water quality model and national water quality assessment approaches follow.

1. National Water Quality Model

One approach EPA used to estimate the benefits of the Phase II municipal and construction site controls was the National Water Pollution Control Assessment Model (NWPCAM). NWPCAM estimates benefits of the storm water program at the national level, including the impact on small streams. This model estimates water quality and the resultant use support for the 632,000 miles of rivers and streams in the USEPA Reach File Version 1 (RF1), which covers the continental United States. The model analyzes water quality changes by stream reach. The parameters modeled in the NWPCAM are biological oxygen demand (BOD), total suspended solids (TSS), dissolved oxygen (DO), and fecal coliforms (FC).

The model projects changes in water quality due to the Phase II municipal and construction site controls. To calculate the economic benefits of change in water quality, the number of households in the proximity of the stream reach are determined, by overlaying the model results on the 1990 Census of Populated Places and Minor Civil Divisions, and updating the population to 1998. Economic benefits are calculated using the Carson and Mitchell WTP values. The benefits are separately estimated for local and non-local waters on the basis of WTP values and proximity to water quality changes.

The value of the change in use support for local waters is greater than the value of the non-local waters because of the opportunity to use local waters by the local population. This model assumes that if improvement occurs in waters that are not close to population centers the economic value is lower. Therefore, benefits are estimated for local and non-local waters separately. This assumption is based on Carson and Mitchell's survey which asked respondents to apportion each of their stated WTP values between achieving the water quality goals in their own State and achieving those goals in the nation as a whole. On average, respondents allocated 67% of their values to achieving in-State water quality goals and the remainder to the nation as a whole. Carson and Mitchell argue that for valuing local water quality changes 67% is a reasonable upper bound for the local multiplier and 33% for the non-local water quality changes. For the purposes of this analysis, the locality is defined as urban sites and associated populations linked into the NWPCAM framework. Using this methodology, the total monetized benefits of Phase II control of urban and construction site runoff is estimated to be $1.628 billion per year. The local and non-local benefits due to Phase II controls are presented in Exhibit 4.

EXHIBIT 4.—LOCAL AND NON-LOCAL BENEFITS ESTIMATES DUE TO PHASE II CONTROLS NATIONAL WATER QUALITY MODEL ESTIMATE

Use support	Local benefits ($million/yr)	Non-local benefits[1] ($million/yr)	Total benefits ($million/yr)
Swimming, Fishing, and Boating	306.20	60.60	366.80
Fishing and Boating	395.10	51.90	447.00
Boating	700.10	114.60	814.70
Total	1401.40	227.10	1628.50

[1] To estimate non-local willingness to pay per household, the 33% of willingness is multiplied by the fraction of previously impaired national waters (in each use category) that attain the beneficial use as a result of the Phase II rule. To estimate the aggregate non-local benefits, non-local willingness to pay is multiplied with the total number of households in the US.

While the numbers of miles that are estimated to change their use support are small, the benefits estimates are quite significant. This is because urban runoff and, to a large extent, construction activity occurs where the people actually reside and the water quality changes mostly occur close to these population centers. NWPCAM indicates that changes in pollution loads have the most effect immediately downstream of pollution changes. As a result, the aggregate WTP is large because large numbers of households in these population centers are associated with the local waters that reflect improvement in designated use support.

2. National Water Quality Assessment

EPA also estimated benefits of the Phase II Storm Water program using the 1998 National Water Quality Inventory (305(b)) Report to Congress, rather than the NWPCAM as a basis for estimating impairment addressed by the rule. The Water Quality Assessment method separately estimates benefits associated with improvements to fresh water, marine water and construction site controls, and then aggregates these separate categories into an estimate of total annual benefits.

a. Municipal Measures

i. Fresh Waters Benefits

In order to develop estimates for the potential value of the municipal measures (except storm water runoff controls for construction sites), EPA applied Carson & Mitchell WTP values to estimated existing and projected future fresh water impairment. Carson & Mitchell did not evaluate marine waters, so only fresh water values were available from their research. Even though the Carson and Mitchell estimates apply to all fresh water, it is not clear how these values would be apportioned among rivers, lakes, and the Great Lakes. The 305(b) data indicate that lakes are the most impaired by urban runoff/storm sewers, followed closely by the Great Lakes, and then rivers. Therefore, EPA applied the WTP values to the categories separately and assumed that the higher resulting value for lakes represents the high end of the range (*i.e.*, assuming that lake impairment is more indicative of national fresh water impairment) and that the lower resulting value for impaired rivers represents the low end of a value range for all fresh waters (*i.e.*, assuming that river impairment is more indicative of national fresh water impairment). In addition, EPA estimated that the post-construction runoff

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requirements of the municipal program might result in benefits of at least $16.8 million annually from avoided future runoff. The post-construction estimate significantly underestimates potential program benefits because it does not account for avoided hydrologic changes and resulting water quality impairment associated with increases in imperviousness from development and redevelopment. Summing the benefits across the water quality use support levels yields an estimate of benefits ranging from approximately $121.9 million to $378.2 million per year.

ii. Marine Waters Benefits

In addition to the fresh water benefits captured by the Carson and Mitchell study, EPA anticipates benefits as a result of improvements to marine waters. Sufficient methods have not been developed to quantify national-level benefits for commercial or recreational fishing. EPA used beach closure data and visitation estimates from its Beach Watch Program to estimate potential reductions in marine swimming visits due to storm water runoff contamination events in 1997. The estimated 86,100 trips that did not occur because of beach closures in coastal Phase II communities is a lower bound because it represents only those beaches that report both closures and visitation data. EPA estimates potential swimming benefits from the rule to be at least $2.1 million annually.

EPA developed an analysis of potential benefits associated with avoided health impacts from exposure to contaminants in storm sewer effluent. Based on a study of incremental illnesses found among people who swam within one yard of storm drains in Santa Monica Bay, EPA estimated a range of incremental illnesses (Haile *et al.*, 1996). Depending on assumptions made about number of exposures to contaminants and contaminant concentrations, benefits ranged from $7.0 million to $29.9 million annually.

b. Construction Benefits

The major pollutant resulting from construction activities is sediment. However, in addition to sediment, construction activities also yield pollutants such as pesticides, petroleum products, and solvents. Because circumstances will vary considerably from site to site, data is not available with which to develop estimates of benefits for each site and aggregate to obtain a national-level estimate.

In the proposed rule, EPA estimated the combined benefits of all wet weather programs, and then used expert opinions to allocate them to different individual programs. To eliminate the possible overlap between the benefits of the soil and erosion control requirements, municipal measures, and other wet weather storm water programs, EPA chose to use an approach in today's final rule that directly estimates the benefits of soil and erosion requirements.

A survey of North Carolina residents (Paterson *et al.*, 1993) indicated that households are willing to pay for erosion and sediment controls similar to those in today's rule. Based on income and other indicators, the values derived from the study are expected to be similar to values held in the rest of the country. Using the mean value of the willingness to pay of $25 per household, EPA projects annual benefits of the soil and erosion requirements to range from $540.5–$686 million.

c. Summary of Benefits From the National Water Quality Assessment

Total benefits from municipal measures and construction site controls are expected to range from $671.5 million to $1.1 billion per year, including benefits of approximately $13.7 million per year associated with small stream improvements. A summary of the potential benefits is presented in Exhibit 5.

As shown in Exhibit 5, it was not possible to monetize all categories of benefits using the WTP estimates. In particular, benefits for improving marine water quality such as fishing and passive use benefits are not included in the values used to estimate the potential benefits of the municipal minimum measures (excluding construction sites controls), and they are not estimated separately, because information is not currently available.

EXHIBIT 5.—POTENTIAL ANNUAL BENEFITS OF THE PHASE II STORM WATER RULE NATIONAL WATER QUALITY ASSESSMENT ESTIMATE

Benefit category	Annual WTP
Municipal Minimum Measures [1]	
Fresh Water Use and Passive Use [2]	$121.9–$378.2
Marine Recreational Swimming	$2.1
Human Health (Marine Waters)	$7.0–$29.9
Other Marine Use and Passive Use	(+)
Erosion and Sediment Controls for Construction Sites	
Fresh Water and Marine Use and Passive Use [3]	$540.5–$686
Total Phase II Program	
Total Use & Passive Use (Fresh Water and Marine)	>$671.5–>$1,096.2

+= positive benefits expected but not monetized.

[1] Includes water quality benefit of municipal programs, based on 80% effectiveness of municipal programs.

[2] Based on research by Carson and Mitchell (1993). Fresh water value only. Does not include commercial fishery, navigation, or diversionary (*e.g.* municipal drinking water cost savings or risk reductions) benefits. May not fully capture human health risk reduction or ecological values.

[3] Based on research by Paterson *et al.* (1993). Although the survey's description of the benefits of reducing soil erosion from construction sites included reduced dredging, avoided flooding, and water storage capacity benefits, these benefit categories may not be fully incorporated in the WTP values. Small streams may account for over 2% of total benefits.

C. Qualitative Benefits

There are additional benefits to storm water control that cannot be quantified or monetized. Thus, the current estimate of monetized benefits may understate the true value of storm water controls because it omits many ways in which society is likely to benefit from reduced storm water pollution, such as improved aesthetic quality of waters, benefits to wildlife and to threatened and endangered species, cultural values, and biodiversity benefits.

A benefit that EPA did not monetize completely is the flood control benefits attributable to municipal storm water controls reducing downstream flooding, although flood control benefits associated with sediment and erosion control are already reflected to some extent in the construction benefits. Similarly, the Agency could not value the benefits from increased property value due to storm water controls reflected in the rule, even though a commenter suggested inclusion of these benefits in the estimates.

Moreover, while a number of commenters requested that EPA include ecological benefits, the Agency was not able to fully monetize these benefits. Urbanization usually increases the amount of sediment, nutrients, metals and other pollutants associated with land disturbance and development. Development usually not only results in a dramatic increase in the volume of water runoff, but also in a substantial decrease in that water's quality due to stream scour, runoff and dispersion of toxic pollutants, and oversiltation. These kinds of secondary benefits could not be fully reflected in the monetized benefits. EPA was able to only monetize the aquatic life support benefits for waters assumed to be impaired. Thus, only the aquatic life support benefits attributable to municipal controls, reflected through human satisfaction, are taken into account.

Reduced nutrient level is another benefit of the storm water control which is not fully captured by the economic analysis. High nutrient levels often lead to eutrophication of the aquatic system. The quality change in ecological sources as the result of storm water controls to reduce pollutants is not fully reflected in the present benefits.

D. National Economic Impact

Finally, the Agency determined that the rule will have minimal impacts on the economy or employment. This is because the final rule regulates small MS4s and construction sites under 5 acres, not the typical industrial plants or other non-construction activities that could directly impact production and thus those sectors of the economy.

Discussions with representatives within the construction industry indicate that construction costs will likely be passed on to buyers, thus not seriously affecting the housing industry directly. One commenter argued that the rule will have a negative employment effect because the builders will build fewer homes requiring less building materials as a result of the declining demand induced by the cost of the soil and erosion controls. EPA disagrees with this argument because the cost of the controls, as the percentage of the price of a median home, is negligible and will be passed on to final buyers.

Flexibility within the rule allows MS4s to tailor the storm water program requirements to their needs and financial position, minimizing impacts. For sedimentation and erosion controls on construction sites, the rule contemplates application of commonly used BMPs to reduce costs for the construction industry. Thus, the rule attempts to use existing practices to prevent pollution, which should minimize impacts on States, Tribes, municipalities and the construction industry.

Thus, EPA concludes that the effect of the rule, if any, on the national economy will be minimal. The benefits of today's rule more than offset any cost impacts on the national economy.

IV. Regulatory Requirements

A. Paperwork Reduction Act

The Office of Management and Budget (OMB) has approved some of the information collection requirements contained in this final rule (*i.e.* those found in 40 CFR 122.26(g) and 123.35(b)) under the provisions of the *Paperwork Reduction Act*, 44 U.S.C. 3501 *et seq.* and has assigned OMB control number 2040–0211.

The burden and costs described below are for the information collection, reporting, and record keeping requirements for the three year period beginning with the effective date of today's rule. Additional information collection requirements for regulated small MS4s and small construction sites will occur after this initial three year period and will be counted in a subsequent information collection requirement. The total burden of the information collection requirements for the first three years of this rule is estimated at 56,369 hours with a corresponding cost of $2,151,305 million annually. This burden and cost is for industrial facilities to complete and submit the no exposure certification, for NPDES-authorized States to process and review the no exposure certification, and for the NPDES-authorized States to develop designation criteria and assess additional MS4s outside of urbanized areas. Compliance with the applicable information collection requirements imposed under this rule are mandatory, pursuant to CWA section 402.

Exhibit 6 presents average annual burden and cost estimates for Phase II respondents for the first three years. Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, disclose or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust existing ways for complying with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information.

EXHIBIT 6.—AVERAGE ANNUAL BURDEN AND COST ESTIMATES FOR PHASE II RESPONDENTS

Information collection activity	A Respondents per year (projected) [1]	B Burden hours per respondent per year (predicted)	(A)×(B)=C Annual respondent burden hours (projected)	D Respondent labor cost ($/hr) (1998 $)	(C)×(D)=E Annual Cost ($) (projected)
Ind. No Expos. Facilities:[2]					
No Expos. Certification	36,377	1.0	36,377	44.35	1,613,320
Annual Subtotal			36,377		1,613,320
NPDES-Authorized States:[3]					
Designation of Addit. MS4s[4]	15	332.8	4,892	26.91	131,644

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EXHIBIT 6.—AVERAGE ANNUAL BURDEN AND COST ESTIMATES FOR PHASE II RESPONDENTS—Continued

Information collection activity	A Respondents per year (projected) [1]	B Burden hours per respondent per year (predicted)	(A)×(B)=C Annual respondent burden hours (projected)	D Respondent labor cost ($/hr) (1998 $)	(C)×(D)=E Annual Cost ($) (projected)
No Exp. Cert. Proc. & Rev	30,200	0.5	15,100	26.91	406,341
Annual Subtotal			19,992		537,985
Annual Totals			56,369		2,151,305

Notes:
[1] Source: U.S. EPA, Office of Wastewater Management. Economic Analysis for the Storm Water Phase II Rule.
[2] The total number of potential no exposure respondents was divided by 5 to estimate an annual total. It was assumed that the annual number of respondents for the no exposure certification would be spread over the five year period the exclusion applies.
[3] The number of respondents in each category represents only those respondents located within the 44 NPDES-authorized States and Territories. The burden and cost estimates provided in this section are for the NPDES-authorized States in their role as the permitting authority for municipal designations and industrial no exposure.
[4] The number of respondents for this activity, 15, represents the number of NPDES-authorized States and Territories that must develop designation criteria and assess small MS4s located outside of an urbanized area for possible Phase II coverage divided by the three year ICR period.

Given the requirements of today's regulation, EPA believes there will be no capital startup and no operation and maintenance costs associated with information collection requirements of the rule.

The government burden associated with today's rule will impact State, Tribal, and Territorial governments (NPDES-authorized governmental entities) that have storm water program authority, as well as the federal government (*i.e.*, EPA), where it is the NPDES permitting authority. As of March 1999, 43 States and the Virgin Islands had NPDES authority.

The annual burden imposed upon authorized governmental entities (delegated States and the Virgin Islands) and the federal government for the next three years is estimated to be 19,992 hours ($537,985) and 4,087 hours ($115,948) respectively, for a total of 24,079 hours ($653,933). This estimate is based on the average time that governments will expend to carry out the following activities: designate additional MS4s (332.8 hours) and process and review "no exposure" certificates from industrial dischargers (0.5 hour).

Under the existing rule, storm water discharges from light industrial activities identified under § 122.26(b)(14)(xi) were exempted from the permit application requirements if they were not exposed to storm water. Today's rule expands the applicability of the "no exposure" exclusion to include all industrial activity regulated under § 122.26(b)(14) (except category (x), construction). The "no exposure" provision is applied through the use of a written certification process, thus representing a slight reporting burden increase for "light" industries with "no exposure'.

In addition to the information collection, reporting, and record keeping burden for the next three years, today's rule contains information collection requirements that will not begin until three years or more from the effective date of today's rule. These information collection requirements were not included in the information collection request approved by OMB. EPA will submit these burden estimates for OMB approval when it submits ICR 2040–0211 to OMB for renewal in three years. The rule burdens for regulated small MS4s and small construction sites that will be included in the ICR renewal fall into three areas: application for an NPDES permit or submittal of waiver information, record keeping of storm water management activities, and submittal of reports to the permitting authority. There will also be an additional burden for the permitting authority to review this information.

An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations are listed in 40 CFR Part 9 and 48 CFR Chapter 15. EPA is amending the table in 40 CFR Part 9 of currently approved ICR control numbers issued by OMB for various regulations to list the first three years of information requirements contained in this final rule.

B. Executive Order 12866

Under Executive Order 12866, [58 FR 51,735 (October 4, 1993)] the Agency must determine whether the regulatory action is "significant" and therefore subject to OMB review and the requirements of the Executive Order. The Order defines "significant regulatory action" as one that is likely to result in a rule that may:

(1) have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;

(2) create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

(4) raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

Pursuant to the terms of Executive Order 12866, it has been determined that this rule is a "significant regulatory action". As such, this action was submitted to OMB for review. Changes made in response to OMB suggestions or recommendations will be documented in the public record.

C. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), Public Law 104–4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and tribal governments and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "Federal mandates" that may result in expenditures to State, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year. Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative if the Administrator publishes with the final rule an explanation why that alternative was not adopted.

EPA has determined that today's rule contains a Federal mandate that may result in expenditures of $100 million or more in any one year for both State, local, and tribal governments, in the aggregate, and the private sector. Accordingly, EPA has prepared under section 202 of the UMRA a written statement which is summarized below.

1. Summary of UMRA Section 202 Written Statement

EPA promulgates today's storm water regulation pursuant to the specific mandate of Clean Water Act section 402(p)(6), as well as sections 301, 308, 402, and 501. (33 U.S.C. sections 1342(p)(6), 1311, 1318, 1342, 1361.) Section 402(p)(6) of the CWA requires that EPA designate sources to be regulated to protect water quality and establish a comprehensive program to regulate those sources.

In the *Economic Analysis of the Final Phase II Rule* (EA), EPA describes the qualitative and monetized benefits associated with today's rule and then compares the monetized benefits with the estimated costs for the rule. EPA developed detailed estimates of the costs and benefits of complying with each of the incremental requirements imposed by the rule. These estimates, including descriptions of the methodology and assumptions used, are described in detail in the EA. The Agency used two approaches, a national water quality model and national water quality assessment, to estimate the potential benefits of the rule. Both approaches show that the benefits are likely to exceed costs. Exhibit 3 in section III of this preamble summarizes the costs and benefits associated with the basic elements of today's rule.

There are additional benefits to storm water control that cannot be quantified or monetized. Thus, the current estimate of monetized benefits may understate the true value of storm water controls because it omits many ways by which society is likely to benefit from reduced storm water pollution, such as improved aesthetic quality of waters, benefits to wildlife and to threatened and endangered species, cultural values, and biodiversity benefits.

Several commenters asserted that today's rule is an unfunded mandate and that, without funding, the monitoring of the already existing pollution control programs would suffer. In section II.D.3 of the preamble, EPA lists some of the programs that EPA anticipates may provide funds to help develop and, in limited circumstances, implement storm water management programs.

In the EA, EPA reviewed the expected effect of today's rule on the national economy. The Agency determined that the rule will have minimal impacts on the economy or employment. This is because the final rule regulates small MS4s and construction sites under 5 acres, not the typical industrial plants or other non-construction activities that could directly impact production and thus those sectors of the economy.

Discussions with representatives within the construction industry indicate that construction costs will likely be passed on to buyers, thus not seriously affecting the housing industry directly. Flexibility within the rule allows MS4s to tailor the storm water program requirements to their needs and financial position, minimizing impacts. For sedimentation and erosion controls on construction sites, the rule contemplates application of commonly used BMPs to reduce costs for the construction industry. Thus, the rule attempts to use existing practices to prevent pollution, which should minimize impacts on States, Tribes, municipalities and the construction industry.

Thus, EPA concludes that the effect of the rule, if any, on the national economy would be minimal. The benefits of today's rule more than offset any cost impacts on the national economy.

Consistent with the intergovernmental consultation provisions of section 204 of the UMRA and Executive Order 12875, "Enhancing the Intergovernmental Partnership," EPA consulted with the governmental entities affected by this rule.

First, EPA provided States, Tribal and local governments with the opportunity to comment on draft alternative approaches for the proposed rule through publishing a notice requesting information and public comment in the Federal Register on September 9, 1992 (57 FR 41344). This notice presented a full range of regulatory alternatives. At that time, EPA received more than 130 comments, including approximately 43 percent from municipalities and 24 percent from State or Federal agencies. These comments were the genesis of many of the provisions in the today's rule, including reliance on the NPDES program framework (including general permits), providing State and local governments flexibility in selecting additional sources requiring regulation, and focusing on high priority polluters. These comments helped to focus on pollution prevention, watershed-based concerns and BMPs. They also led to certain exemptions for facilities that do not pollute national waters.

In early 1993, EPA, in conjunction with the Rensselaerville Institute, held public and expert meetings to assist in developing and analyzing options for identifying unregulated storm water sources and possible controls. These meetings provided participants an additional opportunity to provide input into the CWA section 402(p)(6) program development process. The final rule addresses several of the key concerns identified in these groups, including provisions that provide flexibility to the States to select sources to be controlled and types of permits to be issued, and flexibility to MS4s in selecting BMPs.

EPA also conducted outreach with representatives of small entities, including small government representatives, in conjunction with the convening of a Small Business Advocacy Review Panel under SBREFA which is discussed in section IV.E. of the preamble.

In addition, EPA established the Urban Wet Weather Flows Advisory Committee under the Federal Advisory Committee Act (FACA). The Urban Wet Weather Flows Advisory Committee, in turn established the Storm Water Phase II Subcommittee. Consistent with FACA, the membership of the Committee and the Storm Water Phase II Subcommittee was balanced among EPA's various outside stakeholder interests, including representatives from State governments, municipal governments (both elected officials and appointed officials) and Tribal governments, as well as industrial and commercial sectors, agriculture, environmental and public interest groups.

In general, municipal and Tribal government representatives supported the NPDES approach in today's rule for the following reasons: It will be uniformly applied on a nationwide basis; it provides flexibility to allow incorporation of State and local programs; it resolves the problem of donut holes that cause water quality impacts in urbanized areas; and it allows co-permitting of small regulated

MS4s with those regulated under the existing storm water program.

In contrast, State representatives sought alternative approaches for State implementation of the storm water program for Phase II sources. State representatives asserted that a non-NPDES alternative approach best facilitated watershed management and avoided duplication and overlapping regulations. These representatives pointed out that there are a variety of State programs—not based on the CWA—implementing effective storm water controls, and that EPA should provide incentives for their implementation and improvement in performance. EPA continues to believe that an NPDES approach is the best approach in order to adequately protect water quality. However, EPA has worked with States on an alternative approach that provides flexibility within the NPDES framework. The final rule allows States with a watershed permitting approach to phase in permit coverage for MS4s in jurisdictions with a population less than 10,000 and provides two waivers from coverage for small MS4s. This issue is discussed in section II.C of the preamble, Program Framework: NPDES Approach.

Some municipal governments objected that the rule's minimum measures for small MS4s violate the Tenth Amendment insofar as they require the operators of MS4s to regulate third parties according to the "minimum measures" for municipal storm water management programs. EPA disagrees that today's rule is inconsistent with Tenth Amendment principles. Permits issued under today's rule will not compel political subdivisions of States to regulate in their sovereign capacities, but rather to effectively control discharges out of their storm sewer systems in their owner/operator capacities. For MS4s that do not accept this "default" minimum measures-based approach (to control discharges out of the storm sewer system by exercising local powers to control discharges into the storm sewer system), today's rule allows for alternative permits through individual permit applications. EPA made revisions to the rule to allow regulated small MS4s to opt out of the minimum measures approach and instead apply for an individual permit. This issue is discussed in section II.H.3.c.iii of the preamble, Alternative Permit Option/ Tenth Amendment.

2. Selection of the Least Costly, Most Cost-Effective or Least Burdensome Alternative That Achieves the Objectives of the Statute

Today's rule evolved over time and incorporated aspects of alternatives that responded to concerns presented by the various stakeholders. A primary characteristic of today's rule is the flexibility it offers both the permitting authority and the regulated sources (small MS4s and small construction sites), by the use of general permits, implementation of BMPs suited to specific locations, and allowing MS4s to develop their own program goals.

In the administrative record supporting the proposed rule, EPA estimated ranges of costs associated with six different options, including a no action option, the proposed option, and four other options that considered various combinations of the following: Covering all the unregulated construction sites below 5 acres, all small MS4s, certain industrial and commercial activities, and all point sources. EPA developed detailed cost estimates for the incremental requirements imposed under the final regulation, and for each of the alternatives, and applied these estimates to the remaining unregulated point sources of storm water. The Agency compared the estimated annual range of costs imposed under today's rule and other major options considered. The range of values for each option included the costs for compliance, including paperwork requirements for the operators of small construction sites, industrial facilities, and MS4s and administrative costs for State and Federal NPDES permitting authorities.

Today's rule reflects the least costly option that achieves the objectives of the statute, thus meeting the requirements of section 205. EPA did not consider "no regulation" to be an "option" because it would not achieve the objectives of CWA section 402(p)(6). A portion of currently unregulated point sources of storm water need to reduce pollutants to protect water quality.

Today's rule is estimated to range in cost from $847.6 million to $981.3 million annually, although the cost estimate for the proposed rule was reported as a range of $138 to $869 million annually. That range reflected a unit cost range for the municipal minimum measures and a cost range per construction site for soil erosion control. EPA has since revised its cost analysis to allow it to report the current estimate, which is toward the high end of the original cost range. The four other regulatory options considered at proposal involved higher regulatory costs and, therefore, were not selected. These four options and their estimate costs are as follows:

(1) An option based on the August 7, 1995 direct final rule was estimated to cost between $2.2 billion and $78.9 billion per year.

(2) A "Plan B" option was estimated to cost between $0.6 billion and $3.2 billion per year.

(3) An option based on the September 30, 1996 draft proposed rule was estimated to cost between $0.2 billion and $3.7 billion per year.

(4) An option based on the February 13, 1997 draft proposed rule, was estimated to cost between $0.2 billion and $3.5 billion.

There are three reasons why the costs for these four options exceeded the estimated cost range for the proposed rule. The first two options regulated substantially more municipal governments. The first, third, and fourth options required industrial facilities to apply for permits. Finally, the first three options applied permit requirements to construction sites below 1 acre. Consequently, these options would be more costly than today's rule even with the revised analysis methods used to estimate costs.

3. Effects on Small Governments

Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements. EPA has determined that this rule contains no regulatory requirements that might significantly or uniquely affect small governments. Although today's rule expands the NPDES program (with modifications) to certain MS4s serving populations below 100,000 and although many MS4s are owned by small governments, EPA does not believe today's rule significantly or uniquely affects small governments. As explained in section IV.E. of the preamble, EPA today certifies that the rule will not have a significant impact on small governmental jurisdictions. In addition, the rule will not have a unique impact on small governments because the rule will affect small governments in to the same extent as (or to a lesser extent than) larger governments that are already covered by the existing storm water rules. Thus, today's rule is not subject to the requirements of section 203 of UMRA.

Notwithstanding this finding, in developing today's rule, EPA provided notice of the requirements to potentially affected small governments; enabled officials of affected small governments to provide meaningful and timely input in the development of regulatory proposals; and informed, educated and advised small governments on compliance with the requirements.

Concerning notice, EPA provided States, local, and Tribal governments with the opportunity to comment on alternative approaches for an early draft of the proposed rule by publishing a notice requesting information and public comment in the **Federal Register** on September 9, 1992 (57 FR 41344). This notice presented a full range of regulatory alternatives. At that time, EPA received more than 130 comments, including approximately 43 percent from municipalities and 24 percent from State or Federal agencies.

The Agency also provided, through the SBREFA panel process and the FACA process, the opportunity for elected officials of small governments (and their representatives) to meaningfully participate in the development of the rule. Through such participation and exchange, EPA not only notified potentially affected small governments of requirements of the developing rule, but also allowed officials of affected small governments to have meaningful and timely input into the development of regulatory proposals.

In addition to involving municipalities in the development of the rule, EPA also continues to inform, educate, and advise small governments on compliance with the requirements of today's rule. For example, EPA supported 10 workshops, presented by the American Public Works Association from September 1998 through May 1999, designed to educate local governments on the implementation of the rule. The workshop curriculum included information on a variety of key issues such as anticipated regulatory requirements, agency reporting, best management practices, construction site controls, post construction management for new and redeveloped sites, public education and public involvement strategies, detection and control of illicit discharges, and good housekeeping practices. Moreover, EPA has prepared a series of fact sheets, available on the EPA website at www.epa.gov/owm/sw/toolbox, that explains the rule in detail.

Finally, to assist small governments in implementing the Phase II program, EPA is committed to the following: (1) developing a tool box of implementation strategies; (2) providing written technical assistance, including guidance on developing BMPs and measurable goals; and (3) compiling a comprehensive evaluation of the NPDES municipal storm water Phase II program over the next 13 years.

D. Executive Order 13132

Executive Order 13132, entitled "Federalism" (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure "meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications." "Policies that have federalism implications" is defined in the Executive Order to include regulations that have "substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government." Under Executive Order 13132, EPA may not issue a regulation that has federalism implications, that imposes substantial direct compliance costs, and that is not required by statute, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by State and local governments, or EPA consults with State and local officials early in the process of developing the proposed regulation. EPA also may not issue a regulation that has federalism implications and that preempts State law unless the Agency consults with State and local officials early in the process of developing the proposed regulation.

If EPA complies by consulting, Executive Order 13132 requires EPA to provide to the Office of Management and Budget (OMB), in a separately identified section of the preamble to the rule, a federalism summary impact statement (FSIS). The FSIS must include a description of the extent of EPA's prior consultation with State and local officials, a summary of the nature of their concerns and the agency's position supporting the need to issue the regulation, and a statement of the extent to which the concerns of State and local officials have been met. For final rules subject to Executive Order 13132, EPA also must submit to OMB a statement from the agency's Federalism Official certifying that EPA has fulfilled the Executive Order's requirements.

EPA has concluded that this final rule may have federalism implications. As discussed above in section IV.C., the rule contains a Federal mandate that may result in the expenditure by State, local and tribal governments, in the aggregate, of $100 million or more in any one year. Accordingly, the rule may have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. Moreover, the rule will impose substantial direct compliance costs on State or local governments. Accordingly, EPA provides the following FSIS under section 6(b) of Executive Order 13132.

1. Description of the Extent of the Agency's Prior Consultation with State and Local Governments

Although this rule was proposed long before the November 2, 1999 effective date of Executive Order 13132, EPA consulted extensively with affected State and local governments pursuant to the intergovernmental consultation provisions of Executive Order 12875, "Enhancing the Intergovernmental Partnership" (now revoked by Executive Order 13132) and section 204 of UMRA.

First, EPA provided State and local governments the opportunity to comment on draft alternative approaches for the proposed rule through publishing a notice requesting information and public comment in the **Federal Register** on September 9, 1992 (57 FR 41344). This notice presented a full range of regulatory alternatives. At that time, EPA received more than 130 comments, including approximately 43 percent from municipalities and 24 percent from State or Federal agencies. These comments were the genesis of many of the provisions in the today's rule, including reliance on the NPDES program framework (including general permits), providing State and local governments flexibility in selecting additional sources requiring regulation, and focusing on high priority polluters. These comments helped to focus on pollution prevention, watershed-based concerns and BMPs. They also led to certain exemptions for facilities that do not pollute national waters.

In early 1993, EPA, in conjunction with the Rensselaerville Institute, held public and expert meetings to assist in developing and analyzing options for identifying unregulated storm water sources and possible controls. These meetings provided participants an additional opportunity to provide input into the CWA section 402(p)(6) program

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development process. The final rule addresses several of the key concerns identified in these groups, including provisions that provide flexibility to the States to select sources to be controlled and types of permits to be issued, and flexibility to MS4s in selecting BMPs.

EPA also conducted outreach with representatives of small entities, including small governments, in conjunction with the convening of a Small Business Advocacy Review Panel under SBREFA which is discussed in section III.F. of the preamble.

In addition, EPA established the Urban Wet Weather Flows Advisory Committee (FACA), which in turn established the Storm Water Phase II Subcommittee. Consistent with the Federal Advisory Committee Act, the membership of the Committee and the Storm Water Phase II Subcommittee was balanced among EPA's various outside stakeholder interests, including representatives from State governments, municipal governments (both elected officials and appointed officials) and Tribal governments, as well as industrial and commercial sectors, agriculture, environmental and public interest groups.

2. Summary of Nature of State and Local Government Concerns, and Statement of the Extent to Which Those Concerns Have Been Met

In general, municipal government representatives supported the NPDES approach in today's rule for the following reasons: it will be uniformly applied on a nationwide basis; it provides flexibility to allow incorporation of State and local programs; it resolves the problem of donut holes that cause water quality impacts in urbanized areas; and it allows co-permitting of small regulated MS4s with those regulated under the existing storm water program.

In contrast, State representatives sought alternative approaches for State implementation of the storm water program for Phase II sources. State representatives asserted that a non-NPDES alternative approach best facilitated watershed management and avoided duplication and overlapping regulations. These representatives pointed out that there are a variety of State programs—not based on the CWA—implementing effective storm water controls, and that EPA should provide incentives for their implementation and improvement in performance. EPA continues to believe that an NPDES approach is the best approach in order to adequately protect water quality. However, EPA has worked with States on an alternative approach that provides flexibility within the NPDES framework. The final rule allows States with a watershed permitting approach to phase in permit coverage for MS4s in jurisdictions with a population less than 10,000 and provides two waivers from coverage for small MS4s. This issue is discussed in section II.C of the preamble, Program Framework: NPDES Approach.

Some municipal governments objected that the rule's minimum measures for small MS4s violate the Tenth Amendment insofar as they require the operators of MS4s to regulate third parties according to the "minimum measures" for municipal storm water management programs. EPA disagrees that today's rule is inconsistent with Tenth Amendment principles. Permits issued under today's rule will not compel political subdivisions of States to regulate in their sovereign capacities, but rather to effectively control discharges out of their storm sewer systems in their owner/operator capacities. For MS4s that do not accept this "default" minimum measures-based approach (to control discharges out of the storm sewer system by exercising local powers to control discharges into the storm sewer system), today's rule allows for alternative permits through individual permit applications. EPA made revisions to the rule to allow regulated small MS4s to opt out of the minimum measures approach and instead apply for an individual permit. This issue is discussed in section II.H.3.c.iii of the preamble, Alternative Permit Option/ Tenth Amendment.

3. Summary of the Agency's Position Supporting the Need To Issue the Regulation

As discussed more fully in section I.B. above, today's rule is needed because uncontrolled storm water discharges from areas of urban development and construction activity have been shown to have negative impacts on receiving waters by changing the physical, biological, and chemical composition of the water, resulting in an unhealthy environment for aquatic organisms, wildlife, and people. As discussed in section II.C., the NPDES approach in today's rule is needed to ensure uniform application on a nationwide basis, to provide flexibility to allow incorporation of State and local programs, to resolve the problem of donut holes that cause water quality impacts in urbanized areas, and to allow co-permitting of small regulated MS4s with those regulated under the existing storm water program.

The draft final rule was transmitted to OMB on July 6, 1999. Because transmittal occurred before the November 2, 1999 effective date of Executive Order 13132, certification under section 8 of the Executive Order is not required.

E. Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), 5 U.S.C. 601 et seq.

The RFA generally requires an Agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impact of today's rule on small entities, small entity is defined as: (1) a building contractor (SIC 15) with up to $17.0 million in annual revenue; (2) a small governmental jurisdiction that is a government of a city, county, town, school district, or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.

After considering the economic impacts of today's final rule on small entities, I certify that this action will not have a significant economic impact on a substantial number of small entities.

Although this final rule will not have a significant economic impact on a substantial number of small entities, EPA nonetheless has tried to reduce the impact of this rule on small entities.

For purposes of evaluating the economic impact of this rule on small governmental jurisdictions, EPA compared annual compliance costs with annual government revenues obtained from the 1992 Census of Governments, using state-specific estimates of annual revenue per capita for municipalities in three population size categories (fewer than 10,000, 10,000–25,000, and 25,000–50,000).

In order to estimate the annual compliance cost for small governmental jurisdictions, EPA used the mean variable municipal cost of $8.93 per household as calculated in a 1998 study of 121 municipalities conducted by the national Association of Flood and Stormwater Management Agencies (NAFSMA). In addition, EPA used the estimated fixed administrative costs of $1,545 per municipality for reporting, recordkeeping, and application requirements for today's rule.

In evaluating the economic impact of this rule on small governmental jurisdictions, EPA determined that compliance costs represent more than 1 percent of estimated revenues for only 10 percent of small governments and more than 3 percent of the revenue for 0.7 percent of these entities. In both absolute and relative terms, EPA does not consider this a significant economic impact on a substantial number of small entities.

EPA normally uses the "sales test" for determining the economic impact on small businesses. Under a sales test, annual compliance costs are compared with the small business's total annual sales. However, the direct application of the sales test is not suitable in this case, because of the uncertainty associated with estimating the number of units an "average" developer/contractor develops or builds in a typical year. For this rule, EPA has approximated the sales test by estimating compliance costs for three sizes of construction sites and comparing them with a representative sale price for three building categories. Although EPA's analysis is not exactly a "sales test," it is similar to the sales test, producing comparable results.

For small building contractors, EPA estimated administrative compliance costs of $870 per site for applying for coverage, reporting, record keeping, monitoring and preparing a storm water pollution prevention plan. EPA estimated compliance costs for installing soil and erosion controls as ranging from $1,206 to $8,709 per site. EPA compliance cost estimates are based on 27 theoretical model construction sites designed to mimic the mostly likely used best management practices around the country.

In evaluating the economic impact on small building contractors, EPA divided the revised compliance costs per construction start by the appropriate homes-to-site ratio for each of the three sizes of construction sites. The average compliance cost per home ranges from approximately $450 to $650. EPA concluded that compliance costs are roughly 0.22 to 0.43 percent of both the mean, $181,300, and median, $151,000, sale price of a home.

The absence of data to specifically assess annual compliance costs for building contractors as a percentage of annual sales (i.e., a very direct estimate of the impact on potentially affected small businesses) led EPA to perform additional market analysis to examine the ability of potentially affected firms to pass along regulatory costs to buyers for single-family homes constructed subject to today's rule. If the small building contractors covered by the rule are able to pass on the costs of compliance, either completely or partially, to their purchasers, then the rule's impact on these small business entities is significantly reduced. The market analysis shows that demand for homes is not overly sensitive to small changes in price, therefore builders should be able to pass on at least a significant fraction of the compliance costs to buyers.

EPA also assessed the effect of the building contractors' costs on average monthly mortgage rates and on the demand for new homes. Based on that screening analysis, EPA concludes that the costs to building contractors, and the potential changes in housing prices and monthly mortgage payments for single-family home buyers, are not expected to have a significant impact on the market for single-family houses. In both absolute and relative terms, EPA does not consider this a significant economic impact on a substantial number of small entities.

EPA also certified this rule at proposal. Even though the Agency was not required to, we convened a Small Business Advocacy Review Panel ("Panel") in June 1997. A number of small entity representatives had already been actively involved with EPA through the FACA process, and were, therefore, broadly knowledgeable about the development of the proposed and final rules. Prior to convening the Panel, EPA consulted with the Small Business Administration to identify a group of small entity representatives to advise the Panel. The Agency distributed a briefing package describing its preliminary analysis under the RFA to the small entity representatives (as well as to representatives from OMB and SBA) and conducted two telephone conference calls and an all-day meeting at EPA Headquarters in May of 1997 with small entity representatives. With this preliminary work complete, in June 1997, EPA formally convened the SBREFA Panel, comprising representatives from OMB, SBA, EPA's Office of Water and EPA's Small Business Advocacy Chair. The Panel received written comments from small entity representatives based on their involvement in the earlier meetings, and invited additional comments.

Consistent with requirements of the RFA, the Panel evaluated the assembled materials and small-entity comments on issues related to: (1) a description and the number of small entities that would be regulated; (2) a description of the projected record keeping, reporting and other compliance requirements applicable to small entities; (3) identification of other Federal rules that may duplicate, overlap, or conflict with the proposal to the final rule; and (4) regulatory alternatives that would minimize any significant economic impact of the rule on small entities while accomplishing the stated objectives of the CWA section 402(p)(6).

On August 7, 1997, the Panel provided a Final Report (hereinafter, "Report") to the EPA Administrator. A copy of the Report is included in the docket for the rule. The Panel acknowledged and commended EPA's efforts to work with stakeholders, including small entities, through the FACA process. The SBREFA Panel stated that, because of EPA's extensive outreach and responsiveness in addressing stakeholder concerns, commenters during the SBREFA process raised fewer concerns than might otherwise have been expected. Based on the advice and recommendations of the Panel, today's rule includes a number of provisions designed to minimize any significant impact on small entities. (See Appendix 5).

F. National Technology Transfer And Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 ("NTTAA"), Public Law 104–113, section 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (*e.g.*, materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standard bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This action does not mandate the use of any particular technical standards, although in designing appropriate BMPs regulated small MS4s and small construction sites are encouraged to use any voluntary consensus standards that may be applicable and appropriate. Because no specific technical standards are included in the rule, section 12(d) of the NTTAA is not applicable.

G. Executive Order 13045

Executive Order 13045: "Protection of Children from Environmental Health Risks and Safety Risks" (62 FR 19885, April 23, 1997) applies to any rule that: (1) Is determined to be "economically significant" as defined under E.O. 12866, and (2) concerns an environmental health or safety risk that EPA has reason to believe may have a disproportionate effect on children. If the regulatory action meets both criteria, the Agency must evaluate the environmental health or safety effects of the planned rule on children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency.

This final rule is not subject to E.O. 13045 because it does not concern an environmental health or safety risk that may have a disproportionate effect on children. The rule expands the scope of the existing NPDES permitting program to require small municipalities and small construction sites to regulate their storm water discharges. The rule does not itself, however, establish standards or criteria that would be included in permits for those sources. Such standards or criteria will be developed through other actions, for example, in the establishment of water quality standards or subsequently in the issuance of permits themselves. As such, today's action does not concern an environmental health or safety risk that may have a disproportionate effect on children. To the extent it does address a risk that may have a disproportionate effect on children, expanding the scope of the permitting program will have a corresponding disproportionate benefit to children to protect them from such risk.

H. Executive Order 13084

Under Executive Order 13084, EPA may not issue a regulation that is not required by statute, that significantly or uniquely affects the communities of Indian tribal governments, and that imposes substantial direct compliance costs on those communities, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by the Tribal governments, or EPA consults with those governments. If EPA complies by consulting, Executive Order 13084 requires EPA to provide to the Office of Management and Budget, in a separately identified section of the preamble to the rule, a description of the extent of EPA's prior consultation with representatives of affected Tribal governments, a summary of the nature of their concerns, and a statement supporting the need to issue the regulation. In addition, Executive Order 13084 requires EPA to develop an effective process permitting elected officials and other representatives of Indian Tribal governments "to provide meaningful and timely input in the development of regulatory policies on matters that significantly or uniquely affect their communities."

Today's rule does not significantly or uniquely affect the communities of Indian Tribal governments. Even though the Agency is not required to address Tribes under the Regulatory Flexibility Act, EPA used the same revenue test that was used for municipalities to assess the impact of the rule on communities of Tribal governments and determine that they will not be significantly affected. In addition, the rule will not have a unique impact on the communities of Tribal governments because small municipal governments are also covered by this rule and larger municipal governments are already covered by the existing storm water rules. Accordingly, the requirements of section 3(b) of Executive Order 13084 do not apply to this rule.

I. Congressional Review Act

The Congressional Review Act, 5 U.S.C. section 801 *et seq.*, as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and the Comptroller General of the United States. EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the United States prior to publication of the rule in the Federal Register. A major rule cannot take effect until 60 days after it is published in the **Federal Register**. This rule is a "major rule" as defined by 5 U.S.C. 804(2). This rule will be effective on February 7, 2000.

List of Subjects

40 CFR Part 9

Environmental protection, Reporting and recordkeeping requirements.

40 CFR Part 122

Administrative practice and procedure, Confidential business information, Environmental protection, Hazardous substances, Incorporation by reference, Reporting and recordkeeping requirements, Sewage disposal, Waste treatment and disposal, Water pollution control.

40 CFR Part 123

Administrative practice and procedure, Confidential business information, Hazardous materials, Indians—lands, Intergovernmental relations, Penalties, Reporting and recordkeeping requirements, Sewage disposal, Waste treatment and disposal, Water pollution control, Penalties.

40 CFR Part 124

Administrative practice and procedure, Air pollution control, Hazardous waste, Indians—lands, Reporting and recordkeeping requirements, Water pollution control, Water supply.

Dated: October 29, 1999.

Carol M. Browner,

Administrator.

Appendices to the Preamble

APPENDIX 1 TO PREAMBLE—FEDERALLY-RECOGNIZED AMERICAN INDIAN AREAS LOCATED FULLY OR PARTIALLY IN BUREAU OF THE CENSUS URBANIZED AREAS

[Based on 1990 Census data]

State	American Indian Area	Urbanized Area
AZ	Pascua Yacqui Reservation (pt.): Pascua Yacqui Tribe of Arizona	Tucson, AZ (Phase I).
AZ	Salt River Reservation (pt.): Salt River Pima-Maricopa Indian Community of the Salt River Reservation, California.	Phoenix, AZ (Phase I).
AZ	San Xavier Reservation (pt.): Tohono O'odham Nation of Arizona (formerly known as the Papago Tribe of the Sells, Gila Bend & San Xavier Reservation).	Tucson, AZ (Phase I).
CA	Augustine Reservation: Augustine Band of Cahuilla Mission of Indians of the Augustine Reservation, CA.	Indio-Coachella, CA (Phase I).
CA	Cabazon Reservation: Cabazon Band of Cahuilla Mission Indians of the Cabazon Reservation, CA.	Indio-Coachella, CA (Phase I).

APPENDIX 1 TO PREAMBLE—FEDERALLY-RECOGNIZED AMERICAN INDIAN AREAS LOCATED FULLY OR PARTIALLY IN BUREAU OF THE CENSUS URBANIZED AREAS—Continued

[Based on 1990 Census data]

State	American Indian Area	Urbanized Area
CA	Fort Yuma (Quechan) (pt.): Quechan Tribe of the Fort Yuma Indian Reservation, California & Arizona.	Yuma, AZ–CA.
CA	Redding Rancheria: Redding Rancheria of California	Redding, CA.
FL	Hollywood Reservation: Seminole Tribe	Fort Lauderdale, FL (Phase I).
FL	Seminole Trust Lands: Seminole Tribe of Florida, Dania, Big Cypress & Brighton Reservations.	Fort Lauderdale, FL (Phase I).
ID	Fort Hall Reservation and Trust Lands: Shosone-Bannock Tribes of the Fort Hall Reservation of Idaho.	Pocatello, ID.
ME	Penobscot Reservation and Trust Lands (pt.): Penobscot Tribe of Maine	Bangor, ME.
MN	Shakopee Community: Shakopee Mdewakanton Sioux Community of Minnesota (Prior Lake).	Minneapolis-St. Paul, MN (Phase I).
NM	Sandia Pueblo (pt.): Pueblo of Sandia, New Mexico	Albuquerque, NM (Phase I).
NV	Las Vegas Colony: Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony, Nevada.	Las Vegas, NV (Phase I).
NV	Reno-Sparks Colony: Reno-Sparks Indian Colony, Nevada	Reno, NV (Phase I).
OK	Osage Reservation (pt.): Osage Nation of Oklahoma	Tulsa, OK (Phase I).
OK	Absentee Shawnee-Citizens Band of Potawatomi TJSA (pt.): Absentee-Shawnee Tribe of Indians of Oklahoma; Citizen Potawatomi Nation, Oklahoma.	Oklahoma City, OK (Phase I).
OK	Cherokee TJSA 9 (pt.): Cherokee Nation of Oklahoma; United Keetoowah Band of Cherokee Indians of Oklahoma.	Ft. Smith, AR–OK; Tulsa, OK (Phase I).
OK	Cheyenne-Arapaho TJSA (pt.): Cheyenne-Arapaho Tribes of Oklahoma	Oklahoma City, OK (Phase I).
OK	Choctaw TJSA (pt.): Choctaw Nation of Oklahoma	Ft. Smith, AR–OK (Phase I).
OK	Creek TJSA (pt.): Alabama-Quassarte Tribal Town of the Creek Nation of Oklahoma; Kialegee Tribal Town of the Creek Indian Nation of Oklahoma; Muscogee (Creek) Nation of Oklahoma; Thlopthlocco Tribal Town of the Creek Nation of Oklahoma.	Tulsa, OK (Phase I).
OK	Kiowa-Comanche-Apache-Ft. Sill Apache: Apache Tribe of Oklahoma; Comanche Indian Tribe, Oklahoma; Fort Sill Apache Tribe of Oklahoma; Kiowa Indian Tribe of Oklahoma.	Lawton, OK.
TX	Ysleta del Sur Reservation: Ysleta Del Sur Pueblo of Texas	El Paso, TX–NM (Phase I).
WA	Muckleshoot Reservation and Trust Lands (pt.): Muckleshoot Indian Tribe of the Muckleshoot Reservation.	Seattle, WA (Phase I).
WA	Puyallup Reservation and Trust Lands (pt.): Puyallup Tribe of the Puyallup Reservation, WA.	Tacoma, WA (Phase I).
WA	Yakima Reservation (pt.): Confederated Tribes and Bands of the Yakama Indian Nation of the Yakama Reservation, WA.	Yakima, WA.
WI	Oneida (West) (pt.): Oneida Tribe of Wisconsin	Green Bay, WI.

Please Note

"(pt.)" indicates that the American Indian Area (AIA) listed is only partially located within the referenced urbanized area.

The first line under "American Indian Area" is the name of the federally-recognized reservation/colony/rancheria or trust land as it appears in the Bureau of the Census data. After this first line, the names of the tribes included in the AIA are listed as they appear in the Bureau of Indian Affairs' list of Federally Recognized Indian Tribes. (**Federal Register**: Nov. 13, 1998, Vol. 66, No. 220, pgs. 58211–58216)

"TJSAs" are Tribal Jurisdiction Statistical Areas in Oklahoma that are defined in conjunction with the federally-recognized tribes in Oklahoma who have definite land areas under their jurisdiction, but do not have reservation status.

"(Phase I)" indicates that the referenced urbanized area includes a medium or large MS4 currently regulated under the existing NPDES storm water program (i.e., Phase I). Any Tribally operated MS4 within these such urban areas would not automatically have been covered under Phase I, however.

Sources

Michael Ratcliffe, Geographic Concepts Division, Bureau of the Census, U.S. Department of Commerce.

1990 Census of Population and Housing, Summary Population and Housing Characteristics, United States. Tables 9 & 10. [1990 CPH–1–1]. Bureau of the Census, U.S. Department of Commerce.

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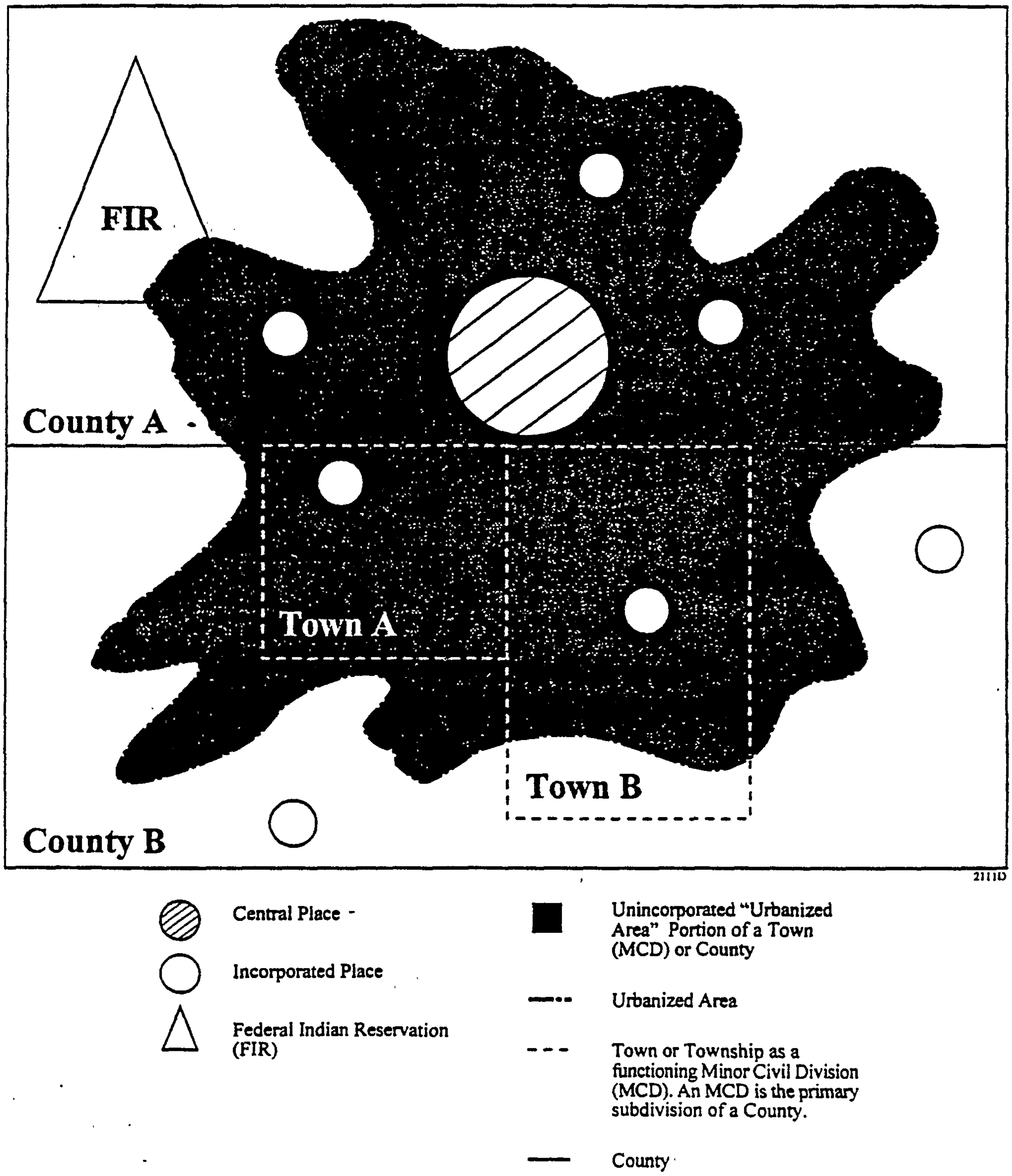
APPENDIX 2 TO PREAMBLE—URBANIZED AREA ILLUSTRATION



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Appendix 3 to the Preamble—Urbanized Areas of the United States and Puerto Rico

(Source: 1990 Census of Population and Housing, U.S. Bureau of the Census—This list is subject to change with the Decennial Census)

Alabama

Anniston
Auburn-Opelika
Birmingham
Columbus, GA–AL
Decatur
Dothan
Florence
Gadsden
Huntsville
Mobile
Montgomery
Tuscaloosa

Alaska

Anchorage

Arizona

Phoenix
Tucson
Yuma, AZ–CA

Arkansas

Fayetteville-Springdale
Fort Smith, AR–OK
Little Rock-North Little Rock
Memphis, TN–AR–MS
Pine Bluff
Texarkana, AR–TX

California

Antioch-Pittsburgh
Bakersfield
Chico
Davis
Fairfield
Fresno
Hemet-San Jacinto
Hesperia-Apple Valley-Victorville
Indio-Coachella
Lancaster-Palmdale
Lodi
Lompoc
Los Angeles
Merced
Modesto
Napa
Oxnard-Ventura
Palm Springs
Redding
Riverside-San Bernardino
Sacramento
Salinas
San Diego
San Francisco-Oakland
San Jose
San Luis Obispo
Santa Barbara
Santa Cruz
Santa Maria
Santa Rosa
Seaside-Monterey
Simi Valley
Stockton
Vacaville
Visalia
Watsonville
Yuba City
Yuma

Colorado

Boulder
Colorado Springs
Denver
Fort Collins
Grand Junction
Greeley
Longmont
Pueblo

Connecticut

Bridgeport-Milford
Bristol
Danbury, CT–NY
Hartford-Middletown
New Britain
New Haven-Meriden
New London-Norwich
Norwalk
Springfield, MA–CT
Stamford, CT–NY
Waterbury
Worcester, MA–CT

Delaware

Dover
Wilmington, DE–NJ–MD–PA

District of Columbia

Washington, DC–MD–VA

Florida

Daytona Beach
Deltona
Fort Lauderdale-Hollywood-Pompano Beach
Fort Myers-Cape Coral
Fort Pierce
Fort Walton Beach
Gainesville
Jacksonville
Kissimmee
Lakeland
Melbourne-Palm Bay
Miami-Hialeah
Naples
Ocala
Orlando
Panama City
Pensacola
Punta Gorda
Sarasota-Bradenton
Spring Hill
Stuart
Tallahassee
Tampa-St. Petersburg-Clearwater
Titusville
Vero Beach
West Palm Beach-Boca Raton-Delray Beach
Winter Haven

Georgia

Albany
Athens
Atlanta
Augusta
Brunswick
Chattanooga
Columbus
Macon
Rome
Savannah
Warner Robins

Hawaii

Honolulu
Kailua

Idaho

Boise City
Idaho Falls
Pocatello

Illinois

Alton
Aurora
Beloit, WI–IL
Bloomington-Normal
Champaign-Urbana
Chicago, IL-Northwestern IN
Crystal Lake
Davenport-Rock Island-Moline, IA–IL
Decatur
Dubuque
Elgin
Joliet
Kankakee
Peoria
Rockford
Round Lake Beach-McHenry, IL–WI
St. Louis, MO–IL
Springfield

Indiana

Anderson
Bloomington
Chicago, IL-Northwestern IN
Elkhart-Goshen
Evansville, IN–KY
Fort Wayne
Indianapolis
Kokomo
Lafayette-West Lafayette
Louisville, KY–IN
Muncie
South Bend-Mishawaka, IN–MI
Terre Haute

Iowa

Cedar Rapids
Davenport-Rock Island-Moline, IA–IL
Des Moines
Dubuque, IA–IL–WI
Iowa City
Omaha, NE–IA
Sioux City, IA–NE–SD
Waterloo-Cedar Falls

Kansas

Kansas City, MO–KS
Lawrence
St. Joseph, MO–KS
Topeka
Wichita

Kentucky

Cincinnati, OH–KY
Clarksville, TN–KY
Evansville, IN–KY
Huntington-Ashland, WV–KY–OH
Lexington-Fayette
Louisville, KY–IN
Owensboro

Louisiana

Alexandria
Baton Rouge
Houma
Lafayette
Lake Charles
Monroe
New Orleans
Shreveport

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Slidell

Maine

Bangor
Lewiston-Auburn
Portland
Portsmouth-Dover-Rochester, NH–ME

Maryland

Annapolis
Baltimore
Cumberland
Frederick
Hagerstown, MD–PA–WV
Washington, DC–MD–VA
Wilmington, DE–NJ–MD–PA

Massachusetts

Boston
Brockton
Fall River, MA–RI
Fitchburg-Leominster
Hyannis
Lawrence-Haverhill, MA–NH
Lowell, MA–NH
New Bedford
Pittsfield
Providence-Pawtucket, RI–MA
Springfield, MA–CT
Taunton
Worcester, MA–CT

Michigan

Ann Arbor
Battle Creek
Bay City
Benton Harbor
Detroit
Flint
Grand Rapids
Holland
Jackson
Kalamazoo
Lansing-East Lansing
Muskegon
Port Huron
Saginaw
South Bend-Mishawaka, IN–MI
Toledo, OH–MI

Minnesota

Duluth, MN–WI
Fargo-Moorhead, ND–MN
Grand Forks, ND–MN
La Crosse, WI–MN
Minneapolis-St.Paul
Rochester
St. Cloud

Mississippi

Biloxi-Gulfport
Hattiesburg
Jackson
Memphis, TN–AR–MS
Pascagoula

Missouri

Columbia
Joplin
Kansas City, MO–KS
St. Joseph, MO–KS
St. Louis, MO–IL
Springfield

Montana

Billings
Great Falls
Missoula

Nebraska

Lincoln
Omaha, NE–IA
Sioux City, IA–NE–SD

Nevada

Las Vegas
Reno

New Hampshire

Lawrence-Haverhill, MA–NH
Lowell, MA–NH
Manchester
Nashua
Portsmouth-Dover-Rochester, NH–ME

New Jersey

Allentown-Bethlehem-Easton, PA–NJ
Atlantic City
New York, NY-Northeastern NJ
Philadelphia, PA–NJ
Trenton, NJ–PA
Vineland-Millville
Wilmington, DE–NJ–MD–PA

New Mexico

Albuquerque
El Paso
Las Cruces
Santa Fe

New York

Albany-Schenectady-Troy
Binghamton
Buffalo-Niagara Falls
Danbury, CT–NY
Elmira
Glens Falls
Ithaca
Newburgh
New York, NY–Northeastern NJ
Poughkeepsie
Rochester
Stamford, CT–NY
Syracuse
Utica-Rome

North Carolina

Asheville
Burlington
Charlotte
Durham
Fayetteville
Gastonia
Goldsboro
Greensboro
Greenville
Hickory
High Point
Jacksonville
Kannapolis
Raleigh
Rocky Mount
Wilmington
Winston-Salem

North Dakota

Bismark
Fargo-Moorhead, ND–MN
Grand Forks, ND–MN

Ohio

Akron
Canton
Cincinnati, OH–KY
Cleveland
Columbus
Dayton
Hamilton
Huntington-Ashland, WV–KY–OH
Lima
Lorain-Elyria
Mansfield
Middletown
Newark
Parkersburg, WV–OH
Sharon, PA–OH
Springfield
Steubenville-Weirton, OH–WV–PA
Toledo, OH–MI
Wheeling, WV–OH
Youngstown-Warren

Oklahoma

Fort Smith, AR–OK
Lawton
Oklahoma City
Tulsa

Oregon

Eugene-Springfield
Longview
Medford
Portland-Vancouver, OR–WA
Salem

Pennsylvania

Allentown-Bethlehem-Easton, PA–NJ
Altoona
Erie
Hagerstown, MD–PA–WV
Harrisburg
Johnstown
Lancaster
Monessen
Philadelphia, PA–NJ
Pittsburgh
Pottstown
Reading
Scranton-Wilkes-Barre
Sharon, PA–OH
State College
Steubenville-Weirton, OH–WV–PA
Trenton, NJ–PA
Williamsport
Wilmington, DE–NJ–MD–PA
York

Rhode Island

Fall River, MA–RI
Newport
Providence-Pawtucket, RI–MA

South Carolina

Anderson
Augusta, GA–SC
Charleston
Columbia
Florence
Greenville
Myrtle Beach
Rock Hill
Spartanburg
Sumter

South Dakota

Rapid City
Sioux City, IA–NE–SD
Sioux Falls

Tennessee

Bristol, TN-Bristol, VA

Chattanooga, TN–GA
Clarksville, TN–KY
Jackson
Johnson City
Kingsport, TN–VA
Knoxville
Memphis, TN–AR–MS
Nashville

Texas

Abilene
Amarillo
Austin
Beaumont
Brownsville
Bryan-College Station
Corpus Christi
Dallas-Fort Worth
Denton
El Paso, TX–NM
Galveston
Harlingen
Houston
Killeen
Laredo
Lewisville
Longview
Lubbock
McAllen-Edinburg-Mission
Midland
Odessa
Port Arthur
San Angelo
San Antonio
Sherman-Denison
Temple
Texarkana, TX-Texarkana, AR
Texas City
Tyler
Victoria
Waco
Wichita Falls

Utah

Logan
Ogden
Provo-Orem
Salt Lake City

Vermont

Burlington

Virginia

Bristol, TN-Bristol, VA
Charlottesville
Danville
Fredericksburg
Kingsport, TN–VA
Lynchburg
Norfolk-Virginia Beach-Newport News
Petersburg
Richmond
Roanoke
Washington, DC–MD–VA

Washington

Bellingham
Bremerton
Longview, WA–OR
Olympia
Portland-Vancouver, OR–WA
Richland-Kennewick-Pasco
Seattle
Spokane
Tacoma
Yakima

West Virginia

Charleston
Cumberland, MD–WV
Hagerstown, MD–PA–WV
Huntington-Ashland, WV–KY–OH
Parkersburg, WV–OH
Steubenville-Weirton, OH–WV–PA
Wheeling, WV–OH

Wisconsin

Appleton-Neenah
Beloit, WI–IL
Duluth, MN–WI
Eau Claire
Green Bay
Janesville
Kenosha
La Crosse, WI–MN
Madison
Milwaukee
Oshkosh
Racine
Round Lake Beach-McHenry, IL–WI
Sheboygan
Wausau

Wyoming

Casper
Cheyenne

Puerto Rico

Aquadilla
Arecibo
Caguas
Cayey
Humacao
Mayaguez
Ponce
San Juan
Vega Baja-Manati

BILLING CODE 6560–50–P

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Appendix 4 to the Preamble—No Exposure Certification Form

NPDES FORM 3510-11

EPA

United States Environmental Protection Agency
Washington, DC 20460

Form Approved
OMB No. 2040-0211

NO EXPOSURE CERTIFICATION for Exclusion from NPDES Storm Water Permitting

Submission of this No Exposure Certification constitutes notice that the entity identified in Section A does not require permit authorization for its storm water discharges associated with industrial activity in the State identified in Section B under EPA's Storm Water Multi-Sector General Permit due to the existence of a condition of no exposure.

A condition of no exposure exists at an industrial facility when all industrial materials and activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snowmelt, and/or runoff. Industrial materials or activities include, but are not limited to, material handling equipment or activities, industrial machinery, raw materials, intermediate products, by-products, final products, or waste products. Material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, final product or waste product. A storm resistant shelter is not required for the following industrial materials and activities:

- drums, barrels, tanks, and similar containers that are tightly sealed, provided those containers are not deteriorated and do not leak. "Sealed" means banded or otherwise secured and without operational taps or valves;
- adequately maintained vehicles used in material handling; and
- final products, other than products that would be mobilized in storm water discharges (e.g., rock salt).

A No Exposure Certification must be provided for each facility qualifying for the no exposure exclusion. In addition, the exclusion from NPDES permitting is available on a facility-wide basis only, not for individual outfalls. If any industrial activities or materials are or will be exposed to precipitation, the facility is not eligible for the no exposure exclusion.

By signing and submitting this No Exposure Certification form, the entity in Section A is certifying that a condition of no exposure exists at its facility or site, and is obligated to comply with the terms and conditions of 40 CFR 122.26(g).

ALL INFORMATION MUST BE PROVIDED ON THIS FORM.

Detailed instructions for completing this form and obtaining the no exposure exclusion are provided on pages 3 and 4.

A. Facility Operator Information

1. Name: ______ 2. Phone: ______

3. Mailing Address: a. Street: ______

b. City: ______ c. State: ___ d. Zip Code: _____-____

B. Facility/Site Location Information

1. Facility Name: ______

2. a. Street Address: ______

b. City: ______ c. County: ______

d. State: ___ e. Zip Code: _____-____

3. Is the facility located on Indian Lands? Yes ☐ No ☐

4. Is this a Federal facility? Yes ☐ No ☐

5. a. Latitude: ___° ___' ___" b. Longitude: ___° ___' ___"

6. a. Was the facility or site previously covered under an NPDES storm water permit? Yes ☐ No ☐

b. If yes, enter NPDES permit number: ______

7. SIC/Activity Codes: Primary: ____ Secondary (if applicable): ____

8. Total size of site associated with industrial activity: ______ acres

9. a. Have you paved or roofed over a formerly exposed, pervious area in order to qualify for the no exposure exclusion? Yes ☐ No ☐

b. If yes, please indicate approximately how much area was paved or roofed over. Completing this question does not disqualify you for the no exposure exclusion. However, your permitting authority may use this information in considering whether storm water discharges from your site are likely to have an adverse impact on water quality, in which case you could be required to obtain permit coverage.

Less than one acre ☐ One to five acres ☐ More than five acres ☐

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NPDES FORM 3510-11 | EPA | **NO EXPOSURE CERTIFICATION for Exclusion from NPDES Storm Water Permitting** | Form Approved OMB No. 2040-0211

C. Exposure Checklist

Are any of the following materials or activities exposed to precipitation, now or in the foreseeable future? (Please check either "Yes" or "No" in the appropriate box.) ***If you answer "Yes" to any of these questions (1) through (11), you are not eligible for the no exposure exclusion.***

	Yes	No
1. Using, storing or cleaning industrial machinery or equipment, and areas where residuals from using, storing or cleaning industrial machinery or equipment remain and are exposed to storm water	☐	☐
2. Materials or residuals on the ground or in storm water inlets from spills/leaks	☐	☐
3. Materials or products from past industrial activity	☐	☐
4. Material handling equipment (except adequately maintained vehicles)	☐	☐
5. Materials or products during loading/unloading or transporting activities	☐	☐
6. Materials or products stored outdoors (except final products intended for outside use [e.g., new cars] where exposure to storm water does not result in the discharge of pollutants)	☐	☐
7. Materials contained in open, deteriorated or leaking storage drums, barrels, tanks, and similar containers	☐	☐
8. Materials or products handled/stored on roads or railways owned or maintained by the discharger	☐	☐
9. Waste material (except waste in covered, non-leaking containers [e.g., dumpsters])	☐	☐
10. Application or disposal of process wastewater (unless otherwise permitted)	☐	☐
11. Particulate matter or visible deposits of residuals from roof stacks and/or vents not otherwise regulated (i.e., under an air quality control permit) and evident in the storm water outflow	☐	☐

D. Certification Statement

I certify under penalty of law that I have read and understand the eligibility requirements for claiming a condition of "no exposure" and obtaining an exclusion from NPDES storm water permitting.

I certify under penalty of law that there are no discharges of storm water contaminated by exposure to industrial activities or materials from the industrial facility or site identified in this document (except as allowed under 40 CFR 122.26(g)(2)).

I understand that I am obligated to submit a no exposure certification form once every five years to the NPDES permitting authority and, if requested, to the operator of the local municipal separate storm sewer system (MS4) into which the facility discharges (where applicable). I understand that I must allow the NPDES permitting authority, or MS4 operator where the discharge is into the local MS4, to perform inspections to confirm the condition of no exposure and to make such inspection reports publicly available upon request. I understand that I must obtain coverage under an NPDES permit prior to any point source discharge of storm water from the facility.

Additionally, I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Print Name: ______________________

Print Title: ______________________

Signature: ______________________

Date: __________

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NPDES FORM 3510-11 | EPA | Instructions for the NO EXPOSURE CERTIFICATION for Exclusion from NPDES Storm Water Permitting | Form Approved OMB No. 2040-0211

Who May File a No Exposure Certification

Federal law at 40 CFR Part 122.26 prohibits point source discharges of storm water associated with industrial activity to waters of the U.S. without a National Pollutant Discharge Elimination System (NPDES) permit. However, NPDES permit coverage is not required for discharges of storm water associated with industrial activities identified at 40 CFR 122.26(b)(14)(i)-(ix) and (xi) if the discharger can certify that a condition of "no exposure" exists at the industrial facility or site.

Storm water discharges from construction activities identified in 40 CFR 122.26(b)(14)(x) and (b)(15) are not eligible for the no exposure exclusion.

Obtaining and Maintaining the No Exposure Exclusion

This form is used to certify that a condition of no exposure exists at the industrial facility or site described herein. This certification is only applicable in jurisdictions where EPA is the NPDES permitting authority and must be re-submitted at least once every five years.

The industrial facility operator must maintain a condition of no exposure at its facility or site in order for the no exposure exclusion to remain applicable. If conditions change resulting in the exposure of materials and activities to storm water, the facility operator must obtain coverage under an NPDES storm water permit immediately.

Where to File the No Exposure Certification Form

Mail the completed no exposure certification form to:

Storm Water No Exposure Certification (4203)
USEPA
401 M Street, SW
Washington, D.C. 20460

Completing the Form

You <u>must</u> type or print, using uppercase letters, in appropriate areas only. Enter only one character per space (i.e., between the marks). Abbreviate if necessary to stay within the number of characters allowed for each item. Use one space for breaks between words. One form must be completed for each facility or site for which you are seeking to certify a condition of no exposure. Additional guidance on completing this form can be accessed through EPA's web site at www.epa.gov/owm/sw. Please make sure you have addressed all applicable questions and have made a photocopy for your records before sending the completed form to the above address.

Section A. Facility Operator Information

1. Provide the legal name of the person, firm, public organization, or any other entity that operates the facility or site described in this certification. The name of the operator may or may not be the same as the name of the facility. The operator is the legal entity that controls the facility's operation, rather than the plant or site manager.
2. Provide the telephone number of the facility operator.
3. Provide the mailing address of the operator (P.O. Box numbers may be used). Include the city, state, and zip code. All correspondence will be sent to this address.

Section B. Facility/Site Location Information

1. Enter the official or legal name of the facility or site.
2. Enter the complete street address (if no street address exists, provide a geographic description [e.g., Intersection of Routes 9 and 55]), city, county, state, and zip code. Do not use a P.O. Box number.
3. Indicate whether the facility is located on Indian Lands.
4. Indicate whether the industrial facility is operated by a department or agency of the Federal Government (see also Section 313 of the Clean Water Act).
5. Enter the latitude and longitude of the approximate center of the facility or site in degrees/minutes/seconds. Latitude and longitude can be obtained from United States Geological Survey (USGS) quadrangle or topographic maps, by calling 1-(888) ASK-USGS, or by accessing EPA's web site at <u>http://www.epa.gov/owm/sw/industry/index.htm</u> and selecting Latitude and Longitude Finders under the Resources/Permit section.

   Latitude and longitude for a facility in decimal form must be converted to degrees (°), minutes ('), and seconds (") for proper entry on the certification form. To convert decimal latitude or longitude to degrees/minutes/seconds, follow the steps in the following example.

   <u>Example</u>: Convert decimal latitude 45.1234567 to degrees (°), minutes ('), and seconds (").

   a) The numbers to the left of the decimal point are the degrees: 45°.
   b) To obtain minutes, multiply the first four numbers to the right of the decimal point by 0.006: 1234 x 0.006 = 7.404.
   c) The numbers to the left of the decimal point in the result obtained in (b) are the minutes: 7'.
   d) To obtain seconds, multiply the remaining three numbers to the right of the decimal from the result obtained in (b) by 0.06: 404 x 0.06 = 24.24. Since the numbers to the right of the decimal point are not used, the result is 24".
   e) The conversion for 45.1234567 = 45° 7' 24".
6. Indicate whether the facility was previously covered under an NPDES storm water permit. If so, include the permit number.
7. Enter the 4-digit SIC code which identifies the facility's primary activity, and second 4-digit SIC code identifying the facility's secondary activity, if applicable. SIC codes can be obtained from the <u>Standard Industrial Classification Manual, 1987</u>.
8. Enter the total size of the site associated with industrial activity in acres. Acreage may be determined by dividing square footage by 43,560, as demonstrated in the following example.

   <u>Example</u>: Convert 54,450 ft^2 to acres

   Divide 54,450 ft^2 by 43,560 square feet per acre:
   54,450 ft^2 ÷ 43,560 ft^2/acre = 1.25 acres.
9. Check "Yes" or "No" as appropriate to indicate whether you have paved or roofed over a formerly exposed, pervious area (i.e., lawn, meadow, dirt or gravel road/parking lot) in order to qualify for no exposure. If yes, also indicate approximately how much area was paved or roofed over and is now impervious area.

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NPDES FORM 3510-11 EPA

Instructions for the NO EXPOSURE CERTIFICATION for Exclusion from NPDES Storm Water Permitting

Form Approved OMB No. 2040-0211

Section C. Exposure Checklist

Check "Yes" or "No" as appropriate to describe the exposure conditions at your facility. If you answer "Yes" to **ANY** of the questions (1) through (11) in this section, a potential for exposure exists at your site and you cannot certify to a condition of no exposure. You must obtain (or already have) coverage under an NPDES storm water permit. After obtaining permit coverage, you can institute modifications to eliminate the potential for a discharge of storm water exposed to industrial activity, and then certify to a condition of no exposure.

Section D. Certification Statement

Federal statutes provide for severe penalties for submitting false information on this application form. Federal regulations require this application to be signed as follows:

For a corporation: by a responsible corporate officer, which means:

(i) president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation, or

(ii) the manager of one or more manufacturing, production, or operating facilities, provided the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

For a partnership or sole proprietorship: by a general partner or the proprietor; or

For a municipal, State, Federal, or other public facility: by either a principal executive or ranking elected official.

Paperwork Reduction Act Notice

Public reporting burden for this certification is estimated to average 1.0 hour per certification, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose to provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments regarding the burden estimate, any other aspect of the collection of information, or suggestions for improving this form, including any suggestions which may increase or reduce this burden to: Director, OPPE Regulatory Information Division (2137), USEPA, 401 M Street, SW, Washington, D.C. 20460. Include the OMB control number of this form on any correspondence. Do not send the completed No Exposure Certification form to this address.

EPA Form 3510-11 (10-99) Page 4 of 4

BILLING CODE 6560-50-C

Appendix 5 to Preamble—Regulatory Flexibility for Small Entities

A. Regulatory Flexibility for Small Municipal Storm Sewer Systems (MS4s)

Different Compliance, Reporting, or Timetables That Are Responsive to Resources of Small Entities

NPDES permitting authorities can issue general permits instead of requiring individual permits. This flexibility avoids the high application costs and administrative burden associated with individual permits.

NPDES permitting authorities can specify a time period of up to five years for small MS4s to fully develop and implement their program

Analytic monitoring is not required.

After the first permit term and subsequent permit terms, submittal of a summary report is only required in years two and four (Phase I municipalities are currently required to submit a detailed report each year).

A brief reporting format is encouraged to facilitate compiling and analyzing data from submitted reports. EPA intends to develop a model form for this purpose.

NPDES Permitting Authorities can phase in permit coverage for small MS4s serving jurisdictions with a population under 10,000 on a schedule consistent with a State watershed permitting approach.

Clarifying, Consolidating, or Simplifying Compliance and Reporting Requirements

The rule avoids duplication in permit requirements by allowing NPDES permitting authorities to include permit conditions that direct an MS4 to follow the requirements of a qualifying local program rather than the requirements of a minimum measure. Compliance with these programs is considered compliance with the NPDES general permit.

The rule allows NPDES permitting authorities to recognize existing responsibilities among different municipal entities to satisfy obligations for the minimum control measures.

A further alternative allows a small MS4 to satisfy its NPDES permit obligations if another governmental entity is already implementing a minimum control measure in the jurisdiction of the small MS4. The following conditions must be met:

1. The other entity is implementing the control measure,

2. The particular control measure (or component thereof) is at least as stringent as the corresponding NPDES permit requirement, and

3. The other entity agrees to implement the control measure on your behalf.

The rule allows a covered small MS4 to "piggy-back" on to the storm water management program of an adjoining Phase I MS4. A small MS4 is waived from the application requirements of § 122.26(d)(1)(iii), (iv) and (d)(2)(iii) [discharge characterization] and may satisfy the requirements of § 122.26(d)(1)(v) and (d)(2)(iv) [identifying a management plan] by referencing the adjoining Phase I MS4's storm water management plan.

The rule accommodates the use of the watershed approach through NPDES general permits that could be issued on a watershed basis. The small MS4 can develop measures that are tailored to meet their watershed requirements. The small MS4's storm water management program can tie into watershed-wide plans.

Performance Rather Than Design Standards for Small Entities

Small governmental jurisdictions whose MS4s are covered by this rule are allowed to choose the best management practices (BMPs) to be implemented and the measurable goals for each of the minimum control measures:

1. Public education and outreach on storm water impacts

2. Public Involvement/Participation

3. Illicit discharge detection and elimination

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4. Construction site storm water runoff control
5. Post-construction storm water management in new development and redevelopment
6. Pollution prevention/good housekeeping for municipal operations

EPA will provide guidance and recommend, but not mandate, certain BMPs for some of the minimum control measures listed above. States can provide guidance to supplement or supplant EPA guidance.

Small MS4s can identify the measurable goals for each of the minimum control measures listed above. In their reports to the NPDES permitting authority, the small MS4s must evaluate their progress towards achievement of their identified measurable goals.

Waivers for Small Entities From Coverage

The rule allows permitting authorities to waive from coverage MS4s operated by small governmental jurisdictions located within an urbanized area and serving a population less than 1,000 people where the permitting authority has determined the MS4 is not contributing substantially to the pollutant loadings of an interconnected MS4 and, if the MS4 discharges pollutants that have been identified as a cause of impairment in the receiving water of the MS4 then the permitting authority has determined that storm water controls are not needed based on a TMDL that addresses the pollutants of concern.

The rule allows the permitting authority to waive from coverage MS4s serving a population under 10,000 where the permitting authority has evaluated all waters that receive a discharge from the MS4 and the permitting authority has determined that storm water controls are not needed based on a TMDL that addresses the pollutants of concern and future discharges do not have the potential to result in exceedances of water quality standards.

B. Regulatory Flexibility for Small Construction Activities

Different Compliance, Reporting, or Timetables That Are Responsive to Resources of Small Entities

The rule gives NPDES permitting authorities discretion not to require the submittal of a notice of intent (NOI) for coverage under a NPDES general permit, thereby reducing administrative and financial burden. All construction sites disturbing greater than 5 acres must submit an NOI.

Clarifying, Consolidating, or Simplifying Compliance and Reporting Requirements

The rule avoids duplication by allowing the NPDES permitting authority to incorporate by reference State, Tribal, or local programs under a NPDES general permit. Compliance with these programs is considered compliance with the NPDES general permit.

Performance Rather Than Design Standards for Small Entities

The operator of a covered construction activity selects and implement the BMPs most appropriate for the construction site based on the operator's storm water pollution prevention plan.

Waivers for Small Entities From Coverage

Waivers could be granted based on the use of a rainfall erosivity factor or a comprehensive analysis of water quality impacts.

(A) *Low rainfall waiver:* When the rainfall erosivity factor ("R" from Revised Universal Soil Loss Equation) is less than 5 during the period of construction activity, a permit is not required.

(B) *Determination based on Water Quality Analysis:* The NPDES permitting authority can waive from coverage construction activities disturbing from 1 acre up to 5 acres of land where storm water controls are not needed based on:

1. A TMDL approved or established by EPA that addresses the pollutants of concern, or
2. For non-impaired waters, an equivalent analysis that determines that such allocations are not needed to protect water quality based on consideration of existing in-stream concentrations, expected growth in pollutant contributions from all sources, and a margin of safety.

C. Regulatory Flexibility for Industrial/Commercial Facilities

Waivers for Small Entities From Coverage

The rule provides a "no-exposure" waiver provision for Phase I industrial/commercial facilities. Qualifying facilities seeking this provision simply need to complete a self-certification form indicating that no industrial materials or activities are exposed to rain, snow, snow melt and/or runoff.

Appendix 6 of Preamble—Governmental Entities Located Fully or Partially Within an Urbanized Area

(This is a reference list only, *not* a list of all operators of small MS4s subject to §§ 122.32–122.36. For example, a listed governmental entity is only regulated if it operates a small MS4 within an "urbanized area" boundary as determined by the Bureau of the Census. Furthermore, entities such as military bases, large hospitals, prison complexes, universities, sewer districts, and highway departments that operate a small MS4 within an urbanized area are also subject to the permitting regulations but are not individually listed here. See § 122.26(b)(16) for the definition of a small MS4 and § 122.32(a) for the definition of a regulated small MS4.)

(Source: 1990 Census of Population and Housing, U.S. Bureau of the Census. This list is subject to change with the Decennial Census)

AL Anniston city
AL Attalla city
AL Auburn city
AL Autauga County
AL Blue Mountain town
AL Calhoun County
AL Colbert County
AL Dale County
AL Decatur city
AL Dothan city
AL Elmore County
AL Etowah County
AL Flint City town
AL Florence city
AL Gadsden city
AL Glencoe city
AL Grimes town
AL Hartselle city
AL Hobson City town
AL Hokes Bluff city
AL Houston County
AL Kinsey town
AL Lauderdale County
AL Lee County
AL Limestone County
AL Madison County
AL Midland City town
AL Montgomery County
AL Morgan County
AL Muscle Shoals city
AL Napier Field town
AL Northport city
AL Opelika city
AL Oxford city
AL Phenix City city
AL Prattville city
AL Priceville town
AL Rainbow City city
AL Russell County
AL Sheffield city
AL Southside city
AL Sylvan Springs town
AL Talladega County
AL Tuscaloosa city
AL Tuscaloosa County
AL Tuscumbia city
AL Weaver city
AR Alexander town
AR Barling city
AR Benton County
AR Cammack Village city
AR Crawford County
AR Crittenden County
AR Farmington city
AR Fayetteville city
AR Fort Smith city
AR Greenland town
AR Jacksonville city
AR Jefferson County
AR Johnson city
AR Marion city
AR Miller County
AR North Little Rock city
AR Pine Bluff city
AR Pulaski County
AR Saline County
AR Sebastian County
AR Shannon Hills city
AR Sherwood city
AR Springdale city
AR Sunset town
AR Texarkana city
AR Van Buren city
AR Washington County
AR West Memphis city
AR White Hall city
AZ Apache Junction city
AZ Chandler city
AZ El Mirage town
AZ Gilbert town
AZ Guadalupe town
AZ Maricopa County
AZ Oro Valley town
AZ Paradise Valley town
AZ Peoria city
AZ Pinal County

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AZ	South Tucson city
AZ	Surprise town
AZ	Tolleson city
AZ	Youngtown town
AZ	Yuma city
AZ	Yuma County
CA	Apple Valley town
CA	Belvedere city
CA	Benicia city
CA	Brentwood city
CA	Butte County
CA	Capitola city
CA	Carmel-by-the-Sea city
CA	Carpinteria city
CA	Ceres city
CA	Chico city
CA	Compton city
CA	Corte Madera town
CA	Cotati city
CA	Davis city
CA	Del Rey Oaks city
CA	Fairfax town
CA	Hesperia city
CA	Imperial County
CA	Lakewood city
CA	Lancaster city
CA	Larkspur city
CA	Lodi city
CA	Lompoc city
CA	Marin County
CA	Marina city
CA	Marysville city
CA	Merced city
CA	Merced County
CA	Mill Valley city
CA	Monterey city
CA	Monterey County
CA	Morgan Hill city
CA	Napa city
CA	Napa County
CA	Novato city
CA	Pacific Grove city
CA	Palm Desert city
CA	Palmdale city
CA	Piedmont city
CA	Placer County
CA	Redding city
CA	Rocklin city
CA	Rohnert Park city
CA	Roseville city
CA	Ross town
CA	San Anselmo town
CA	San Buenaventura (Ventura) city
CA	San Francisco city
CA	San Joaquin County
CA	San Luis Obispo city
CA	San Luis Obispo County
CA	San Rafael city
CA	Sand City city
CA	Santa Barbara city
CA	Santa Barbara County
CA	Santa Cruz city
CA	Santa Cruz County
CA	Santa Maria city
CA	Sausalito city
CA	Scotts Valley city
CA	Seaside city
CA	Shasta County
CA	Solano County
CA	Sonoma County
CA	Stanislaus County
CA	Suisun City city
CA	Sutter County
CA	Tiburon town
CA	Tulare County
CA	Vacaville city
CA	Victorville city
CA	Villa Park city
CA	Visalia city
CA	Watsonville city
CA	West Sacramento city
CA	Yolo County
CA	Yuba City city
CA	Yuba County
CO	Adams County
CO	Arvada city
CO	Boulder city
CO	Boulder County
CO	Bow Mar town
CO	Broomfield city
CO	Cherry Hills Village city
CO	Columbine Valley town
CO	Commerce City city
CO	Douglas County
CO	Edgewater city
CO	El Paso County
CO	Englewood city
CO	Evans city
CO	Federal Heights city
CO	Fort Collins city
CO	Fountain city
CO	Garden City town
CO	Glendale city
CO	Golden city
CO	Grand Junction city
CO	Greeley city
CO	Greenwood Village city
CO	Jefferson County
CO	La Salle town
CO	Lakeside town
CO	Larimer County
CO	Littleton city
CO	Longmont city
CO	Manitou Springs city
CO	Mesa County
CO	Mountain View town
CO	Northglenn city
CO	Pueblo city
CO	Pueblo County
CO	Sheridan city
CO	Thornton city
CO	Weld County
CO	Westminster city
CO	Wheat Ridge city
CT	Ansonia city
CT	Avon town
CT	Beacon Falls town
CT	Berlin town
CT	Bethel town
CT	Bloomfield town
CT	Bozrah town
CT	Branford town
CT	Bridgeport city
CT	Bristol city
CT	Brookfield town
CT	Burlington town
CT	Cheshire town
CT	Cromwell town
CT	Danbury city
CT	Darien town
CT	Derby city
CT	Durham town
CT	East Granby town
CT	East Hartford town
CT	East Haven town
CT	East Lyme town
CT	East Windsor town
CT	Easton town
CT	Ellington town
CT	Enfield town
CT	Fairfield County
CT	Fairfield town
CT	Farmington town
CT	Franklin town
CT	Glastonbury town
CT	Greenwich town
CT	Groton city
CT	Groton town
CT	Guilford town
CT	Hamden town
CT	Hartford city
CT	Hartford County
CT	Ledyard town
CT	Lisbon town
CT	Litchfield County
CT	Manchester town
CT	Meriden city
CT	Middlebury town
CT	Middlefield town
CT	Middlesex County
CT	Middletown city
CT	Milford city (remainder)
CT	Monroe town
CT	Montville town
CT	Naugatuck borough
CT	New Britain city
CT	New Canaan town
CT	New Fairfield town
CT	New Haven city
CT	New Haven County
CT	New London city
CT	New London County
CT	New Milford town
CT	Newington town
CT	Newtown town
CT	North Branford town
CT	North Haven town
CT	Norwalk city
CT	Norwich city
CT	Orange town
CT	Oxford town
CT	Plainville town
CT	Plymouth town
CT	Portland town
CT	Preston town
CT	Prospect town
CT	Rocky Hill town
CT	Seymour town
CT	Shelton city
CT	Sherman town
CT	Somers town
CT	South Windsor town
CT	Southington town
CT	Sprague town
CT	Stonington town
CT	Stratford town
CT	Suffield town
CT	Thomaston town
CT	Thompson town
CT	Tolland County
CT	Tolland town
CT	Trumbull town
CT	Vernon town
CT	Wallingford town
CT	Waterbury city
CT	Waterford town
CT	Watertown town
CT	West Hartford town
CT	West Haven city
CT	Weston town
CT	Westport town
CT	Wethersfield town
CT	Wilton town
CT	Windham County
CT	Windsor Locks town
CT	Windsor town
CT	Wolcott town
CT	Woodbridge town

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CT Woodmont borough
DE Camden town
DE Dover city
DE Kent County
DE Newark city
DE Wyoming town
FL Alachua County
FL Baldwin town
FL Bay County
FL Belleair Shore town
FL Biscayne Park village
FL Brevard County
FL Callaway city
FL Cape Canaveral city
FL Cedar Grove town
FL Charlotte County
FL Cinco Bayou town
FL Clay County
FL Cocoa Beach city
FL Cocoa city
FL Collier County
FL Daytona Beach city
FL Daytona Beach Shores city
FL Destin city
FL Edgewater city
FL El Portal village
FL Florida City city
FL Fort Pierce city
FL Fort Walton Beach city
FL Gainesville city
FL Gulf Breeze city
FL Hernando County
FL Hillsboro Beach town
FL Holly Hill city
FL Indialantic town
FL Indian Harbour Beach city
FL Indian River County
FL Indian River Shores town
FL Indian Shores town
FL Kissimmee city
FL Lazy Lake village
FL Lynn Haven city
FL Malabar town
FL Marion County
FL Martin County
FL Mary Esther city
FL Melbourne Beach town
FL Melbourne city
FL Melbourne Village town
FL Naples city
FL New Smyrna Beach city
FL Niceville city
FL Ocala city
FL Ocean Breeze Park town
FL Okaloosa County
FL Orange Park town
FL Ormond Beach city
FL Osceola County
FL Palm Bay city
FL Panama City city
FL Parker city
FL Ponce Inlet town
FL Port Orange city
FL Port St. Lucie city
FL Punta Gorda city
FL Rockledge city
FL Santa Rosa County
FL Satellite Beach city
FL Sewall's Point town
FL Shalimar town
FL South Daytona city
FL Springfield city
FL St. Johns County
FL St. Lucie County
FL St. Lucie village
FL Stuart city
FL Sweetwater city
FL Titusville city
FL Valparaiso city
FL Vero Beach city
FL Virginia Gardens village
FL Volusia County
FL Walton County
FL Weeki Wachee city
FL West Melbourne city
FL Windermere town
GA Albany city
GA Athens city
GA Bartow County
GA Brunswick city
GA Catoosa County
GA Centerville city
GA Chattahoochee County
GA Cherokee County
GA Chickamauga city
GA Clarke County
GA Columbia County
GA Conyers city
GA Dade County
GA Dougherty County
GA Douglas County
GA Douglasville city
GA Fayette County
GA Floyd County
GA Fort Oglethorpe city
GA Glynn County
GA Grovetown city
GA Henry County
GA Houston County
GA Jones County
GA Lee County
GA Lookout Mountain city
GA Mountain Park city
GA Oconee County
GA Payne city
GA Rockdale County
GA Rome city
GA Rossville city
GA Stockbridge city
GA Vernonburg town
GA Walker County
GA Warner Robins city
GA Winterville city
GA Woodstock city
IA Altoona city
IA Asbury city
IA Bettendorf city
IA Black Hawk County
IA Buffalo city
IA Carter Lake city
IA Cedar Falls city
IA Clive city
IA Coralville city
IA Council Bluffs city
IA Dallas County
IA Dubuque city
IA Dubuque County
IA Elk Run Heights city
IA Evansdale city
IA Hiawatha city
IA Iowa City city
IA Johnson County
IA Johnston city
IA Le Claire city
IA Linn County
IA Marion city
IA Norwalk city
IA Panorama Park city
IA Pleasant Hill city
IA Polk County
IA Pottawattamie County
IA Raymond city
IA Riverdale city
IA Robins city
IA Scott County
IA Sergeant Bluff city
IA Sioux City city
IA University Heights city
IA Urbandale city
IA Warren County
IA Waterloo city
IA West Des Moines city
IA Windsor Heights city
IA Woodbury County
ID Ada County
ID Ammon city
ID Bannock County
ID Bonneville County
ID Chubbuck city
ID Idaho Falls city
ID Iona city
ID Pocatello city
ID Power County
IL Addison township
IL Addison village
IL Algonquin township
IL Algonquin village
IL Alorton village
IL Alsip village
IL Alton city
IL Antioch township
IL Antioch village
IL Arlington Heights village
IL Aroma Park village
IL Aroma township
IL Aurora city
IL Aurora township
IL Avon township
IL Ball township
IL Bannockburn village
IL Barrington township
IL Barrington village
IL Bartlett village
IL Bartonville village
IL Batavia city
IL Batavia township
IL Beach Park village
IL Bedford Park village
IL Belleville city
IL Bellevue village
IL Bellwood village
IL Bensenville village
IL Benton township
IL Berkeley village
IL Berwyn city
IL Bethalto village
IL Blackhawk township
IL Bloom township
IL Bloomingdale township
IL Bloomingdale village
IL Bloomington city
IL Bloomington township
IL Blue Island city
IL Bolingbrook village
IL Bourbonnais township
IL Bourbonnais village
IL Bowling township
IL Bradley village
IL Bremen township
IL Bridgeview village
IL Bristol township
IL Broadview village
IL Brookfield village
IL Brooklyn village
IL Buffalo Grove village
IL Burbank city
IL Burnham village
IL Burr Ridge village

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IL Burritt township
IL Burton township
IL Cahokia village
IL Calumet City city
IL Calumet Park village
IL Calumet township
IL Canteen township
IL Capital township
IL Carbon Cliff village
IL Carol Stream village
IL Carpentersville Village
IL Cary village
IL Caseyville township
IL Caseyville village
IL Centreville city
IL Centreville township
IL Champaign city
IL Champaign County
IL Champaign township
IL Channahon township
IL Cherry Valley township
IL Cherry Valley village
IL Chicago city
IL Chicago Heights city
IL Chicago Ridge village
IL Chouteau township
IL Cicero town
IL Cincinnati township
IL Clarendon Hills village
IL Coal Valley township
IL Coal Valley village
IL Collinsville city
IL Collinsville township
IL Colona township
IL Colona village
IL Columbia city
IL Country Club Hills city
IL Countryside city
IL Crest Hill city
IL Crestwood village
IL Crete township
IL Crete village
IL Creve Coeur village
IL Crystal Lake city
IL Cuba township
IL Curran township
IL Darien city
IL Decatur city
IL Decatur township
IL Deer Park village
IL Deerfield township
IL Deerfield village
IL Des Plaines city
IL Dixmoor village
IL Dolton village
IL Dorr township
IL Downers Grove township
IL Downers Grove village
IL Dry Grove township
IL Du Page township
IL Dundee township
IL Dunleith township
IL Dupo village
IL East Alton village
IL East Dubuque city
IL East Dundee village
IL East Hazel Crest village
IL East Moline city
IL East Peoria city
IL East St. Louis city
IL Edwardsville city
IL Edwardsville township
IL Ela township
IL Elgin city
IL Elgin township
IL Elk Grove township
IL Elk Grove Village village
IL Elm Grove township
IL Elmhurst city
IL Elmwood Park village
IL Evanston city
IL Evergreen Park village
IL Fairmont City village
IL Fairview Heights city
IL Flossmoor village
IL Fondulac township
IL Ford Heights village
IL Forest Park village
IL Forest View village
IL Forsyth village
IL Fort Russell township
IL Foster township
IL Fox Lake village
IL Fox River Grove village
IL Frankfort township
IL Frankfort village
IL Franklin Park village
IL Fremont township
IL Gardner township
IL Geneva city
IL Geneva township
IL Gilberts village
IL Glen Carbon village
IL Glen Ellyn village
IL Glencoe village
IL Glendale Heights village
IL Glenview village
IL Glenwood village
IL Godfrey township
IL Golf village
IL Grafton township
IL Grandview village
IL Granite City city
IL Grant township
IL Grayslake village
IL Green Oaks village
IL Green Rock city
IL Groveland township
IL Gurnee village
IL Hainesville village
IL Hampton township
IL Hampton village
IL Hanna township
IL Hanover Park village
IL Hanover township
IL Harlem township
IL Harristown township
IL Harristown village
IL Hartford village
IL Harvey city
IL Harwood Heights village
IL Hawthorn Woods village
IL Hazel Crest village
IL Henry County
IL Hensley township
IL Hickory Hills city
IL Hickory Point township
IL Highland Park city
IL Highwood city
IL Hillside village
IL Hinsdale village
IL Hodgkins village
IL Hoffman Estates village
IL Hollis township
IL Homer township
IL Hometown city
IL Homewood village
IL Indian Creek village
IL Indian Head Park village
IL Inverness village
IL Itasca village
IL Jarvis township
IL Jerome village
IL Jo Daviess County
IL Joliet city
IL Joliet township
IL Justice village
IL Kane County
IL Kankakee city
IL Kankakee County
IL Kankakee township
IL Kendall County
IL Kenilworth village
IL Kickapoo township
IL Kildeer village
IL La Grange Park village
IL La Grange village
IL Lake Barrington village
IL Lake Bluff village
IL Lake Forest city
IL Lake in the Hills village
IL Lake Villa township
IL Lake Villa village
IL Lake Zurich village
IL Lakemoor village
IL Lakewood village
IL Lansing village
IL Leland Grove city
IL Lemont township
IL Leyden township
IL Libertyville township
IL Libertyville village
IL Limestone township
IL Lincolnshire village
IL Lincolnwood village
IL Lindenhurst village
IL Lisle township
IL Lisle village
IL Lockport city
IL Lockport township
IL Lombard village
IL Long Creek township
IL Long Grove village
IL Loves Park city
IL Lynwood village
IL Lyons township
IL Lyons village
IL Machesney Park village
IL Macon County
IL Madison city
IL Madison County
IL Maine township
IL Markham city
IL Marquette Heights city
IL Maryville village
IL Matteson village
IL Maywood village
IL McCook village
IL McCullom Lake village
IL McHenry city
IL McHenry County
IL McHenry township
IL McLean County
IL Medina township
IL Melrose Park village
IL Merrionette Park village
IL Midlothian village
IL Milan village
IL Milton township
IL Moline city
IL Moline township
IL Monee township
IL Monroe County
IL Montgomery village
IL Moro township
IL Morton Grove village
IL Morton township
IL Morton village

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IL Mount Prospect village
IL Mount Zion township
IL Mount Zion village
IL Mundelein village
IL Nameoki township
IL Naperville city
IL Naperville township
IL National City village
IL New Lenox township
IL New Lenox village
IL New Millford village
IL New Trier township
IL Newport township
IL Niles township
IL Niles village
IL Normal town
IL Normal township
IL Norridge village
IL North Aurora village
IL North Barrington village
IL North Chicago city
IL North Pekin village
IL North Riverside village
IL Northbrook village
IL Northfield township
IL Northfield village
IL Northlake city
IL Norwood Park township
IL Norwood village
IL Nunda township
IL Oak Brook village
IL Oak Forest city
IL Oak Grove village
IL Oak Lawn village
IL Oak Park village
IL Oakbrook Terrace city
IL Oakley township
IL Oakwood Hills village
IL O'Fallon city
IL O'Fallon township
IL Olympia Fields village
IL Orland Hills village
IL Orland Park village
IL Orland township
IL Oswego township
IL Oswego village
IL Otto township
IL Owen township
IL Palatine township
IL Palatine village
IL Palos Heights city
IL Palos Hills city
IL Palos Park village
IL Palos township
IL Park City city
IL Park Forest village
IL Park Ridge city
IL Pekin city
IL Pekin township
IL Peoria city
IL Peoria County
IL Peoria Heights village
IL Phoenix village
IL Pin Oak township
IL Plainfield township
IL Plainfield village
IL Pontoon Beach village
IL Posen village
IL Precinct 10
IL Prospect Heights city
IL Proviso township
IL Rich township
IL Richton Park village
IL Richwoods township
IL River Forest village
IL River Grove village
IL Riverdale village
IL Riverside township
IL Riverside village
IL Riverwoods village
IL Robbins village
IL Rochester township
IL Rock Island city
IL Rock Island County
IL Rock Island township
IL Rockdale village
IL Rockford township
IL Rockton township
IL Rockton village
IL Rolling Meadows city
IL Romeoville village
IL Roscoe township
IL Roscoe village
IL Roselle village
IL Rosemont village
IL Round Lake Beach village
IL Round Lake Heights village
IL Round Lake Park village
IL Round Lake village
IL Roxana village
IL Rutland township
IL Sangamon County
IL Sauget village
IL Sauk Village village
IL Savoy village
IL Schaumburg township
IL Schaumburg village
IL Schiller Park village
IL Shields township
IL Shiloh Valley township
IL Shiloh village
IL Shorewood village
IL Silvis city
IL Skokie village
IL Sleepy Hollow village
IL Somer township
IL South Beloit city
IL South Chicago Heights village
IL South Elgin village
IL South Holland village
IL South Moline township
IL South Rock Island township
IL South Roxana village
IL South Wheatland township
IL Southern View village
IL Spring Bay township
IL Springfield city
IL Springfield township
IL St. Charles city
IL St. Charles township
IL St. Clair County
IL St. Clair township
IL Steger village
IL Stickney township
IL Stickney village
IL Stites township
IL Stone Park village
IL Stookey township
IL Streamwood village
IL Sugar Grove township
IL Sugar Loaf township
IL Summit village
IL Sunnyside village
IL Swansea village
IL Tazewell County
IL Thornton township
IL Thornton village
IL Tinley Park village
IL Tolono township
IL Tower Lakes village
IL Tremont township
IL Troy city
IL Troy township
IL University Park village
IL Urbana city
IL Urbana township
IL Venice city
IL Venice township
IL Vernon Hills village
IL Vernon township
IL Villa Park village
IL Warren township
IL Warrenville city
IL Washington city
IL Washington Park village
IL Washington township
IL Wauconda township
IL Waukegan city
IL Waukegan township
IL Wayne township
IL West Chicago city
IL West Deerfield township
IL West Dundee village
IL West Peoria township
IL Westchester village
IL Western Springs village
IL Westmont village
IL Wheatland township
IL Wheaton city
IL Wheeling township
IL Wheeling village
IL Whitmore township
IL Will County
IL Willow Springs village
IL Willowbrook village
IL Wilmette village
IL Winfield township
IL Winfield village
IL Winnebago County
IL Winnetka village
IL Winthrop Harbor village
IL Wood Dale city
IL Wood River city
IL Wood River township
IL Woodford County
IL Woodridge village
IL Woodside township
IL Worth township
IL Worth village
IL York township
IL Zion city
IN Aboite township
IN Adams township
IN Allen County
IN Anderson city
IN Anderson township
IN Baugo township
IN Beech Grove city
IN Bloomington city
IN Bloomington township
IN Boone County
IN Buck Creek township
IN Calumet township
IN Carmel city
IN Castleton town
IN Cedar Creek township
IN Center township
IN Centre township
IN Chesterfield town
IN Chesterton town
IN Clark County
IN Clarksville town
IN Clay township
IN Clermont town
IN Cleveland township
IN Concord township
IN Country Club Heights town

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IN Crown Point city
IN Crows Nest town
IN Cumberland town
IN Daleville town
IN Delaware County
IN Delaware township
IN Dyer town
IN Eagle township
IN East Chicago city
IN Edgewood town
IN Elkhart city
IN Elkhart County
IN Elkhart township
IN Evansville city
IN Fairfield township
IN Fall Creek township
IN Fishers town
IN Floyd County
IN Fort Wayne city
IN Franklin township
IN Gary city
IN German township
IN Goshen city
IN Greenwood city
IN Griffith town
IN Hamilton County
IN Hamilton township
IN Hammond city
IN Hancock County
IN Hanover township
IN Harris township
IN Harrison township
IN Hendricks County
IN Highland town
IN Hobart city
IN Hobart township
IN Homecroft town
IN Honey Creek township
IN Howard County
IN Howard township
IN Indian Village town
IN Jackson township
IN Jefferson township
IN Jeffersonville city
IN Jeffersonville township
IN Johnson County
IN Knight township
IN Kokomo city
IN Lafayette city
IN Lafayette township
IN Lake County
IN Lake Station city
IN Lawrence city
IN Lawrence township
IN Liberty township
IN Lincoln township
IN Lost Creek township
IN Madison County
IN Meridian Hills town
IN Merrillville town
IN Mishawaka city
IN Monroe County
IN Mount Pleasant township
IN Muncie city
IN Munster town
IN New Albany city
IN New Albany township
IN New Chicago town
IN New Haven city
IN New Whiteland town
IN Newburgh town
IN North Crows Nest town
IN North township
IN Ogden Dunes town
IN Ohio township
IN Osceola town
IN Osolo township
IN Otter Creek township
IN Penn township
IN Perry township
IN Pigeon township
IN Pike township
IN Pleasant township
IN Portage city
IN Portage township
IN Porter County
IN Porter town
IN Richland township
IN Riley township
IN River Forest town
IN Rocky Ripple town
IN Roseland town
IN Ross township
IN Salem township
IN Schererville town
IN Seelyville town
IN Sellersburg town
IN Selma town
IN Silver Creek township
IN South-Bend city
IN Southport city
IN Speedway town
IN Spring Hill town
IN St. John town
IN St. John township
IN St. Joseph County
IN St. Joseph township
IN Sugar Creek township
IN Taylor township
IN Terre Haute city
IN Tippecanoe County
IN Tippecanoe township
IN Union township
IN Utica township
IN Van Buren township
IN Vanderburgh County
IN Vigo County
IN Wabash township
IN Warren Park town
IN Warren township
IN Warrick County
IN Washington township
IN Wayne township
IN Wea township
IN West Lafayette city
IN West Terre Haute town
IN Westchester township
IN Westfield town
IN White River township
IN Whiteland town
IN Whiting city
IN Williams Creek town
IN Woodlawn Heights town
IN Wynnedale town
IN Yorktown town
IN Zionsville town
KS Attica township
KS Bel Aire city
KS Countryside city
KS Delano township
KS Doniphan County
KS Douglas County
KS Eastborough city
KS Elwood city
KS Fairway city
KS Gypsum township
KS Haysville city
KS Johnson County
KS Kechi city
KS Kechi township
KS Lake Quivira city
KS Lawrence city
KS Leawood city
KS Lenexa city
KS Merriam city
KS Minneha township
KS Mission city
KS Mission Hills city
KS Mission township
KS Mission Woods city
KS Monticello township
KS Ohio township
KS Olathe city
KS Olathe township
KS Park City city
KS Park township
KS Prairie Village city
KS Riverside township
KS Roeland Park city
KS Salem township
KS Sedgwick County
KS Shawnee city
KS Shawnee County
KS Shawnee township
KS Soldier township
KS Tecumseh township
KS Topeka township
KS Waco township
KS Wakarusa township
KS Washington township
KS Westwood city
KS Westwood Hills city
KS Williamsport township
KS Wyandotte County
KY Alexandria city
KY Ashland city
KY Bellefonte city
KY Bellevue city
KY Boone County
KY Boyd County
KY Bromley city
KY Bullitt County
KY Campbell County
KY Catlettsburg city
KY Christian County
KY Covington city
KY Crescent Park city
KY Crescent Springs city
KY Crestview city
KY Crestview Hills city
KY Daviess County
KY Dayton city
KY Edgewood city
KY Elsmere city
KY Erlanger city
KY Fairview city
KY Flatwoods city
KY Florence city
KY Forest Hills city
KY Fort Mitchell city
KY Fort Thomas city
KY Fort Wright city
KY Fox Chase city
KY Greenup County
KY Hebron Estates city
KY Henderson city
KY Henderson County
KY Highland Heights city
KY Hillview city
KY Hunters Hollow city
KY Independence city
KY Jessamine County
KY Kenton County
KY Kenton Vale city
KY Lakeside Park city
KY Latonia Lakes city
KY Ludlow city
KY Melbourne city

KY Newport city
KY Oak Grove city
KY Owensboro city
KY Park Hills city
KY Pioneer Village city
KY Raceland city
KY Russell city
KY Silver Grove city
KY Southgate city
KY Taylor Mill city
KY Villa Hills city
KY Wilder city
KY Woodlawn city
KY Wurtland city
LA Alexandria city
LA Baker city
LA Ball town
LA Bossier City city
LA Bossier Parish
LA Broussard town
LA Caddo Parish
LA Calcasieu Parish
LA Carencro city
LA Denham Springs city
LA Houma city
LA Lafayette city
LA Lafayette Parish
LA Lafourche Parish
LA Lake Charles city
LA Livingston Parish
LA Monroe city
LA Ouachita Parish
LA Pineville city
LA Plaquemines Parish
LA Port Allen city
LA Rapides Parish
LA Richwood town
LA Scott town
LA Slidell city
LA St. Bernard Parish
LA St. Charles Parish
LA St. Tammany Parish
LA Sulphur city
LA Terrebonne Parish
LA West Baton Rouge Parish
LA West Monroe city
LA Westlake city
LA Zachary city
MA Abington town
MA Acton town
MA Acushnet town
MA Agawam town
MA Amesbury town
MA Andover town
MA Arlington town
MA Ashland town
MA Attleboro city
MA Auburn town
MA Avon town
MA Barnstable County
MA Barnstable town
MA Bedford town
MA Bellingham town
MA Belmont town
MA Berkshire County
MA Beverly city
MA Billerica town
MA Blackstone town
MA Boxborough town
MA Boylston town
MA Braintree town
MA Bridgewater town
MA Bristol County
MA Brockton city
MA Brookline town
MA Burlington town
MA Cambridge city
MA Canton town
MA Charlton town
MA Chelmsford town
MA Chelsea city
MA Chicopee city
MA Cohasset town
MA Concord town
MA Dalton town
MA Danvers town
MA Dartmouth town
MA Dedham town
MA Dennis town
MA Dighton town
MA Dover town
MA Dracut town
MA Dudley town
MA East Bridgewater town
MA East Longmeadow town
MA Easthampton town
MA Easton town
MA Essex County
MA Essex town
MA Everett city
MA Fairhaven town
MA Fall River city
MA Fitchburg city
MA Foxborough town
MA Framingham town
MA Franklin town
MA Freetown town
MA Georgetown town
MA Gloucester city
MA Grafton town
MA Granby town
MA Groton town
MA Groveland town
MA Hadley town
MA Halifax town
MA Hamilton town
MA Hampden County
MA Hampden town
MA Hampshire County
MA Hanover town
MA Hanson town
MA Haverhill city
MA Hingham town
MA Hinsdale town
MA Holbrook town
MA Holden town
MA Holliston town
MA Holyoke city
MA Hudson town
MA Hull town
MA Lanesborough town
MA Lawrence city
MA Leicester town
MA Leominster city
MA Lexington town
MA Lincoln town
MA Littleton town
MA Longmeadow town
MA Lowell city
MA Ludlow town
MA Lunenburg town
MA Lynn city
MA Lynnfield town
MA Malden city
MA Manchester town
MA Mansfield town
MA Marblehead town
MA Marlborough city
MA Mashpee town
MA Maynard town
MA Medfield town
MA Medford city
MA Medway town
MA Melrose city
MA Merrimac town
MA Methuen town
MA Middlesex County
MA Middleton town
MA Millbury town
MA Millis town
MA Millville town
MA Milton town
MA Nahant town
MA Natick town
MA Needham town
MA New Bedford city
MA Newton city
MA Norfolk town
MA North Andover town
MA North Attleborough town
MA North Reading town
MA Northampton city
MA Northborough town
MA Northbridge town
MA Norton town
MA Norwell town
MA Norwood town
MA Oxford town
MA Paxton town
MA Peabody city
MA Pembroke town
MA Pittsfield city
MA Plainville town
MA Plymouth County
MA Quincy city
MA Randolph town
MA Raynham town
MA Reading town
MA Rehoboth town
MA Revere city
MA Rockland town
MA Rockport town
MA Salem city
MA Sandwich town
MA Saugus town
MA Scituate town
MA Seekonk town
MA Sharon town
MA Shrewsbury town
MA Somerset town
MA Somerville city
MA South Hadley town
MA Southampton town
MA Southborough town
MA Southwick town
MA Springfield city
MA Stoneham town
MA Stoughton town
MA Stow town
MA Sudbury town
MA Sutton town
MA Swampscott town
MA Swansea town
MA Taunton city
MA Tewksbury town
MA Tyngsborough town
MA Uxbridge town
MA Wakefield town
MA Walpole town
MA Waltham city
MA Watertown town
MA Wayland town
MA Webster town
MA Wellesley town
MA Wenham town
MA West Boylston town
MA West Bridgewater town
MA West Springfield town

MA Westborough town
MA Westfield city
MA Westford town
MA Westminster town
MA Weston town
MA Westport town
MA Westwood town
MA Weymouth town
MA Whitman town
MA Wilbraham town
MA Williamsburg town
MA Wilmington town
MA Winchester town
MA Winthrop town
MA Woburn city
MA Worcester County
MA Wrentham town
MA Yarmouth town
MD Allegany County
MD Annapolis city
MD Bel Air town
MD Berwyn Heights town
MD Bladensburg town
MD Bowie city
MD Brentwood town
MD Brookeville town
MD Capitol Heights town
MD Cecil County
MD Cheverly town
MD Chevy Chase Section Five village
MD Chevy Chase Section Three village
MD Chevy Chase town
MD Chevy Chase Village town
MD College Park city
MD Colmar Manor town
MD Cottage City town
MD Cumberland city
MD District Heights city
MD Edmonston town
MD Elkton town
MD Fairmount Heights town
MD Forest Heights town
MD Frederick city
MD Frostburg city
MD Funkstown town
MD Gaithersburg city
MD Garrett Park town
MD Glen Echo town
MD Glenarden town
MD Greenbelt city
MD Hagerstown city
MD Highland Beach town
MD Hyattsville city
MD Kensington town
MD Landover Hills town
MD Laurel city
MD Martin's Additions village
MD Morningside town
MD Mount Rainier city
MD New Carrollton city
MD North Brentwood town
MD Riverdale town
MD Rockville city
MD Seat Pleasant city
MD Smithsburg town
MD Somerset town
MD Takoma Park city
MD University Park town
MD Walkersville town
MD Washington Grove town
MD Williamsport town
ME Androscoggin County
ME Auburn city
ME Bangor city
ME Berwick town
ME Brewer city
ME Cape Elizabeth town
ME Cumberland County
ME Eliot town
ME Falmouth town
ME Gorham town
ME Kittery town
ME Lebanon town
ME Lewiston city
ME Lisbon town
ME Old Town city
ME Orono town
ME Penobscot County
ME Penobscot Indian Island Reservation
ME Portland city
ME Sabattus town
ME Scarborough town
ME South Berwick town
ME South Portland city
ME Veazie town
ME Westbrook city
ME York County
MI Ada township
MI Allegan County
MI Allen Park city
MI Alpine township
MI Ann Arbor township
MI Auburn Hills city
MI Bangor township
MI Bath township
MI Battle Creek city
MI Bay City city
MI Bay County
MI Bedford township
MI Belleville city
MI Benton Charter township
MI Benton Harbor city
MI Berkley city
MI Berlin township
MI Berrien County
MI Beverly Hills village
MI Bingham Farms village
MI Birmingham city
MI Blackman township
MI Bloomfield Hills city
MI Bloomfield township
MI Bridgeport township
MI Brownstown township
MI Buena Vista Charter township
MI Burtchville township
MI Burton city
MI Byron township
MI Calhoun County
MI Canton township
MI Carrollton township
MI Cascade township
MI Cass County
MI Center Line city
MI Chesterfield township
MI Clarkston village
MI Clawson city
MI Clay township
MI Clayton township
MI Clinton County
MI Clinton township
MI Clio city
MI Clyde township
MI Commerce township
MI Comstock township
MI Cooper township
MI Dalton township
MI Davison city
MI Davison township
MI De Witt township
MI Dearborn city
MI Dearborn Heights city
MI Delhi Charter township
MI Delta township
MI Detroit city
MI East China township
MI East Detroit city
MI East Grand Rapids city
MI East Lansing city
MI Eaton County
MI Ecorse city
MI Emmett township
MI Erie township
MI Essexville city
MI Farmington city
MI Farmington Hills city
MI Ferndale city
MI Fillmore township
MI Flat Rock city
MI Flint township
MI Flushing city
MI Flushing township
MI Fort Gratiot township
MI Frankenlust township
MI Franklin village
MI Fraser city
MI Fruitport township
MI Gaines township
MI Garden City city
MI Genesee County
MI Genesee township
MI Georgetown township
MI Gibraltar city
MI Grand Blanc city
MI Grand Blanc township
MI Grand Rapids Charter township
MI Grandville city
MI Grosse Ile township
MI Grosse Pointe city
MI Grosse Pointe Farms city
MI Grosse Pointe Park city
MI Grosse Pointe Shores village
MI Grosse Pointe Woods city
MI Hampton township
MI Hamtramck city
MI Harper Woods city
MI Harrison township
MI Hazel Park city
MI Highland Park city
MI Highland township
MI Holland city
MI Holland township
MI Howard township
MI Hudsonville city
MI Huntington Woods city
MI Huron township
MI Independence township
MI Ingham County
MI Inkster city
MI Ira township
MI Jackson city
MI Jackson County
MI James township
MI Kalamazoo city
MI Kalamazoo County
MI Kalamazoo township
MI Keego Harbor city
MI Kent County
MI Kentwood city
MI Kimball township
MI Kochville township
MI Lake Angelus city
MI Laketon township
MI Laketown township
MI Lansing city
MI Lansing township
MI Lathrup Village city
MI Leoni township
MI Lincoln Park city

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MI Lincoln township
MI Livonia city
MI Macomb County
MI Macomb township
MI Madison Heights city
MI Marysville city
MI Melvindale city
MI Meridian township
MI Milford township
MI Milton township
MI Monitor township
MI Monroe County
MI Mount Clemens city
MI Mount Morris city
MI Mount Morris township
MI Mundy township
MI Muskegon city
MI Muskegon County
MI Muskegon Heights city
MI Muskegon township
MI New Baltimore city
MI Niles city
MI Niles township
MI North Muskegon city
MI Northville city
MI Northville township
MI Norton Shores city
MI Novi city
MI Novi township
MI Oak Park city
MI Oakland Charter township
MI Oakland County
MI Orchard Lake Village city
MI Orion township
MI Oshtemo township
MI Ottawa County
MI Parchment city
MI Park township
MI Pavilion township
MI Pennfield township
MI Pittsfield township
MI Plainfield township
MI Pleasant Ridge city
MI Plymouth city
MI Plymouth township
MI Pontiac city
MI Port Huron city
MI Port Huron township
MI Portage city
MI Portsmouth township
MI Redford township
MI Richfield township
MI River Rouge city
MI Riverview city
MI Rochester city
MI Rochester Hills city
MI Rockwood city
MI Romulus city
MI Roosevelt Park city
MI Roseville city
MI Ross township
MI Royal Oak city
MI Royal Oak township
MI Saginaw city
MI Saginaw County
MI Saginaw township
MI Schoolcraft township
MI Scio township
MI Shelby township
MI Shoreham village
MI Sodus township
MI South Rockwood village
MI Southfield city
MI Southfield township
MI Southgate city
MI Spaulding township
MI Spring Arbor township
MI Springfield city
MI Springfield township
MI St. Clair city
MI St. Clair County
MI St. Clair Shores city
MI St. Clair township
MI St. Joseph Charter township
MI St. Joseph city
MI Stevensville village
MI Sullivan township
MI Summit township
MI Sumpter township
MI Superior township
MI Swartz Creek city
MI Sylvan Lake city
MI Taylor city
MI Texas township
MI Thetford township
MI Thomas township
MI Trenton city
MI Troy city
MI Utica city
MI Van Buren township
MI Vienna township
MI Walker city
MI Walled Lake city
MI Washington township
MI Washtenaw County
MI Waterford township
MI Wayne city
MI West Bloomfield township
MI Westland city
MI White Lake township
MI Whiteford township
MI Williamstown township
MI Wixom city
MI Wolverine Lake village
MI Woodhaven city
MI Wyandotte city
MI Wyoming city
MI Ypsilanti city
MI Ypsilanti township
MI Zeeland city
MI Zilwaukee city
MN Andover city
MN Anoka city
MN Anoka County
MN Apple Valley city
MN Arden Hills city
MN Benton County
MN Birchwood Village city
MN Blaine city
MN Bloomington city
MN Brooklyn Center city
MN Brooklyn Park city
MN Burnsville city
MN Carver County
MN Cascade township
MN Champlin city
MN Chanhassen city
MN Circle Pines city
MN Clay County
MN Coon Rapids city
MN Cottage Grove city
MN Credit River township
MN Crystal city
MN Dakota County
MN Dayton city
MN Deephaven city
MN Dilworth city
MN Duluth city
MN Eagan city
MN East Grand Forks city
MN Eden Prairie city
MN Excelsior city
MN Falcon Heights city
MN Farmington city
MN Fort Snelling unorg.
MN Fridley city
MN Gem Lake city
MN Golden Valley city
MN Grant township
MN Greenwood city
MN Ham Lake city
MN Haven township
MN Hennepin County
MN Hermantown city
MN Hilltop city
MN Hopkins city
MN Houston County
MN Inver Grove Heights city
MN La Crescent city
MN La Crescent township
MN Lake Elmo city
MN Lakeville city
MN Landfall city
MN Lauderdale city
MN Le Sauk township
MN Lexington city
MN Lilydale city
MN Lino Lakes city
MN Little Canada city
MN Long Lake city
MN Loretto city
MN Mahtomedi city
MN Maple Grove city
MN Maple Plain city
MN Maplewood city
MN Marion township
MN Medicine Lake city
MN Medina city
MN Mendota city
MN Mendota Heights city
MN Midway township
MN Minden township
MN Minnetonka Beach city
MN Minnetonka city
MN Minnetrista city
MN Moorhead city
MN Moorhead township
MN Mound city
MN Mounds View city
MN New Brighton city
MN New Hope city
MN Newport city
MN North Oaks city
MN North St. Paul city
MN Oakdale city
MN Oakport township
MN Olmsted County
MN Orono city
MN Osseo city
MN Plymouth city
MN Polk County
MN Prior Lake city
MN Proctor city
MN Ramsey city
MN Robbinsdale city
MN Rochester city
MN Rochester township
MN Rosemount city
MN Roseville city
MN Sartell city
MN Sauk Rapids city
MN Sauk Rapids township
MN Savage city
MN Scott County
MN Sherburne County
MN Shoreview city
MN Shorewood city
MN South St. Paul city

MN Spring Lake Park city
MN Spring Park city
MN St. Anthony city
MN St. Cloud city
MN St. Cloud township
MN St. Louis County
MN St. Paul Park city
MN Stearns County
MN Sunfish Lake city
MN Tonka Bay city
MN Vadnais Heights city
MN Victoria city
MN Waite Park city
MN Washington County
MN Wayzata city
MN West St. Paul city
MN White Bear Lake city
MN White Bear township
MN Willernie city
MN Woodbury city
MN Woodland city
MN Wright County
MO Airport Drive village
MO Airport township
MO Andrew County
MO Arnold city
MO Avondale city
MO Ballwin city
MO Battlefield town
MO Bella Villa city
MO Bellefontaine Neighbors city
MO Bellerive village
MO Bel-Nor village
MO Bel-Ridge village
MO Belton city
MO Berkeley city
MO Beverly Hills city
MO Big Creek township
MO Birmingham village
MO Black Jack city
MO Blanchette township
MO Blue Springs city
MO Blue township
MO Bonhomme township
MO Boone County
MO Boone township
MO Breckenridge Hills village
MO Brentwood city
MO Bridgeton city
MO Brooking township
MO Buchanan County
MO Calverton Park village
MO Campbell No. 1 township
MO Campbell No. 2 township
MO Carl Junction city
MO Carroll township
MO Carterville city
MO Cass County
MO Cedar township
MO Center township
MO Charlack city
MO Chesterfield city
MO Chouteau township
MO Christian County
MO Clarkson Valley city
MO Clay County
MO Clay township
MO Claycomd village
MO Clayton city
MO Clayton township
MO Cliff Village village
MO Columbia city
MO Columbia township
MO Concord township
MO Cool Valley city
MO Cottleville town
MO Cottleville township
MO Country Club Hills city
MO Country Club village
MO Country Life Acres village
MO Crestwood city
MO Creve Coeur city
MO Creve Coeur township
MO Crystal Lake Park city
MO Dardenne township
MO Dellwood city
MO Dennis Acres village.
MO Des Peres city
MO Duquesne village
MO Edmundson village
MO Ellisville city
MO Fenton city
MO Ferguson city
MO Ferguson township
MO Flordell Hills city
MO Florissant city
MO Florissant township
MO Fox township
MO Friedens township
MO Frontenac city
MO Galena township
MO Gallatin township
MO Gladstone city
MO Glen Echo Park village
MO Glenaire village
MO Glendale city
MO Grandview city
MO Grantwood Village town
MO Gravois township
MO Greendale city
MO Greene County
MO Hadley township
MO Hanley Hills village
MO Harvester township
MO Hazelwood city
MO High Ridge township
MO Hillsdale village
MO Houston Lake city
MO Huntleigh city
MO Imperial township
MO Iron Gates village
MO Jackson County
MO Jasper County
MO Jefferson County
MO Jefferson township
MO Jennings city
MO Joplin city
MO Joplin township
MO Kickapoo township
MO Kimmswick city
MO Kinloch city
MO Kirkwood city
MO Ladue city
MO Lake St. Louis city
MO Lake Tapawingo city
MO Lake Waukomis city
MO Lakeshire city
MO Leawood village
MO Lee's Summit city
MO Lemay township
MO Lewis and Clark township
MO Liberty city
MO Liberty township
MO Mac Kenzie village
MO Manchester city
MO Maplewood city
MO Marlborough village
MO Maryland Heights city
MO May township
MO Meramec township
MO Midland township
MO Mineral township
MO Missouri River township
MO Missouri township
MO Moline Acres city
MO Mount Pleasant township
MO Newton County
MO Normandy city
MO Normandy township
MO North Campbell No. 1 township
MO North Campbell No. 2 township
MO North Campbell No. 3 township
MO North Kansas City city
MO North View township
MO Northmoor city
MO Northwest township
MO Northwoods city
MO Norwood Court town
MO Oakland city
MO Oakland Park village
MO Oaks village
MO Oakview village
MO Oakwood Park village
MO Oakwood village
MO O'Fallon city
MO O'Fallon township
MO Olivette city
MO Overland city
MO Pagedale city
MO Parkdale town
MO Parkville city
MO Pasadena Hills city
MO Pasadena Park village
MO Pettis township
MO Pine Lawn city
MO Platte County
MO Platte township
MO Platte Woods city
MO Pleasant Valley city
MO Prairie township
MO Queeny township
MO Randolph village
MO Raymore city
MO Raymore township
MO Raytown city
MO Redings Mill village
MO Richmond Heights city
MO Rivers township
MO Riverside city
MO Riverview village
MO Rock Hill city
MO Rock township
MO Rocky Fork township
MO Saginaw village
MO Shoal Creek Drive village
MO Shoal Creek township
MO Shrewsbury city
MO Silver Creek village
MO Sioux township
MO Sni-A-Bar township
MO Spanish Lake township
MO Spencer Creek township
MO St. Ann city
MO St. Charles city
MO St. Ferdinand township
MO St. George city
MO St. John city
MO St. Joseph city
MO St. Louis city
MO St. Peters city
MO St. Peters township
MO Sugar Creek city
MO Sunset Hills city
MO Sycamore Hills village
MO Town and Country city
MO Twin Groves township
MO Twin Oaks village
MO Unity Village village

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MO University City city
MO Uplands Park village
MO Valley Park city
MO Velda Village city
MO Velda Village Hills village
MO Vinita Park city
MO Vinita Terrace village
MO Warson Woods city
MO Washington township
MO Wayne township
MO Weatherby Lake city
MO Webb City city
MO Webster Groves city
MO Wellston city
MO Wentzville township
MO Westwood village
MO Wilbur Park village
MO Wilson township
MO Winchester city
MO Windsor township
MO Woodson Terrace city
MO Zumbehl township
MS Bay St. Louis city
MS Biloxi city
MS Brandon city
MS Clinton city
MS DeSoto County
MS D'Iberville city
MS Flowood town
MS Forrest County
MS Gautier city
MS Gulfport city
MS Hancock County
MS Harrison County
MS Hattiesburg city
MS Hinds County
MS Horn Lake city
MS Jackson County
MS Lamar County
MS Long Beach city
MS Madison city
MS Madison County
MS Moss Point city
MS Ocean Springs city
MS Pascagoula city
MS Pass Christian city
MS Pearl city
MS Petal city
MS Rankin County
MS Richland city
MS Ridgeland city
MS Southaven city
MS Waveland city
MT Billings city
MT Cascade County
MT Great Falls city
MT Missoula city
MT Missoula County
MT Yellowstone County
NC Alamance County
NC Apex town
NC Archdale city
NC Asheville city
NC Belmont city
NC Belville town
NC Bessemer City city
NC Biltmore Forest town
NC Black Mountain town
NC Brookford town
NC Brunswick County
NC Buncombe County
NC Burke County
NC Burlington city
NC Cabarrus County
NC Carrboro town
NC Cary town
NC Catawba County
NC Chapel Hill town
NC China Grove town
NC Clemmons village
NC Concord city
NC Conover city
NC Cramerton town
NC Dallas town
NC Davidson County
NC Durham County
NC Edgecombe County
NC Elon College town
NC Fletcher town
NC Forsyth County
NC Garner town
NC Gaston County
NC Gastonia city
NC Gibsonville town
NC Goldsboro city
NC Graham city
NC Greenville city
NC Guilford County
NC Harnett County
NC Haw River town
NC Henderson County
NC Hickory city
NC High Point city
NC Hildebran town
NC Hope Mills town
NC Indian Trail town
NC Jacksonville city
NC Jamestown town
NC Kannapolis city
NC Landis town
NC Leland town
NC Long View town
NC Lowell city
NC Matthews town
NC McAdenville town
NC Mebane city
NC Mecklenburg County
NC Mint Hill town
NC Montreat town
NC Mount Holly city
NC Nash County
NC New Hanover County
NC Newton city
NC Onslow County
NC Orange County
NC Pineville town
NC Pitt County
NC Randolph County
NC Ranlo town
NC Rocky Mount city
NC Rowan County
NC Rural Hall town
NC Spring Lake town
NC Stallings town
NC Thomasville city
NC Union County
NC Wake County
NC Walkertown town
NC Wayne County
NC Weaverville town
NC Wilmington city
NC Winterville town
NC Woodfin town
NC Wrightsville Beach town
ND Barnes township
ND Bismarck city
ND Bismarck unorg.
ND Burleigh County
ND Captain's Landing township
ND Cass County
ND Fargo city
ND Grand Forks city
ND Grand Forks County
ND Grand Forks township
ND Hay Creek township
ND Lincoln city
ND Mandan city
ND Mandan unorg.
ND Morton County
ND Reed township
ND West Fargo city
NE Bellevue city
NE Bellevue No. 2 precinct
NE Benson precinct
NE Boys Town village
NE Chicago precinct
NE Covington precinct
NE Dakota County
NE Douglas County
NE Douglas precinct
NE Florence precinct
NE Garfield precinct
NE Gilmore No. 1 precinct
NE Gilmore No. 2 precinct
NE Gilmore No. 3 precinct
NE Grant precinct
NE Highland No. 1 precinct
NE Highland No. 2 precinct
NE Jefferson precinct
NE La Platte precinct
NE La Vista city
NE Lancaster County
NE Lancaster precinct
NE McArdle precinct
NE Millard precinct
NE Papillion city
NE Papillion No. 2 precinct
NE Pawnee precinct
NE Ralston city
NE Richland No. 1 precinct
NE Richland No. 2 precinct
NE Richland No. 3 precinct
NE Sarpy County
NE South Sioux City city
NE Union precinct
NE Yankee Hill precinct
NH Amherst town
NH Auburn town
NH Bedford town
NH Dover city
NH Durham town
NH Goffstown town
NH Hillsborough County
NH Hollis town
NH Hooksett town
NH Hudson town
NH Litchfield town
NH Londonderry town
NH Madbury town
NH Manchester city
NH Merrimack County
NH Merrimack town
NH Nashua city
NH New Castle town
NH Newington town
NH Pelham town
NH Plaistow town
NH Portsmouth city
NH Rochester city
NH Rockingham County
NH Rollinsford town
NH Rye town
NH Salem town
NH Somersworth city
NH Strafford County
NH Windham town
NJ Aberdeen township
NJ Absecon city

NJ Allendale borough
NJ Allenhurst borough
NJ Alpha borough
NJ Alpine borough
NJ Asbury Park city
NJ Atlantic City city
NJ Atlantic County
NJ Atlantic Highlands borough
NJ Audubon borough
NJ Audubon Park borough
NJ Avon-by-the-Sea borough
NJ Barrington borough
NJ Bay Head borough
NJ Bayonne city
NJ Beachwood borough
NJ Bedminster township
NJ Belleville township
NJ Bellmawr borough
NJ Belmar borough
NJ Bergenfield borough
NJ Berkeley Heights township
NJ Berkeley township
NJ Berlin borough
NJ Berlin township
NJ Bernards township
NJ Bernardsville borough
NJ Beverly city
NJ Bloomfield township
NJ Bloomingdale borough
NJ Bogota borough
NJ Boonton town
NJ Boonton township
NJ Bordentown city
NJ Bordentown township
NJ Bound Brook borough
NJ Bradley Beach borough
NJ Branchburg township
NJ Brick township
NJ Bridgewater township
NJ Brielle borough
NJ Brigantine city
NJ Brooklawn borough
NJ Buena borough
NJ Buena Vista township
NJ Burlington city
NJ Burlington County
NJ Burlington township
NJ Butler borough
NJ Byram township
NJ Caldwell Borough township
NJ Camden city
NJ Cape May County
NJ Carlstadt borough
NJ Carneys Point township
NJ Carteret borough
NJ Cedar Grove township
NJ Chatham borough
NJ Chatham township
NJ Cherry Hill township
NJ Chesilhurst borough
NJ Chester township
NJ Chesterfield township
NJ Cinnaminson township
NJ City of Orange township
NJ Clark township
NJ Clayton borough
NJ Clementon borough
NJ Cliffside Park borough
NJ Clifton city
NJ Closter borough
NJ Collingswood borough
NJ Colts Neck township
NJ Commercial township
NJ Cranford township
NJ Cresskill borough
NJ Cumberland County
NJ Deal borough
NJ Delanco township
NJ Delran township
NJ Demarest borough
NJ Denville township
NJ Deptford township
NJ Dover town
NJ Dover township
NJ Dumont borough
NJ Dunellen borough
NJ East Brunswick township
NJ East Greenwich township
NJ East Hanover township
NJ East Newark borough
NJ East Orange city
NJ East Rutherford borough
NJ Eastampton township
NJ Eatontown borough
NJ Edgewater borough
NJ Edgewater Park township
NJ Edison township
NJ Egg Harbor township
NJ Elizabeth city
NJ Elk township
NJ Elmwood Park borough
NJ Emerson borough
NJ Englewood city
NJ Englewood Cliffs borough
NJ Englishtown borough
NJ Essex Fells township
NJ Evesham township
NJ Ewing township
NJ Fair Haven borough
NJ Fair Lawn borough
NJ Fairfield township
NJ Fairview borough
NJ Fanwood borough
NJ Fieldsboro borough
NJ Florence township
NJ Florham Park borough
NJ Fort Lee borough
NJ Franklin Lakes borough
NJ Franklin township
NJ Freehold borough
NJ Freehold township
NJ Galloway township
NJ Garfield city
NJ Garwood borough
NJ Gibbsboro borough
NJ Glassboro borough
NJ Glen Ridge Borough township
NJ Glen Rock borough
NJ Gloucester City city
NJ Gloucester County
NJ Gloucester township
NJ Green Brook township
NJ Greenwich township
NJ Guttenberg town
NJ Hackensack city
NJ Haddon Heights borough
NJ Haddon township
NJ Haddonfield borough
NJ Hainesport township
NJ Haledon borough
NJ Hamilton township
NJ Hanover township
NJ Harding township
NJ Harrington Park borough
NJ Harrison town
NJ Hasbrouck Heights borough
NJ Haworth borough
NJ Hawthorne borough
NJ Hazlet township
NJ Helmetta borough
NJ Highland Park borough
NJ Highlands borough
NJ Hillsborough township
NJ Hillsdale borough
NJ Hillside township
NJ Hi-Nella borough
NJ Hoboken city
NJ Ho-Ho-Kus borough
NJ Holmdel township
NJ Hopatcong borough
NJ Hopewell township
NJ Howell township
NJ Hunterdon County
NJ Interlaken borough
NJ Irvington township
NJ Island Heights borough
NJ Jackson township
NJ Jamesburg borough
NJ Jefferson township
NJ Jersey City city
NJ Keansburg borough
NJ Kearny town
NJ Kenilworth borough
NJ Keyport borough
NJ Kinnelon borough
NJ Lakehurst borough
NJ Lakewood township
NJ Laurel Springs borough
NJ Lavallette borough
NJ Lawnside borough
NJ Lawrence township
NJ Leonia borough
NJ Lincoln Park borough
NJ Linden city
NJ Lindenwold borough
NJ Linwood city
NJ Little Falls township
NJ Little Ferry borough
NJ Little Silver borough
NJ Livingston township
NJ Loch Arbour village
NJ Lodi borough
NJ Long Branch city
NJ Longport borough
NJ Lopatcong township
NJ Lumberton township
NJ Lyndhurst township
NJ Madison borough
NJ Magnolia borough
NJ Mahwah township
NJ Manalapan township
NJ Manasquan borough
NJ Manchester township
NJ Mantoloking borough
NJ Mantua township
NJ Manville borough
NJ Maple Shade township
NJ Maplewood township
NJ Margate City city
NJ Marlboro township
NJ Matawan borough
NJ Maywood borough
NJ Medford Lakes borough
NJ Medford township
NJ Mendham borough
NJ Mendham township
NJ Mercer County
NJ Merchantville borough
NJ Metuchen borough
NJ Middlesex borough
NJ Middlesex County
NJ Middletown township
NJ Midland Park borough
NJ Millburn township
NJ Millstone borough
NJ Milltown borough
NJ Millville city
NJ Mine Hill township

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NJ Monmouth Beach borough
NJ Monmouth County
NJ Monroe township
NJ Montclair township
NJ Montvale borough
NJ Montville township
NJ Moonachie borough
NJ Moorestown township
NJ Morris County
NJ Morris Plains borough
NJ Morris township
NJ Morristown town
NJ Mount Arlington borough
NJ Mount Ephraim borough
NJ Mount Holly township
NJ Mount Laurel township
NJ Mount Olive township
NJ Mountain Lakes borough
NJ Mountainside borough
NJ National Park borough
NJ Neptune City borough
NJ Neptune township
NJ Netcong borough
NJ New Brunswick city
NJ New Milford borough
NJ New Providence borough
NJ Newark city
NJ Newfield borough
NJ North Arlington borough
NJ North Bergen township
NJ North Brunswick township
NJ North Caldwell township
NJ North Haledon borough
NJ North Plainfield borough
NJ Northfield city
NJ Northvale borough
NJ Norwood borough
NJ Nutley township
NJ Oakland borough
NJ Oaklyn borough
NJ Ocean City city
NJ Ocean County
NJ Ocean Gate borough
NJ Ocean township
NJ Oceanport borough
NJ Old Bridge township
NJ Old Tappan borough
NJ Oradell borough
NJ Palisades Park borough
NJ Palmyra borough
NJ Paramus borough
NJ Park Ridge borough
NJ Parsippany-Troy Hills township
NJ Passaic city
NJ Passaic County
NJ Passaic township
NJ Paterson city
NJ Paulsboro borough
NJ Pennington borough
NJ Penns Grove borough
NJ Pennsauken township
NJ Pennsville township
NJ Pequannock township
NJ Perth Amboy city
NJ Phillipsburg town
NJ Pine Beach borough
NJ Pine Hill borough
NJ Pine Valley borough
NJ Piscataway township
NJ Pitman borough
NJ Pittsgrove township
NJ Plainfield city
NJ Pleasantville city
NJ Pohatcong township
NJ Point Pleasant Beach borough
NJ Point Pleasant borough
NJ Pompton Lakes borough
NJ Prospect Park borough
NJ Rahway city
NJ Ramsey borough
NJ Randolph township
NJ Raritan borough
NJ Readington township
NJ Red Bank borough
NJ Ridgefield borough
NJ Ridgefield Park village
NJ Ridgewood village
NJ Ringwood borough
NJ River Edge borough
NJ River Vale township
NJ Riverdale borough
NJ Riverside township
NJ Riverton borough
NJ Rochelle Park township
NJ Rockaway borough
NJ Rockaway township
NJ Rockleigh borough
NJ Roseland borough
NJ Roselle borough
NJ Roselle Park borough
NJ Roxbury township
NJ Rumson borough
NJ Runnemede borough
NJ Rutherford borough
NJ Saddle Brook township
NJ Saddle River borough
NJ Salem County
NJ Sayreville borough
NJ Scotch Plains township
NJ Sea Bright borough
NJ Sea Girt borough
NJ Seaside Heights borough
NJ Seaside Park borough
NJ Secaucus town
NJ Shamong township
NJ Shrewsbury borough
NJ Shrewsbury township
NJ Somerdale borough
NJ Somers Point city
NJ Somerset County
NJ Somerville borough
NJ South Amboy city
NJ South Belmar borough
NJ South Bound Brook borough
NJ South Brunswick township
NJ South Hackensack township
NJ South Orange Village township
NJ South Plainfield borough
NJ South River borough
NJ South Toms River borough
NJ Spotswood borough
NJ Spring Lake borough
NJ Spring Lake Heights borough
NJ Springfield township
NJ Stanhope borough
NJ Stratford borough
NJ Summit city
NJ Sussex County
NJ Tabernacle township
NJ Tavistock borough
NJ Teaneck township
NJ Tenafly borough
NJ Teterboro borough
NJ Tinton Falls borough
NJ Totowa borough
NJ Trenton city
NJ Union Beach borough
NJ Union City city
NJ Union township
NJ Upper Saddle River borough
NJ Upper township
NJ Ventnor City city
NJ Verona township
NJ Victory Gardens borough
NJ Vineland city
NJ Voorhees township
NJ Waldwick borough
NJ Wall township
NJ Wallington borough
NJ Wanaque borough
NJ Warren County
NJ Warren township
NJ Washington township
NJ Watchung borough
NJ Waterford township
NJ Wayne township
NJ Weehawken township
NJ Wenonah borough
NJ West Caldwell township
NJ West Deptford township
NJ West Long Branch borough
NJ West New York town
NJ West Orange township
NJ West Paterson borough
NJ Westampton township
NJ Westfield town
NJ Westville borough
NJ Westwood borough
NJ Wharton borough
NJ Willingboro township
NJ Winfield township
NJ Winslow township
NJ Woodbridge township
NJ Woodbury city
NJ Woodbury Heights borough
NJ Woodcliff Lake borough
NJ Woodlynne borough
NJ Wood-Ridge borough
NJ Wyckoff township
NM Bernalillo County
NM Corrales village
NM Dona Ana County
NM Las Cruces city
NM Los Ranchos de Albuquerque village
NM Mesilla town
NM Rio Rancho city
NM Sandoval County
NM Santa Fe city
NM Santa Fe County
NM Sunland Park city
NY Albany city
NY Albany County
NY Amherst town
NY Amityville village
NY Ardsley village
NY Ashland town
NY Atlantic Beach village
NY Babylon town
NY Babylon village
NY Baldwinsville village
NY Ballston town
NY Barker town
NY Baxter Estates village
NY Bayville village
NY Beacon city
NY Bedford town
NY Belle Terre village
NY Bellerose village
NY Bellport village
NY Bethlehem town
NY Big Flats town
NY Binghamton city
NY Binghamton town
NY Blasdell village
NY Boston town
NY Briarcliff Manor village
NY Brighton town
NY Brightwaters village

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NY Bronxville village
NY Brookhaven town
NY Brookville village
NY Broome County
NY Brunswick town
NY Buchanan village
NY Buffalo city
NY Camillus town
NY Camillus village
NY Carmel town
NY Cayuga Heights village
NY Cedarhurst village
NY Charlton town
NY Cheektowaga town
NY Chemung County
NY Chenango town
NY Chestnut Ridge village
NY Chili town
NY Cicero town
NY Clarence town
NY Clarkstown town
NY Clay town
NY Clayville village
NY Clifton Park town
NY Clinton village
NY Cohoes city
NY Colonie town
NY Colonie village
NY Conklin town
NY Cornwall on Hudson village
NY Cornwall town
NY Cortlandt town
NY Croton-on-Hudson village
NY De Witt town
NY Deerfield town
NY Depew village
NY Dickinson town
NY Dobbs Ferry village
NY Dryden town
NY Dutchess County
NY East Fishkill town
NY East Greenbush town
NY East Hills village
NY East Rochester village
NY East Rockaway village
NY East Syracuse village
NY East Williston village
NY Eastchester town
NY Elma town
NY Elmira city
NY Elmira Heights village
NY Elmira town
NY Elmsford village
NY Endicott village
NY Erie County
NY Evans town
NY Fairport village
NY Farmingdale village
NY Fayetteville village
NY Fenton town
NY Fishkill town
NY Fishkill village
NY Floral Park village
NY Flower Hill village
NY Floyd town
NY Fort Edward town
NY Fort Edward village
NY Frankfort town
NY Freeport village
NY Garden City village
NY Gates town
NY Geddes town
NY Glen Cove city
NY Glens Falls city
NY Glenville town
NY Grand Island town
NY Grand View-on-Hudson village
NY Great Neck Estates village
NY Great Neck Plaza village
NY Great Neck village
NY Greece town
NY Green Island village
NY Greenburgh town
NY Guilderland town
NY Halfmoon town
NY Hamburg town
NY Hamburg village
NY Harrison village
NY Hastings-on-Hudson village
NY Haverstraw town
NY Haverstraw village
NY Hempstead town
NY Hempstead village
NY Henrietta town
NY Herkimer County
NY Hewlett Bay Park village
NY Hewlett Harbor village
NY Hewlett Neck village
NY Hillburn village
NY Horseheads town
NY Horseheads village
NY Hudson Falls village
NY Huntington Bay village
NY Huntington town
NY Hyde Park town
NY Irondequoit town
NY Irvington village
NY Island Park village
NY Islandia village
NY Islip town
NY Ithaca city
NY Ithaca town
NY Johnson City village
NY Kenmore village
NY Kensington village
NY Kent town
NY Kings Point village
NY Kingsbury town
NY Kirkland town
NY Kirkwood town
NY La Grange town
NY Lackawanna city
NY LaFayette town
NY Lake Grove village
NY Lake Success village
NY Lancaster town
NY Lancaster village
NY Lansing town
NY Lansing village
NY Larchmont village
NY Lattingtown village
NY Lawrence village
NY Lee town
NY Lewiston town
NY Lewiston village
NY Lindenhurst village
NY Liverpool village
NY Lloyd Harbor village
NY Lloyd town
NY Long Beach city
NY Lynbrook village
NY Lysander town
NY Malta town
NY Malverne village
NY Mamaroneck town
NY Mamaroneck village
NY Manlius town
NY Manlius village
NY Manorhaven village
NY Marcy town
NY Massapequa Park village
NY Matinecock village
NY Menands village
NY Mill Neck village
NY Mineola village
NY Minoa village
NY Monroe County
NY Montebello village
NY Montgomery town
NY Moreau town
NY Mount Kisco village
NY Mount Pleasant town
NY Mount Vernon city
NY Munsey Park village
NY Muttontown village
NY New Castle town
NY New Hartford town
NY New Hartford village
NY New Hempstead village
NY New Hyde Park village
NY New Rochelle city
NY New Square village
NY New Windsor town
NY New York Mills village
NY Newburgh city
NY Newburgh town
NY Niagara County
NY Niagara Falls city
NY Niagara town
NY Niskayuna town
NY North Castle town
NY North Greenbush town
NY North Hempstead town
NY North Hills village
NY North Syracuse village
NY North Tarrytown village
NY North Tonawanda city
NY Northport village
NY Nyack village
NY Ogden town
NY Old Brookville village
NY Old Westbury village
NY Oneida County
NY Onondaga County
NY Onondaga town
NY Orange County
NY Orangetown town
NY Orchard Park town
NY Orchard Park village
NY Oriskany village
NY Ossining town
NY Ossining village
NY Oswego County
NY Owego town
NY Oyster Bay town
NY Paris town
NY Patchogue village
NY Patterson town
NY Peekskill city
NY Pelham Manor village
NY Pelham town
NY Pelham village
NY Pendleton town
NY Penfield town
NY Perinton town
NY Philipstown town
NY Phoenix village
NY Piermont village
NY Pittsford town
NY Pittsford village
NY Plandome Heights village
NY Plandome Manor village
NY Plandome village
NY Pleasant Valley town
NY Pleasantville village
NY Poestenkill town
NY Pomona village
NY Poospatuck Reservation

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NY Poquott village
NY Port Chester village
NY Port Dickinson village
NY Port Jefferson village
NY Port Washington North village
NY Poughkeepsie city
NY Poughkeepsie town
NY Pound Ridge town
NY Putnam County
NY Putnam Valley town
NY Queensbury town
NY Ramapo town
NY Rensselaer city
NY Rensselaer County
NY Riverhead town
NY Rochester city
NY Rockville Centre village
NY Rome city
NY Roslyn Estates village
NY Roslyn Harbor village
NY Roslyn village
NY Rotterdam town
NY Russell Gardens village
NY Rye Brook village
NY Rye city
NY Rye town
NY Saddle Rock village
NY Salina town
NY Sands Point village
NY Saratoga County
NY Scarsdale town
NY Scarsdale village
NY Schaghticoke town
NY Schenectady city
NY Schenectady County
NY Schodack town
NY Schroeppel town
NY Schuyler town
NY Scotia village
NY Sea Cliff village
NY Shoreham village
NY Sloan village
NY Sloatsburg village
NY Smithtown town
NY Solvay village
NY Somers town
NY South Floral Park village
NY South Glens Falls village
NY South Nyack village
NY Southampton town
NY Southport town
NY Spencerport village
NY Spring Valley village
NY Stewart Manor village
NY Stony Point town
NY Suffern village
NY Suffolk County
NY Syracuse city
NY Tarrytown village
NY Thomaston village
NY Tioga County
NY Tompkins County
NY Tonawanda city
NY Tonawanda town
NY Troy city
NY Tuckahoe village
NY Ulster County
NY Union town
NY Upper Brookville village
NY Upper Nyack village
NY Utica city
NY Valley Stream village
NY Van Buren town
NY Vestal town
NY Veteran town
NY Village of the Branch village
NY Wappinger town
NY Wappingers Falls village
NY Warren County
NY Washington County
NY Waterford town
NY Waterford village
NY Watervliet city
NY Webster town
NY Webster village
NY Wesley Hills village
NY West Haverstraw village
NY West Seneca town
NY Westbury village
NY Westchester County
NY Western town
NY Wheatfield town
NY White Plains city
NY Whitesboro village
NY Whitestown town
NY Williamsville village
NY Williston Park village
NY Woodsburgh village
NY Yonkers city
NY Yorktown town
NY Yorkville village
OH Addyston village
OH Allen County
OH Allen township
OH Amberley village
OH Amelia village
OH American township
OH Amherst city
OH Amherst township
OH Anderson township
OH Arlington Heights village
OH Auglaize County
OH Aurora city
OH Austintown township
OH Avon city
OH Avon Lake city
OH Bainbridge township
OH Barberton city
OH Batavia township
OH Bath township
OH Bay Village city
OH Beachwood city
OH Beaver township
OH Beavercreek city
OH Beavercreek township
OH Bedford city
OH Bedford Heights city
OH Bellaire city
OH Bellbrook city
OH Belmont County
OH Belpre city
OH Belpre township
OH Bentleyville village
OH Berea city
OH Bethel township
OH Bexley city
OH Blendon township
OH Blue Ash city
OH Boardman township
OH Brady Lake village
OH Bratenahl village
OH Brecksville city
OH Brice village
OH Bridgeport village
OH Brilliant village
OH Brimfield township
OH Broadview Heights city
OH Brook Park city
OH Brookfield township
OH Brooklyn city
OH Brooklyn Heights village
OH Brookside village
OH Brown township
OH Brownhelm township
OH Brunswick city
OH Brunswick Hills township
OH Butler County
OH Butler township
OH Campbell city
OH Canfield city
OH Canfield township
OH Canton city
OH Canton township
OH Carlisle township
OH Carlisle village
OH Centerville city
OH Chagrin Falls township
OH Chagrin Falls village
OH Champion township
OH Chesapeake village
OH Cheviot city
OH Chippewa township
OH Cincinnati city
OH Clark County
OH Clear Creek township
OH Clermont County
OH Cleveland city
OH Cleveland Heights city
OH Cleves village
OH Clinton township
OH Coal Grove village
OH Coitsville township
OH Colerain township
OH Columbia township
OH Concord township
OH Copley township
OH Coventry township
OH Cridersville village
OH Cross Creek township
OH Cuyahoga County
OH Cuyahoga Falls city
OH Cuyahoga Heights village
OH Deer Park city
OH Deerfield township
OH Delaware County
OH Delhi township
OH Doylestown village
OH Dublin city
OH Duchouquet township
OH East Cleveland city
OH Eastlake city
OH Eaton township
OH Elmwood Place village
OH Elyria city
OH Elyria township
OH Englewood city
OH Erie County
OH Etna township
OH Euclid city
OH Evendale village
OH Fairborn city
OH Fairfax village
OH Fairfield city
OH Fairfield County
OH Fairfield township
OH Fairlawn city
OH Fairport Harbor village
OH Fairview Park city
OH Fayette township
OH Forest Park city
OH Fort Shawnee village
OH Franklin city
OH Franklin County
OH Franklin township
OH Gahanna city
OH Garfield Heights city
OH Geauga County
OH Genoa township

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OH German township
OH Girard city
OH Glendale village
OH Glenwillow village
OH Golf Manor village
OH Goshen township
OH Grand River village
OH Grandview Heights city
OH Green township
OH Green village
OH Greene County
OH Greenhills village
OH Grove City city
OH Groveport village
OH Hamilton city
OH Hamilton County
OH Hamilton township
OH Hanging Rock village
OH Hanover township
OH Harbor View village
OH Harrison township
OH Hartville village
OH Heath city
OH Highland Heights city
OH Hilliard city
OH Hills and Dales village
OH Hinckley township
OH Holland village
OH Howland township
OH Hubbard city
OH Hubbard township
OH Huber Heights city
OH Hudson township
OH Hudson village
OH Independence city
OH Ironton city
OH Island Creek township
OH Jackson township
OH Jefferson County
OH Jefferson township
OH Jerome township
OH Kent city
OH Kettering city
OH Kirtland city
OH Lake County
OH Lake township
OH Lakeline village
OH Lakemore village
OH Lakewood city
OH Lawrence County
OH Lawrence township
OH Lemon township
OH Lexington village
OH Liberty township
OH Licking County
OH Licking township
OH Lima city
OH Lima township
OH Lincoln Heights city
OH Linndale village
OH Lockland village
OH Lorain city
OH Lorain County
OH Louisville city
OH Loveland city
OH Lowellville village
OH Lucas County
OH Lyndhurst city
OH Macedonia city
OH Mad River township
OH Madeira city
OH Madison township
OH Mahoning County
OH Maineville village
OH Mansfield city
OH Maple Heights city
OH Marble Cliff village
OH Mariemont village
OH Martins Ferry city
OH Mason city
OH Massillon city
OH Maumee city
OH Mayfield Heights city
OH Mayfield village
OH McDonald village
OH Mead township
OH Medina County
OH Mentor city
OH Mentor-on-the-Lake city
OH Meyers Lake village
OH Miami County
OH Miami township
OH Miamisburg city
OH Middleburg Heights city
OH Middletown city
OH Mifflin township
OH Milford city
OH Millbury village
OH Millville village
OH Minerva Park village
OH Mingo Junction city
OH Mogadore village
OH Monclova township
OH Monroe township
OH Monroe village
OH Montgomery city
OH Montgomery County
OH Moorefield township
OH Moraine city
OH Moreland Hills village
OH Mount Healthy city
OH Munroe Falls village
OH New Miami village
OH New Middletown village
OH New Rome village
OH Newark city
OH Newark township
OH Newburgh Heights village
OH Newton township
OH Newtown village
OH Niles city
OH Nimishillen township
OH North Bend village
OH North Canton city
OH North College Hill city
OH North Olmsted city
OH North Randall village
OH North Ridgeville city
OH North Royalton city
OH Northfield Center township
OH Northfield village
OH Northwood city
OH Norton city
OH Norwich township
OH Norwood city
OH Oakwood city
OH Oakwood village
OH Obetz village
OH Ohio township
OH Olmsted Falls city
OH Olmsted township
OH Ontario village
OH Orange township
OH Orange village
OH Oregon city
OH Ottawa County
OH Ottawa Hills village
OH Painesville city
OH Painesville township
OH Palmyra township
OH Parma city
OH Parma Heights city
OH Pease township
OH Pepper Pike city
OH Perry township
OH Perrysburg city
OH Perrysburg city
OH Perrysburg township
OH Pierce township
OH Plain township
OH Pleasant township
OH Poland township
OH Poland village
OH Portage County
OH Powell village
OH Prairie township
OH Proctorville village
OH Pultney township
OH Randolph township
OH Ravenna city
OH Ravenna township
OH Reading city
OH Reminderville village
OH Reynoldsburg city
OH Richfield township
OH Richfield village
OH Richland County
OH Richmond Heights city
OH Riveredge township
OH Riverlea village
OH Riverside village
OH Rocky River city
OH Rome township
OH Ross township
OH Rossford city
OH Russell township
OH Russia township
OH Sagamore Hills township
OH Seven Hills city
OH Shadyside village
OH Shaker Heights city
OH Sharon township
OH Sharonville city
OH Shawnee Hills village
OH Shawnee township
OH Sheffield Lake city
OH Sheffield township
OH Sheffield village
OH Silver Lake village
OH Silverton city
OH Solon city
OH South Amherst village
OH South Euclid city
OH South Point village
OH South Russell village
OH Springboro city
OH Springdale city
OH Springfield city
OH Springfield township
OH St. Bernard city
OH St. Clair township
OH Stark County
OH Steubenville city
OH Steubenville township
OH Stow city
OH Strongsville city
OH Struthers city
OH Suffield township
OH Sugar Bush Knolls village
OH Sugar Creek township
OH Summit County
OH Sycamore township
OH Sylvania city
OH Sylvania township
OH Symmes township
OH Tallmadge city
OH Terrace Park village
OH The Village of Indian Hill city

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OH Timberlake village
OH Trenton city
OH Trotwood city
OH Troy township
OH Trumbull County
OH Truro township
OH Turtle Creek township
OH Tuscarawas township
OH Twinsburg city
OH Twinsburg township
OH Union city
OH Union County
OH Union township
OH University Heights city
OH Upper Arlington city
OH Upper township
OH Urbancrest village
OH Valley View village
OH Valleyview village
OH Vandalia city
OH Vermilion city
OH Vermilion township
OH Violet township
OH Wadsworth city
OH Wadsworth township
OH Waite Hill village
OH Walbridge village
OH Walton Hills village
OH Warren city
OH Warren County
OH Warren township
OH Warrensville Heights city
OH Warrensville township
OH Washington County
OH Washington township
OH Wayne County
OH Wayne township
OH Weathersfield township
OH Wells township
OH West Carrollton City city
OH West Milton village
OH Westerville city
OH Westlake city
OH Whitehall city
OH Whitewater township
OH Wickliffe city
OH Willoughby city
OH Willoughby Hills city
OH Willowick city
OH Wintersville village
OH Wood County
OH Woodlawn village
OH Woodmere village
OH Worthington city
OH Wyoming city
OH Youngstown city
OK Arkoma town
OK Bethany city
OK Bixby city
OK Broken Arrow city
OK Canadian County
OK Catoosa city
OK Choctaw city
OK Cleveland County
OK Comanche County
OK Creek County
OK Del City city
OK Edmond city
OK Forest Park town
OK Hall Park town
OK Harrah town
OK Jenks city
OK Jones town
OK Lake Aluma town
OK Lawton city
OK Le Flore County
OK Logan County
OK Midwest City city
OK Moffett town
OK Moore city
OK Mustang city
OK Nichols Hills city
OK Nicoma Park city
OK Norman city
OK Oklahoma County
OK Osage County
OK Pottawatomie County
OK Rogers County
OK Sand Springs city
OK Sequoyah County
OK Smith Village town
OK Spencer city
OK The Village city
OK Tulsa County
OK Valley Brook town
OK Wagoner County
OK Warr Acres city
OK Woodlawn Park town
OK Yukon city
OR Central Point city
OR Columbia County
OR Durham city
OR Jackson County
OR Keizer city
OR King City city
OR Lane County
OR Marion County
OR Maywood Park city
OR Medford city
OR Phoenix city
OR Polk County
OR Rainier city
OR Springfield city
OR Troutdale city
OR Tualatin city
OR Wood Village city
PA Abington township
PA Adamsburg borough
PA Alburtis borough
PA Aldan borough
PA Aleppo township
PA Aliquippa city
PA Allegheny County
PA Allegheny township
PA Allen township
PA Allenport borough
PA Alsace township
PA Altoona city
PA Ambler borough
PA Ambridge borough
PA Amwell township
PA Antis township
PA Antrim township
PA Archbald borough
PA Arnold city
PA Ashley borough
PA Aspinwall borough
PA Aston township
PA Avalon borough
PA Avoca borough
PA Baden borough
PA Baldwin borough
PA Baldwin township
PA Beaver borough
PA Beaver County
PA Beaver Falls city
PA Bell Acres borough
PA Belle Vernon borough
PA Bellevue borough
PA Ben Avon borough
PA Ben Avon Heights borough
PA Bensalem township
PA Berks County
PA Bern township
PA Bethel Park borough
PA Bethel township
PA Bethlehem city
PA Bethlehem township
PA Big Beaver borough
PA Birdsboro borough
PA Birmingham township
PA Blair County
PA Blair township
PA Blakely borough
PA Blawnox borough
PA Boyertown borough
PA Brackenridge borough
PA Braddock borough
PA Braddock Hills borough
PA Bradfordwoods borough
PA Brentwood borough
PA Bridgeport borough
PA Bridgeville borough
PA Bridgewater borough
PA Brighton township
PA Bristol borough
PA Bristol township
PA Brookhaven borough
PA Brownstown borough
PA Brownsville borough
PA Brownsville township
PA Bryn Athyn borough
PA Buckingham township
PA Bucks County
PA California borough
PA Caln township
PA Cambria County
PA Camp Hill borough
PA Canonsburg borough
PA Canton township
PA Carbondale city
PA Carbondale township
PA Carnegie borough
PA Carroll township
PA Castle Shannon borough
PA Catasauqua borough
PA Cecil township
PA Center township
PA Centre County
PA Chalfant borough
PA Chalfont borough
PA Charleroi borough
PA Charlestown township
PA Chartiers township
PA Cheltenham township
PA Chester city
PA Chester County
PA Chester Heights borough
PA Chester township
PA Cheswick borough
PA Chippewa township
PA Churchill borough
PA Clairton city
PA Clarks Green borough
PA Clarks Summit borough
PA Clifton Heights borough
PA Coal Center borough
PA Coatesville city
PA Colebrookdale township
PA College township
PA Collegeville borough
PA Collier township
PA Collingdale borough
PA Columbia borough
PA Colwyn borough
PA Concord township
PA Conemaugh township
PA Conestoga township

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PA Conewago township
PA Conshohocken borough
PA Conway borough
PA Coplay borough
PA Coraopolis borough
PA Courtdale borough
PA Crafton borough
PA Crescent township
PA Cumberland County
PA Cumru township
PA Daisytown borough
PA Dale borough
PA Dallas borough
PA Dallas township
PA Dallastown borough
PA Darby borough
PA Darby township
PA Daugherty township
PA Dauphin County
PA Delaware County
PA Delmont borough
PA Derry township
PA Dickson City borough
PA Donora borough
PA Dormont borough
PA Douglass township
PA Dover borough
PA Dover township
PA Downingtown borough
PA Doylestown borough
PA Doylestown township
PA Dravosburg borough
PA Duboistown borough
PA Duncansville borough
PA Dunlevy borough
PA Dunmore borough
PA Dupont borough
PA Duquesne city
PA Duryea borough
PA East Allen township
PA East Bradford township
PA East Brandywine township
PA East Caln township
PA East Conemaugh borough
PA East Coventry township
PA East Deer township
PA East Fallowfield township
PA East Goshen township
PA East Hempfield township
PA East Lampeter township
PA East Lansdowne borough
PA East McKeesport borough
PA East Norriton township
PA East Pennsboro township
PA East Petersburg borough
PA East Pikeland township
PA East Pittsburgh borough
PA East Rochester borough
PA East Taylor township
PA East Vincent township
PA East Washington borough
PA East Whiteland township
PA Easton city
PA Easttown township
PA Eastvale borough
PA Economy borough
PA Eddystone borough
PA Edgewood borough
PA. Edgeworth borough
PA Edgmont township
PA Edwardsville borough
PA Elco borough
PA Elizabeth borough
PA Elizabeth township
PA Ellport borough
PA Ellwood City borough
PA Emmaus borough
PA Emsworth borough
PA Erie city
PA Erie County
PA Etna borough
PA Exeter borough
PA Exeter township
PA Export borough
PA Fairfield township
PA Fairview township
PA Fallowfield township
PA Falls township
PA Fallston borough
PA Farrell city
PA Fayette City borough
PA Fayette County
PA Fell township
PA Ferguson township
PA Ferndale borough
PA Findlay township
PA Finleyville borough
PA Folcroft borough
PA Forest Hills borough
PA Forks township
PA Forty Fort borough
PA Forward township
PA Fountain Hill borough
PA Fox Chapel borough
PA Franconia township
PA Franklin borough
PA Franklin County
PA Franklin Park borough
PA Franklin township
PA Frankstown township
PA Frazer township
PA Freedom borough
PA Freemansburg borough
PA Geistown borough
PA Glassport borough
PA Glendon borough
PA Glenfield borough
PA Glenolden borough
PA Green Tree borough
PA Greensburg city
PA Hallam borough
PA Hampden township
PA Hampton township
PA Hanover township
PA Harborcreek township
PA Harmar township
PA Harmony township
PA Harris township
PA Harrisburg city
PA Harrison township
PA Harveys Lake borough
PA Hatboro borough
PA Hatfield borough
PA Hatfield township
PA Haverford township
PA Haysville borough
PA Heidelberg borough
PA Hellam township
PA Hellertown borough
PA Hempfield township
PA Hepburn township
PA Hermitage city
PA Highspire borough
PA Hilltown township
PA Hollidaysburg borough
PA Homestead borough
PA Homewood borough
PA Hopewell township
PA Horsham township
PA Houston borough
PA Hughestown borough
PA Hulmeville borough
PA Hummelstown borough
PA Hunker borough
PA Indiana township
PA Ingram borough
PA Irwin borough
PA Ivyland borough
PA Jackson township
PA Jacobus borough
PA Jeannette city
PA Jefferson borough
PA Jenkins township
PA Jenkintown borough
PA Jermyn borough
PA Jessup borough
PA Johnstown city
PA Juniata township
PA Kenhorst borough
PA Kennedy township
PA Kilbuck township
PA Kingston borough
PA Kingston township
PA Koppel borough
PA Lackawanna County
PA Laflin borough
PA Lancaster city
PA Lancaster County
PA Lancaster township
PA Langhorne borough
PA Langhorne Manor borough
PA Lansdale borough
PA Lansdowne borough
PA Larksville borough
PA Laurel Run borough
PA Laureldale borough
PA Lawrence County
PA Lawrence Park township
PA Lebanon County
PA Leesport borough
PA Leet township
PA Leetsdale borough
PA Lehigh County
PA Lehman township
PA Lemoyne borough
PA Liberty borough
PA Limerick township
PA Lincoln borough
PA Lititz borough
PA Logan township
PA Loganville borough
PA London Britain township
PA Londonderry township
PA Lorain borough
PA Lower Allen township
PA Lower Alsace township
PA Lower Burrell city
PA Lower Chichester township
PA Lower Frederick township
PA Lower Gwynedd township
PA Lower Heidelberg township
PA Lower Macungie township
PA Lower Makefield township
PA Lower Merion township
PA Lower Moreland township
PA Lower Nazareth township
PA Lower Paxton township
PA Lower Pottsgrove township
PA Lower Providence township
PA Lower Salford township
PA Lower Saucon township
PA Lower Southampton township
PA Lower Swatara township
PA Lower Yoder township
PA Loyalsock township
PA Luzerne borough
PA Luzerne County
PA Luzerne township

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PA Lycoming County
PA Lycoming township
PA Macungie borough
PA Madison borough
PA Maidencreek township
PA Malvern borough
PA Manchester township
PA Manheim township
PA Manor borough
PA Manor township
PA Marcus Hook borough
PA Marple township
PA Marshall township
PA Marysville borough
PA Mayfield borough
PA McCandless township
PA McKean township
PA McKees Rocks borough
PA McKeesport city
PA Mechanicsburg borough
PA Media borough
PA Mercer County
PA Middle Taylor township
PA Middletown borough
PA Middletown township
PA Millbourne borough
PA Millcreek township
PA Millersville borough
PA Millvale borough
PA Modena borough
PA Mohnton borough
PA Monaca borough
PA Monessen city
PA Monongahela city
PA Monroe township
PA Montgomery County
PA Montgomery township
PA Montoursville borough
PA Moon township
PA Moosic borough
PA Morrisville borough
PA Morton borough
PA Mount Lebanon township
PA Mount Oliver borough
PA Mount Penn borough
PA Mountville borough
PA Muhlenberg township
PA Munhall borough
PA Municipality of Monroeville borough
PA Municipality of Murrysville borough
PA Nanticoke city
PA Narberth borough
PA Nether Providence township
PA Neville township
PA New Brighton borough
PA New Britain borough
PA New Britain township
PA New Cumberland borough
PA New Eagle borough
PA New Galilee borough
PA New Garden township
PA New Hanover township
PA New Kensington city
PA New Sewickley township
PA New Stanton borough
PA Newell borough
PA Newport township
PA Newton township
PA Newtown borough
PA Newtown township
PA Norristown borough
PA North Belle Vernon borough
PA North Braddock borough
PA North Catasauqua borough
PA North Charleroi borough
PA North Coventry township
PA North Franklin township
PA North Huntingdon township
PA North Irwin borough
PA North Londonderry township
PA North Sewickley township
PA North Strabane township
PA North Versailles township
PA North Wales borough
PA North Whitehall township
PA North York borough
PA Northampton borough
PA Northampton County
PA Northampton township
PA Norwood borough
PA Oakmont borough
PA O'Hara township
PA Ohio township
PA Old Forge borough
PA Old Lycoming township
PA Olyphant borough
PA Ontelaunee township
PA Osborne borough
PA Paint borough
PA Paint township
PA Palmer township
PA Palmyra borough
PA Parkside borough
PA Patterson Heights borough
PA Patterson township
PA Patton township
PA Paxtang borough
PA Penbrook borough
PA Penn borough
PA Penn Hills township
PA Penn township
PA Penndel borough
PA Pennsbury Village borough
PA Pequea township
PA Perkiomen township
PA Perry County
PA Perry township
PA Peters township
PA Phoenixville borough
PA Pine township
PA Pitcairn borough
PA Pittsburgh city
PA Pittston city
PA Pittston township
PA Plains township
PA Pleasant Hills borough
PA Plum borough
PA Plymouth borough
PA Plymouth township
PA Port Vue borough
PA Potter township
PA Pottstown borough
PA Pringle borough
PA Prospect Park borough
PA Pulaski township
PA Radnor township
PA Rankin borough
PA Ransom township
PA Reading city
PA Red Lion borough
PA Reserve township
PA Richland township
PA Ridley Park borough
PA Ridley township
PA Robinson township
PA Rochester borough
PA Rochester township
PA Rockledge borough
PA Roscoe borough
PA Rose Valley borough
PA Ross township
PA Rosslyn Farms borough
PA Rostraver township
PA Royalton borough
PA Royersford borough
PA Rutledge borough
PA Salem township
PA Salisbury township
PA Scalp Level borough
PA Schuylkill township
PA Schwenksville borough
PA Scott township
PA Scranton city
PA Sewickley borough
PA Sewickley Heights borough
PA Sewickley Hills borough
PA Sewickley township
PA Shaler township
PA Sharon city
PA Sharon Hill borough
PA Sharpsburg borough
PA Sharpsville borough
PA Shenango township
PA Shillington borough
PA Shiremanstown borough
PA Silver Spring township
PA Sinking Spring borough
PA Skippack township
PA Somerset County
PA Souderton borough
PA South Abington township
PA South Coatesville borough
PA South Fayette township
PA South Greensburg borough
PA South Hanover township
PA South Heidelberg township
PA South Heights borough
PA South Huntingdon township
PA South Park township
PA South Pymatuning township
PA South Strabane township
PA South Whitehall township
PA South Williamsport borough
PA Southmont borough
PA Southwest Greensburg borough
PA Speers borough
PA Spring City borough
PA Spring Garden township
PA Spring township
PA Springdale borough
PA Springdale township
PA Springettsbury township
PA Springfield township
PA St. Lawrence borough
PA State College borough
PA Steelton borough
PA Stockdale borough
PA Stonycreek township
PA Stowe township
PA Sugar Notch borough
PA Summit township
PA Susquehanna township
PA Sutersville borough
PA Swarthmore borough
PA Swatara township
PA Swissvale borough
PA Swoyersville borough
PA Tarentum borough
PA Taylor borough
PA Telford borough
PA Temple borough
PA Thornburg borough
PA Thornbury township
PA Throop borough
PA Tinicum township
PA Towamencin township
PA Trafford borough
PA Trainer borough

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PA Trappe borough
PA Tredyffrin township
PA Tullytown borough
PA Turtle Creek borough
PA Union township
PA Upland borough
PA Upper Allen township
PA Upper Chichester township
PA Upper Darby township
PA Upper Dublin township
PA Upper Gwynedd township
PA Upper Leacock township
PA Upper Macungie township
PA Upper Makefield township
PA Upper Merion township
PA Upper Milford township
PA Upper Moreland township
PA Upper Pottsgrove township
PA Upper Providence township
PA Upper Saucon township
PA Upper Southampton township
PA Upper St. Clair township
PA Upper Yoder township
PA Uwchlan township
PA Valley township
PA Vanport township
PA Verona borough
PA Versailles borough
PA Wall borough
PA Warminster township
PA Warrington township
PA Warrior Run borough
PA Warwick township
PA Washington city
PA Washington County
PA Washington township
PA Wayne township
PA Wernersville borough
PA Wesleyville borough
PA West Bradford township
PA West Brownsville borough
PA West Chester borough
PA West Conshohocken borough
PA West Deer township
PA West Earl township
PA West Easton borough
PA West Elizabeth borough
PA West Fairview borough
PA West Goshen township
PA West Hanover township
PA West Hempfield township
PA West Homestead borough
PA West Lampeter township
PA West Lawn borough
PA West Manchester township
PA West Mayfield borough
PA West Middlesex borough
PA West Mifflin borough
PA West Newton borough
PA West Norriton township
PA West Pikeland township
PA West Pittston borough
PA West Pottsgrove township
PA West Reading borough
PA West Taylor township
PA West View borough
PA West Whiteland township
PA West Wyoming borough
PA West York borough
PA Westmont borough
PA Westmoreland County
PA Westtown township
PA Wheatland borough
PA Whitaker borough
PA White Oak borough
PA White township
PA Whitehall township
PA Whitemarsh township
PA Whitpain township
PA Wilkes-Barre city
PA Wilkes-Barre township
PA Wilkins township
PA Wilkinsburg borough
PA Williams township
PA Williamsport city
PA Willistown township
PA Wilmerding borough
PA Wilson borough
PA Windber borough
PA Windsor borough
PA Windsor township
PA Worcester township
PA Wormleysburg borough
PA Wrightsville borough
PA Wyoming borough
PA Wyomissing borough
PA Wyomissing Hills borough
PA Yardley borough
PA Yatesville borough
PA Yeadon borough
PA Yoe borough
PA York city
PA York County
PA York township
PA Youngwood borough
PR Aibonita
PR Anasco
PR Aquada
PR Aquadilla
PR Aquas Buenas
PR Arecibo
PR Bayamon
PR Cabo Rojo
PR Caguas
PR Camuy
PR Canovanas
PR Catano
PR Cayey
PR Cidra
PR Dorado
PR Guaynabo
PR Gurabo
PR Hatillo
PR Hormigueros
PR Humacao
PR Juncos
PR Las Piedras
PR Loiza
PR Manati
PR Mayaguez
PR Moca
PR Naguabo
PR Naranjito
PR Penuelas
PR Ponce
PR Rio Grande
PR San German
PR San Lorenzo
PR Toa Alta
PR Toa Baja
PR Trujillo Alto
PR Vega Alta
PR Vega Baja
PR Yabucao
RI Barrington town
RI Bristol town
RI Burrillville town
RI Central Falls city
RI Coventry town
RI Cranston city
RI Cumberland town
RI East Greenwich town
RI East Providence city
RI Glocester town
RI Jamestown town
RI Johnston town
RI Lincoln town
RI Middletown town
RI Newport city
RI Newport County
RI North Kingstown town
RI North Providence town
RI North Smithfield town
RI Pawtucket city
RI Portsmouth town
RI Providence city
RI Providence County
RI Scituate town
RI Smithfield town
RI Tiverton town
RI Warren town
RI Warwick city
RI Washington County
RI West Greenwich town
RI West Warwick town
RI Woonsocket city
SC Aiken city
SC Aiken County
SC Anderson city
SC Anderson County
SC Arcadia Lakes town
SC Berkeley County
SC Burnettown town
SC Cayce city
SC Charleston city
SC Charleston County
SC City View town
SC Columbia city
SC Cowpens town
SC Darlington County
SC Dorchester County
SC Edgefield County
SC Florence city
SC Florence County
SC Folly Beach city
SC Forest Acres city
SC Fort Mill town
SC Georgetown County
SC Goose Creek city
SC Hanahan city
SC Horry County
SC Irmo town
SC Isle of Palms city
SC Lexington County
SC Lincolnville town
SC Mount Pleasant town
SC Myrtle Beach city
SC North Augusta city
SC North Charleston city
SC Pickens County
SC Pineridge town
SC Quinby town
SC Rock Hill city
SC South Congaree town
SC Spartanburg city
SC Spartanburg County
SC Springdale town
SC Sullivan's Island town
SC Summerville town
SC Sumter city
SC Sumter County
SC Surfside Beach town
SC West Columbia city
SC York County
SD Big Sioux township
SD Central Pennington unorg.
SD Lincoln County
SD Mapleton township

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SD Minnehaha County
SD North Sioux City city
SD Pennington County
SD Rapid City city
SD Split Rock township
SD Union County
SD Wayne township
TN Alcoa city
TN Anderson County
TN Bartlett town
TN Belle Meade city
TN Berry Hill city
TN Blount County
TN Brentwood city
TN Bristol city
TN Carter County
TN Church Hill town
TN Clarksville city
TN Collegedale city
TN Davidson County
TN East Ridge city
TN Elizabethton city
TN Farragut town
TN Forest Hills city
TN Germantown city
TN Goodlettsville city
TN Hamilton County
TN Hawkins County
TN Hendersonville city
TN Jackson city
TN Johnson City city
TN Jonesborough town
TN Kingsport city
TN Knox County
TN Lakesite city
TN Lakewood city
TN Lookout Mountain town
TN Loudon County
TN Madison County
TN Maryville city
TN Montgomery County
TN Mount Carmel town
TN Mount Juliet city
TN Oak Hill city
TN Red Bank city
TN Ridgeside city
TN Rockford city
TN Shelby County
TN Signal Mountain town
TN Soddy-Daisy city
TN Sullivan County
TN Sumner County
TN Washington County
TN Williamson County
TN Wilson County
TX Addison city
TX Alamo city
TX Alamo Heights city
TX Allen city
TX Archer County
TX Azle city
TX Balch Springs city
TX Balcones Heights city
TX Bayou Vista village
TX Baytown city
TX Bedford city
TX Bell County
TX Bellaire city
TX Bellmead city
TX Belton city
TX Benbrook city
TX Beverly Hills city
TX Bexar County
TX Blue Mound city
TX Bowie County
TX Brazoria County
TX Brazos County
TX Brookside Village city
TX Brownsville city
TX Bryan city
TX Buckingham town
TX Bunker Hill Village city
TX Cameron County
TX Carrollton city
TX Castle Hills city
TX Cedar Hill city
TX Cedar Park city
TX Chambers County
TX Cibolo city
TX Clear Lake Shores city
TX Clint town
TX Cockrell Hill city
TX College Station city
TX Colleyville city
TX Collin County
TX Comal County
TX Combes town
TX Converse city
TX Copperas Cove city
TX Corinth town
TX Coryell County
TX Crowley city
TX Dallas County
TX Dalworthington Gardens city
TX Deer Park city
TX Denison city
TX Denton city
TX Denton County
TX DeSoto city
TX Dickinson city
TX Donna city
TX Double Oak town
TX Duncanville city
TX Ector County
TX Edgecliff village
TX Edinburg city
TX El Lago city
TX El Paso County
TX Ellis County
TX Euless city
TX Everman city
TX Farmers Branch city
TX Flower Mound town
TX Forest Hill city
TX Fort Bend County
TX Friendswood city
TX Galena Park city
TX Galveston city
TX Galveston County
TX Grand Prairie city
TX Grapevine city
TX Grayson County
TX Gregg County
TX Groves city
TX Guadalupe County
TX Haltom City city
TX Hardin County
TX Harker Heights city
TX Harlingen city
TX Harrison County
TX Hedwig Village city
TX Hewitt city
TX Hickory Creek town
TX Hidalgo County
TX Highland Park town
TX Highland Village city
TX Hill Country Village city
TX Hilshire Village city
TX Hitchcock city
TX Hollywood Park town
TX Howe town
TX Humble city
TX Hunters Creek Village city
TX Hurst city
TX Hutchins city
TX Impact town
TX Jacinto City city
TX Jefferson County
TX Jersey Village city
TX Johnson County
TX Jones County
TX Katy city
TX Kaufman County
TX Keller city
TX Kemah city
TX Kennedale city
TX Killeen city
TX Kirby city
TX Kleberg County
TX La Marque city
TX La Porte city
TX Lacy-Lakeview city
TX Lake Dallas city
TX Lake Worth city
TX Lakeside City town
TX Lakeside town
TX Lampasas County
TX Lancaster city
TX League City city
TX Leander city
TX Leon Valley city
TX Lewisville city
TX Live Oak city
TX Longview city
TX Lubbock County
TX Lumberton city
TX Martin County
TX McAllen city
TX McLennan County
TX Meadows city
TX Midland city
TX Midland County
TX Mission city
TX Missouri City city
TX Montgomery County
TX Morgan's Point city
TX Nash city
TX Nassau Bay city
TX Nederland city
TX Nolanville city
TX North Richland Hills city
TX Northcrest town
TX Nueces County
TX Odessa city
TX Olmos Park city
TX Palm Valley town
TX Palmview city
TX Pantego town
TX Parker County
TX Pearland city
TX Pflugerville city
TX Pharr city
TX Piney Point Village city
TX Port Arthur city
TX Port Neches city
TX Portland city
TX Potter County
TX Primera town
TX Randall County
TX Richardson city
TX Richland Hills city
TX River Oaks city
TX Robinson city
TX Rockwall city
TX Rockwall County
TX Rollingwood city
TX Rose Hill Acres city
TX Rowlett city

TX Sachse city
TX Saginaw city
TX San Angelo city
TX San Benito city
TX San Juan city
TX San Patricio County
TX Sansom Park city
TX Santa Fe city
TX Schertz city
TX Seabrook city
TX Seagoville city
TX Selma city
TX Shavano Park city
TX Sherman city
TX Shoreacres city
TX Smith County
TX Socorro town
TX South Houston city
TX Southside Place city
TX Spring Valley city
TX Stafford town
TX Sugar Land city
TX Sunset Valley city
TX Tarrant County
TX Taylor County
TX Taylor Lake Village city
TX Temple city
TX Terrell Hills city
TX Texarkana city
TX Texas City city
TX Tom Green County
TX Travis County
TX Tye town
TX Tyler city
TX Universal City city
TX University Park city
TX Victoria city
TX Victoria County
TX Wake Village city
TX Waller County
TX Watauga city
TX Webb County
TX Webster city
TX Weslaco city
TX West Lake Hills city
TX West University Place city
TX Westover Hills town
TX Westworth village
TX White Oak city
TX White Settlement city
TX Wichita County
TX Wichita Falls city
TX Williamson County
TX Wilmer city
TX Windcrest city
TX Woodway city
UT American Fork city
UT Bluffdale city
UT Bountiful city
UT Cache County
UT Cedar Hills town
UT Centerville city
UT Clearfield city
UT Clinton city
UT Davis County
UT Draper city
UT Farmington city
UT Farr West city
UT Fruit Heights city
UT Harrisville city
UT Highland city
UT Hyde Park city
UT Kaysville city
UT Layton city
UT Lehi city
UT Lindon city
UT Logan city
UT Mapleton city
UT Midvale city
UT Millville city
UT Murray city
UT North Logan city
UT North Ogden city
UT North Salt Lake city
UT Ogden city
UT Orem city
UT Pleasant Grove city
UT Pleasant View city
UT Providence city
UT Provo city
UT River Heights city
UT Riverdale city
UT Riverton city
UT Roy city
UT Sandy city
UT Smithfield city
UT South Jordan city
UT South Ogden city
UT South Salt Lake city
UT South Weber city
UT Springville city
UT Sunset city
UT Syracuse city
UT Uintah town
UT Utah County
UT Washington Terrace city
UT Weber County
UT West Bountiful city
UT West Jordan city
UT West Point city
UT West Valley City city
UT Woods Cross city
VA Albemarle County
VA Alexandria city
VA Amherst County
VA Bedford County
VA Botetourt County
VA Bristol city
VA Campbell County
VA Charlottesville city
VA Colonial Heights city
VA Danville city
VA Dinwiddie County
VA Fairfax city
VA Falls Church city
VA Fredericksburg city
VA Gate City town
VA Gloucester County
VA Hanover County
VA Herndon town
VA Hopewell city
VA James City County
VA Loudoun County
VA Lynchburg city
VA Manassas city
VA Manassas Park city
VA Occoquan town
VA Petersburg city
VA Pittsylvania County
VA Poquoson city
VA Prince George County
VA Richmond city
VA Roanoke city
VA Roanoke County
VA Salem city
VA Scott County
VA Spotsylvania County
VA Stafford County
VA Suffolk city
VA Vienna town
VA Vinton town
VA Washington County
VA Weber City town
VA Williamsburg city
VA York County
VT Burlington city
VT Chittenden County
VT Colchester town
VT Essex Junction village
VT Essex town
VT Shelburne town
VT South Burlington city
VT Williston town
VT Winooski city
WA Algona city
WA Auburn city
WA Beaux Arts Village town
WA Bellevue city
WA Bellingham city
WA Benton County
WA Bonney Lake city
WA Bothell city
WA Bremerton city
WA Brier city
WA Clyde Hill town
WA Cowlitz County
WA Des Moines city
WA DuPont city
WA Edmonds city
WA Everett city
WA Fife city
WA Fircrest town
WA Franklin County
WA Gig Harbor city
WA Hunts Point town
WA Issaquah city
WA Kelso city
WA Kennewick city
WA Kent city
WA Kirkland city
WA Kitsap County
WA Lacey city
WA Lake Forest Park city
WA Longview city
WA Lynnwood city
WA Marysville city
WA Medina city
WA Mercer Island city
WA Mill Creek city
WA Millwood town
WA Milton city
WA Mountlake Terrace city
WA Mukilteo city
WA Normandy Park city
WA Olympia city
WA Pacific city
WA Pasco city
WA Port Orchard city
WA Puyallup city
WA Redmond city
WA Renton city
WA Richland city
WA Ruston town
WA Selah city
WA Steilacoom town
WA Sumner city
WA Thurston County
WA Tukwila city
WA Tumwater city
WA Union Gap city
WA Vancouver city
WA West Richland city
WA Whatcom County
WA Woodway city
WA Yakima city
WA Yakima County
WA Yarrow Point town
WI Algoma town

WI Allouez village
WI Altoona city
WI Appleton city
WI Ashwaubenon village
WI Bayside village
WI Bellevue town
WI Beloit city
WI Beloit town
WI Big Bend village
WI Black Wolf town
WI Blooming Grove town
WI Brookfield city
WI Brookfield town
WI Brown County
WI Brown Deer village
WI Brunswick town
WI Buchanan town
WI Burke town
WI Butler village
WI Caledonia town
WI Calumet County
WI Campbell town
WI Cedarburg city
WI Cedarburg town
WI Chippewa County
WI Chippewa Falls city
WI Clayton town
WI Combined Locks village
WI Cudahy city
WI Dane County
WI De Pere city
WI De Pere town
WI Delafield town
WI Douglas County
WI Dunn town
WI Eagle Point town
WI Eau Claire city
WI Eau Claire County
WI Elm Grove village
WI Elmwood Park village
WI Fitchburg city
WI Fox Point village
WI Franklin city
WI Germantown town
WI Germantown village
WI Glendale city
WI Grafton town
WI Grafton village
WI Grand Chute town
WI Green Bay city
WI Greendale village
WI Greenfield city
WI Greenville town
WI Hales Corners village
WI Hallie town
WI Harmony town
WI Harrison town
WI Hobart town
WI Holmen village
WI Howard village
WI Janesville city
WI Janesville town
WI Kaukauna city
WI Kenosha city
WI Kenosha County
WI Kimberly village
WI Kohler village
WI La Crosse city
WI La Crosse County
WI La Prairie town
WI Lafayette town
WI Lannon village
WI Lima town
WI Lisbon town
WI Little Chute village
WI Madison town
WI Maple Bluff village
WI Marathon County
WI McFarland village
WI Medary town
WI Menasha city
WI Menasha town
WI Menomonee Falls village
WI Mequon city
WI Middleton city
WI Middleton town
WI Monona city
WI Mount Pleasant town
WI Muskego city
WI Neenah city
WI Neenah town
WI Nekimi town
WI New Berlin city
WI North Bay village
WI Norway town
WI Oak Creek city
WI Onalaska city
WI Onalaska town
WI Oshkosh city
WI Oshkosh town
WI Outagamie County
WI Ozaukee County
WI Pewaukee town
WI Pewaukee village
WI Pleasant Prairie town
WI Pleasant Prairie village
WI Racine city
WI Racine County
WI Rib Mountain town
WI River Hills village
WI Rock County
WI Rock town
WI Rothschild village
WI Salem town
WI Schofield city
WI Scott town
WI Sheboygan city
WI Sheboygan County
WI Sheboygan Falls city
WI Sheboygan Falls town
WI Sheboygan town
WI Shelby town
WI Shorewood Hills village
WI Shorewood village
WI Somers town
WI South Milwaukee city
WI St. Francis city
WI Stettin town
WI Sturtevant village
WI Superior city
WI Superior village
WI Sussex village
WI Thiensville village
WI Turtle town
WI Union town
WI Vandenbroek town
WI Vernon town
WI Washington County
WI Washington town
WI Waukesha city
WI Waukesha County
WI Waukesha town
WI Wausau city
WI Wauwatosa city
WI West Allis city
WI West Milwaukee village
WI Weston town
WI Westport town
WI Wheaton town
WI Whitefish Bay village
WI Wilson town
WI Wind Point village
WI Winnebago County
WV Bancroft town
WV Barboursville village
WV Belle town
WV Benwood city
WV Berkeley County
WV Bethlehem village
WV Brooke County
WV Cabell County
WV Cedar Grove town
WV Ceredo city
WV Charleston city
WV Chesapeake town
WV Clearview village
WV Dunbar city
WV East Bank town
WV Follansbee city
WV Glasgow town
WV Glen Dale city
WV Hancock County
WV Huntington city
WV Hurricane city
WV Kanawha County
WV Kenova city
WV Marmet city
WV Marshall County
WV McMechen city
WV Mineral County
WV Moundsville city
WV Nitro city
WV North Hills town
WV Ohio County
WV Parkersburg city
WV Poca town
WV Putnam County
WV Ridgeley town
WV South Charleston city
WV St. Albans city
WV Triadelphia town
WV Vienna city
WV Wayne County
WV Weirton city
WV Wheeling city
WV Wood County
WY Casper city
WY Cheyenne city
WY Evansville town
WY Laramie County
WY Mills town
WY Natrona County

Appendix 7 of Preamble—Governmental Entities (Located Outside of an Urbanized Area) That Must Be Examined By the NPDES Permitting Authority for Potential Designation Under § 123.35(b)(2)

(All listed entities have a population of at least 10,000 and a population density of at least 1,000. A listed entity would only be potentially designated if it operates a small MS4. See § 122.26(b)(16) for the definition of a small MS4.)

(This list does not include all operators of small MS4s that may be designated by the NPDES permitting authority. Operators of small MS4s in areas with populations below 10,000 and densities below 1,000 may also be designated but examination of them is not required. Also, entities such as military bases, large hospitals, prison complexes, universities, sewer districts, and highway departments that operate a small MS4 in an area listed here, or in an area otherwise designated by the NPDES permitting authority, may be designated and become subject to permitting regulations.) (Source: 1990 Census of Population and Housing, U.S. Bureau of the Census. This list is subject to change with the Decennial Census)

AL Daphne city
AL Jacksonville city
AL Selma city
AR Arkadelphia city
AR Benton city
AR Blytheville city
AR Conway city
AR El Dorado city
AR Hot Springs city
AR Magnolia city
AR Rogers city
AR Searcy city
AR Stuttgart city
AZ Douglas city
CA Arcata city
CA Arroyo Grande city
CA Atwater city
CA Auburn city
CA Banning city
CA Brawley city
CA Calexico city
CA Clearlake city
CA Corcoran city
CA Delano city
CA Desert Hot Springs city
CA Dinuba city
CA Dixon city
CA El Centro city
CA El Paso de Robles (Paso Robles) city
CA Eureka city
CA Fillmore city
CA Gilroy city
CA Grover City city
CA Hanford city
CA Hollister city
CA Lemoore city
CA Los Banos city
CA Madera city
CA Manteca city
CA Oakdale city
CA Oroville city
CA Paradise town
CA Petaluma city
CA Porterville city
CA Red Bluff city
CA Reedley city
CA Ridgecrest city
CA Sanger city
CA Santa Paula city
CA Selma city
CA South Lake Tahoe city
CA Temecula city
CA Tracy city
CA Tulare city
CA Turlock city
CA Ukiah city
CA Wasco city
CA Woodland city
CO Canon City city
CO Durango city
CO Lafayette city
CO Louisville city
CO Loveland city
CO Sterling city
FL Bartow city
FL Belle Glade city
FL De Land city
FL Eustis city
FL Haines City city
FL Key West city
FL Leesburg city
FL Palatka city
FL Plant City city
FL St. Augustine city
FL St. Cloud city
GA Americus city
GA Carrollton city
GA Cordele city
GA Dalton city
GA Dublin city
GA Griffin city
GA Hinesville city
GA Moultrie city
GA Newnan city
GA Statesboro city
GA Thomasville city
GA Tifton city
GA Valdosta city
GA Waycross city
IA Ames city
IA Ankeny city
IA Boone city
IA Burlington city
IA Fort Dodge city
IA Fort Madison city
IA Indianola city
IA Keokuk city
IA Marshalltown city
IA Mason City city
IA Muscatine city
IA Newton city
IA Oskaloosa city
IA Ottumwa city
IA Spencer city
ID Caldwell city
ID Coeur d'Alene city
ID Lewiston city
ID Moscow city
ID Nampa city
ID Rexburg city
ID Twin Falls city
IL Belvidere city
IL Canton city
IL Carbondale city
IL Centralia city
IL Charleston city
IL Danville city
IL De Kalb city
IL Dixon city
IL Effingham city
IL Freeport city
IL Galesburg city
IL Jacksonville city
IL Macomb city
IL Mattoon city
IL Mount Vernon city
IL Ottawa city
IL Pontiac city
IL Quincy city
IL Rantoul village
IL Sterling city
IL Streator city
IL Taylorville city
IL Woodstock city
IN Bedford city
IN Columbus city
IN Crawfordsville city
IN Frankfort city
IN Franklin city
IN Greenfield city
IN Huntington city
IN Jasper city
IN La Porte city
IN Lebanon city
IN Logansport city
IN Madison city
IN Marion city
IN Martinsville city
IN Michigan City city
IN New Castle city
IN Noblesville city
IN Peru city
IN Plainfield town
IN Richmond city
IN Seymour city
IN Shelbyville city
IN Valparaiso city
IN Vincennes city
IN Wabash city
IN Warsaw city
IN Washington city
KS Arkansas City city
KS Atchison city
KS Coffeyville city
KS Derby city
KS Dodge City city
KS El Dorado city
KS Emporia city
KS Garden City city
KS Great Bend city
KS Hays city
KS Hutchinson city
KS Junction City city
KS Leavenworth city
KS Liberal city
KS Manhattan city
KS McPherson city
KS Newton city
KS Ottawa city
KS Parsons city
KS Pittsburg city
KS Salina city
KS Winfield city
KY Bowling Green city
KY Danville city
KY Frankfort city
KY Georgetown city
KY Glasgow city
KY Hopkinsville city
KY Madisonville city
KY Middlesborough city
KY Murray city
KY Nicholasville city
KY Paducah city
KY Radcliff city
KY Richmond city
KY Somerset city
KY Winchester city

LA Abbeville city
LA Bastrop city
LA Bogalusa city
LA Crowley city
LA Eunice city
LA Hammond city
LA Jennings city
LA Minden city
LA Morgan City city
LA Natchitoches city
LA New Iberia city
LA Opelousas city
LA Ruston city
LA Thibodaux city
MA Amherst town
MA Clinton town
MA Milford town
MA Newburyport city
MD Aberdeen town
MD Cambridge city
MD Salisbury city
MD Westminster city
ME Waterville city
MI Adrian city
MI Albion city
MI Alpena city
MI Big Rapids city
MI Cadillac city
MI Escanaba city
MI Grand Haven city
MI Marquette city
MI Midland city
MI Monroe city
MI Mount Pleasant city
MI Owosso city
MI Sturgis city
MI Traverse City city
MN Albert Lea city
MN Austin city
MN Bemidji city
MN Brainerd city
MN Faribault city
MN Fergus Falls city
MN Hastings city
MN Hutchinson city
MN Mankato city
MN Marshall city
MN New Ulm city
MN North Mankato city
MN Northfield city
MN Owatonna city
MN Stillwater city
MN Willmar city
MN Winona city
MO Cape Girardeau city
MO Farmington city
MO Hannibal city
MO Jefferson City city
MO Kennett city
MO Kirksville city
MO Marshall city
MO Maryville city
MO Poplar Bluff city
MO Rolla city
MO Sedalia city
MO Sikeston city
MO Warrensburg city
MO Washington city
MS Brookhaven city
MS Canton city
MS Clarksdale city
MS Cleveland city
MS Columbus city
MS Greenville city
MS Greenwood city
MS Grenada city
MS Indianola city
MS Laurel city
MS McComb city
MS Meridian city
MS Natchez city
MS Starkville city
MS Vicksburg city
MS Yazoo City city
MT Bozeman city
MT Havre city
MT Helena city
MT Kalispell city
NC Albemarle city
NC Asheboro city
NC Boone town
NC Eden city
NC Elizabeth City city
NC Havelock city
NC Henderson city
NC Kernersville town
NC Kinston city
NC Laurinburg city
NC Lenoir city
NC Lexington city
NC Lumberton city
NC Monroe city
NC New Bern city
NC Reidsville city
NC Roanoke Rapids city
NC Salisbury city
NC Sanford city
NC Shelby city
NC Statesville city
NC Tarboro town
NC Wilson city
ND Dickinson city
ND Jamestown city
ND Minot city
ND Williston city
NE Beatrice city
NE Columbus city
NE Fremont city
NE Grand Island city
NE Hastings city
NE Kearney city
NE Norfolk city
NE North Platte city
NE Scottsbluff city
NJ East Windsor township
NJ Plainsboro township
NJ Bridgeton city
NJ Princeton borough
NM Alamogordo city
NM Artesia city
NM Clovis city
NM Deming city
NM Farmington city
NM Gallup city
NM Hobbs city
NM Las Vegas city
NM Portales city
NM Roswell city
NM Silver City town
NV Elko city
NY Amsterdam city
NY Auburn city
NY Batavia city
NY Canandaigua city
NY Corning city
NY Cortland city
NY Dunkirk city
NY Fredonia village
NY Fulton city
NY Geneva city
NY Gloversville city
NY Jamestown city
NY Kingston city
NY Lockport city
NY Massena village
NY Middletown city
NY Ogdensburg city
NY Olean city
NY Oneonta city
NY Oswego city
NY Plattsburgh city
NY Potsdam village
NY Watertown city
OH Alliance city
OH Ashland city
OH Ashtabula city
OH Athens city
OH Bellefontaine city
OH Bowling Green city
OH Bucyrus city
OH Cambridge city
OH Chillicothe city
OH Circleville city
OH Coshocton city
OH Defiance city
OH Delaware city
OH Dover city
OH East Liverpool city
OH Findlay city
OH Fostoria city
OH Fremont city
OH Galion city
OH Greenville city
OH Lancaster city
OH Lebanon city
OH Marietta city
OH Marion city
OH Medina city
OH Mount Vernon city
OH New Philadelphia city
OH Norwalk city
OH Oxford city
OH Piqua city
OH Portsmouth city
OH Salem city
OH Sandusky city
OH Sidney city
OH Tiffin city
OH Troy city
OH Urbana city
OH Washington city
OH Wilmington city
OH Wooster city
OH Xenia city
OH Zanesville city
OK Ada city
OK Altus city
OK Bartlesville city
OK Chickasha city
OK Claremore city
OK McAlester city
OK Miami city
OK Muskogee city
OK Okmulgee city
OK Owasso city
OK Ponca City city
OK Stillwater city
OK Tahlequah city
OK Weatherford city
OR Albany city
OR Ashland city
OR Astoria city
OR Bend city
OR City of the Dalles city
OR Coos Bay city
OR Corvallis city
OR Grants Pass city
OR Hermiston city

OR Klamath Falls city
OR La Grande city
OR Lebanon city
OR McMinnville city
OR Newberg city
OR Pendleton city
OR Roseburg city
OR Woodburn city
PA Berwick borough
PA Bloomsburg town
PA Butler city
PA Carlisle borough
PA Chambersburg borough
PA Ephrata borough
PA Hanover borough
PA Hazleton city
PA Indiana borough
PA Lebanon city
PA Meadville city
PA New Castle city
PA Oil City city
PA Pottsville city
PA Sunbury city
PA Uniontown city
PA Warren city
RI Narragansett town
SC Clemson city
SC Easley city
SC Gaffney city
SC Greenwood city
SC Newberry town
SC Orangeburg city
SD Aberdeen city
SD Brookings city
SD Huron city
SD Mitchell city
SD Vermillion city
SD Watertown city
SD Yankton city
TN Brownsville city
TN Cleveland city
TN Collierville town
TN Cookeville city
TN Dyersburg city
TN Greeneville town
TN Lawrenceburg city
TN McMinnville city
TN Millington city
TN Morristown city
TN Murfreesboro city
TN Shelbyville city
TN Springfield city
TN Union City city
TX Alice city
TX Alvin city
TX Andrews city
TX Angleton city
TX Bay City city
TX Beeville city
TX Big Spring city
TX Borger city
TX Brenham city
TX Brownwood city
TX Burkburnett city
TX Canyon city
TX Cleburne city
TX Conroe city
TX Coppell city
TX Corsicana city
TX Del Rio city
TX Dumas city
TX Eagle Pass city
TX El Campo city
TX Gainesville city
TX Gatesville city
TX Georgetown city
TX Henderson city
TX Hereford city
TX Huntsville city
TX Jacksonville city
TX Kerrville city
TX Kingsville city
TX Lake Jackson city
TX Lamesa city
TX Levelland city
TX Lufkin city
TX Mercedes city
TX Mineral Wells city
TX Mount Pleasant city
TX Nacogdoches city
TX New Braunfels city
TX Palestine city
TX Pampa city
TX Pecos city
TX Plainview city
TX Port Lavaca city
TX Robstown city
TX Rosenberg city
TX Round Rock city
TX San Marcos city
TX Seguin city
TX Snyder city
TX Stephenville city
TX Sweetwater city
TX Taylor city
TX The Colony city
TX Uvalde city
TX Vernon city
TX Vidor city
UT Brigham City city
UT Cedar City city
UT Spanish Fork city
UT Tooele city
VA Blacksburg town
VA Christiansburg town
VA Front Royal town
VA Harrisonburg city
VA Leesburg town
VA Martinsville city
VA Radford city
VA Staunton city
VA Waynesboro city
VA Winchester city
VT Rutland city
WA Aberdeen city
WA Anacortes city
WA Centralia city
WA Ellensburg city
WA Moses Lake city
WA Mount Vernon city
WA Oak Harbor city
WA Port Angeles city
WA Pullman city
WA Sunnyside city
WA Walla Walla city
WA Wenatchee city
WI Beaver Dam city
WI Fond du Lac city
WI Fort Atkinson city
WI Manitowoc city
WI Marinette city
WI Marshfield city
WI Menomonie city
WI Monroe city
WI Oconomowoc city
WI Stevens Point city
WI Sun Prairie city
WI Two Rivers city
WI Watertown city
WI West Bend city
WI Whitewater city
WI Wisconsin Rapids city
WV Beckley city
WV Bluefield city
WV Clarksburg city
WV Fairmont city
WV Martinsburg city
WV Morgantown city
WY Evanston city
WY Gillette city
WY Green River city
WY Laramie city
WY Rock Springs city
WY Sheridan city

For the reasons set forth in the preamble, chapter I of title 40 of the Code of Federal Regulations is amended as follows:

PART 9—OMB APPROVALS UNDER THE PAPERWORK REDUCTION ACT

1. The authority citation for part 9 continues to read as follows:

Authority: 7 U.S.C. 135 *et seq.*, 136–136y; 15 U.S.C. 2001, 2003, 2005, 2006, 2601–2671; 21 U.S.C. 331j, 346a, 348; 31 U.S.C. 9701; 33 U.S.C. 1251 *et seq.*, 1311, 1313d, 1314, 1318, 1321, 1326, 1330, 1342, 1344, 1345 (d) and (e), 1361; E.O. 11735, 38 FR 21243, 3 CFR, 1971–1975 Comp. p. 973; 42 U.S.C. 241, 242b, 243, 246, 300f, 300g, 300g–1, 300g–2, 300g–3, 300g–4, 300g–5, 300g–6, 300j–1, 300j–2, 300j–3, 300j–4, 300j–9, 1857 *et seq.*, 6901–6992k, 7401–7671q, 7542, 9601–9657, 11023, 11048.

2. In § 9.1 the table is amended by adding entries in numerical order under the indicated heading to read as follows:

§ 9.1 OMB approvals under the Paperwork Reduction Act.

* * * * *

R0018209

40 CFR citation	OMB control No.
* * * * * * *	
EPA Administered Permit Programs: The National Pollutant Discharge Elimination System	
* * * * * * *	
122.26(g)	2040–0211
* * * * * * *	
State Permit Requirements	
* * * * * * *	
123.35(b)	2040–0211
* * * * * * *	

PART 122—EPA ADMINISTERED PERMIT PROGRAMS: THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

1. The authority citation for part 122 continues to read as follows:

Authority: The Clean Water Act, 33 U.S.C. 1251 *et seq.*

2. Revise § 122.21(c)(1) to read as follows:

§ 122.21 Application for a permit (applicable to State programs, see § 123.25).

* * * * *

(c) *Time to apply.* (1) Any person proposing a new discharge, shall submit an application at least 180 days before the date on which the discharge is to commence, unless permission for a later date has been granted by the Director. Facilities proposing a new discharge of storm water associated with industrial activity shall submit an application 180 days before that facility commences industrial activity which may result in a discharge of storm water associated with that industrial activity. Facilities described under § 122.26(b)(14)(x) or (b)(15)(i) shall submit applications at least 90 days before the date on which construction is to commence. Different submittal dates may be required under the terms of applicable general permits. Persons proposing a new discharge are encouraged to submit their applications well in advance of the 90 or 180 day requirements to avoid delay. See also paragraph (k) of this section and § 122.26(c)(1)(i)(G) and (c)(1)(ii).

* * * * *

3. Amend § 122.26 as follows:

a. Revise paragraphs (a)(9), (b)(4)(i), (b)(7)(i), (b)(14) introductory text, (b)(14)(x), (b)(14)(xi);

b. Redesignate paragraph (b)(15) as paragraph (b)(20) and add new paragraphs (b)(15) through (b)(19);

c. Revise the heading for paragraph (c), the first sentence of paragraph (c)(1) introductory text, the first sentence of paragraph (c)(1)(ii) introductory text, paragraphs (e) heading and introductory text, (e)(1), (e)(5) introductory text, and (e)(5)(i);

d. Add paragraphs (e)(8) and (e)(9); and

e. Revise paragraphs (f)(4), (f)(5), and (g).

The additions and revisions read as follows:

§ 122.26 Storm water discharges (applicable to State NPDES programs, see § 123.25).

(a) * * *

(9)(i) On and after October 1, 1994, for discharges composed entirely of storm water, that are not required by paragraph (a)(1) of this section to obtain a permit, operators shall be required to obtain a NPDES permit only if:

(A) The discharge is from a small MS4 required to be regulated pursuant to § 122.32;

(B) The discharge is a storm water discharge associated with small construction activity pursuant to paragraph (b)(15) of this section;

(C) The Director, or in States with approved NPDES programs either the Director or the EPA Regional Administrator, determines that storm water controls are needed for the discharge based on wasteload allocations that are part of "total maximum daily loads" (TMDLs) that address the pollutant(s) of concern; or

(D) The Director, or in States with approved NPDES programs either the Director or the EPA Regional Administrator, determines that the discharge, or category of discharges within a geographic area, contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

(ii) Operators of small MS4s designated pursuant to paragraphs (a)(9)(i)(A), (a)(9)(i)(C), and (a)(9)(i)(D) of this section shall seek coverage under an NPDES permit in accordance with §§ 122.33 through 122.35. Operators of non-municipal sources designated pursuant to paragraphs (a)(9)(i)(B), (a)(9)(i)(C), and (a)(9)(i)(D) of this section shall seek coverage under an NPDES permit in accordance with paragraph (c)(1) of this section.

(iii) Operators of storm water discharges designated pursuant to paragraphs (a)(9)(i)(C) and (a)(9)(i)(D) of this section shall apply to the Director for a permit within 180 days of receipt of notice, unless permission for a later date is granted by the Director (see § 124.52(c) of this chapter).

(b) * * *

(4) * * *

(i) Located in an incorporated place with a population of 250,000 or more as determined by the 1990 Decennial Census by the Bureau of the Census (Appendix F of this part); or

* * * * *

(7) * * *

(i) Located in an incorporated place with a population of 100,000 or more but less than 250,000, as determined by the 1990 Decennial Census by the Bureau of the Census (Appendix G of this part); or

* * * * *

(14) *Storm water discharge associate with industrial activity* means the discharge from any conveyance that is used for collecting and conveying storm

water and that is directly related to manufacturing, processing or raw materials storage areas at an industrial plant. The term does not include discharges from facilities or activities excluded from the NPDES program under this part 122. For the categories of industries identified in this section, the term includes, but is not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process waste waters (as defined at part 401 of this chapter); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and final products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water. For the purposes of this paragraph, material handling activities include storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, final product, by-product or waste product. The term excludes areas located on plant lands separate from the plant's industrial activities, such as office buildings and accompanying parking lots as long as the drainage from the excluded areas is not mixed with storm water drained from the above described areas. Industrial facilities (including industrial facilities that are federally, State, or municipally owned or operated that meet the description of the facilities listed in paragraphs (b)(14)(i) through (xi) of this section) include those facilities designated under the provisions of paragraph (a)(1)(v) of this section. The following categories of facilities are considered to be engaging in "industrial activity" for purposes of paragraph (b)(14):

* * * * *

(x) Construction activity including clearing, grading and excavation, except operations that result in the disturbance of less than five acres of total land area. Construction activity also includes the disturbance of less than five acres of total land area that is a part of a larger common plan of development or sale if the larger common plan will ultimately disturb five acres or more;

(xi) Facilities under Standard Industrial Classifications 20, 21, 22, 23, 2434, 25, 265, 267, 27, 283, 285, 30, 31 (except 311), 323, 34 (except 3441), 35, 36, 37 (except 373), 38, 39, and 4221–25;

(15) *Storm water discharge associated with small construction activity* means the discharge of storm water from:

(i) Construction activities including clearing, grading, and excavating that result in land disturbance of equal to or greater than one acre and less than five acres. Small construction activity also includes the disturbance of less than one acre of total land area that is part of a larger common plan of development or sale if the larger common plan will ultimately disturb equal to or greater than one and less than five acres. Small construction activity does not include routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of the facility. The Director may waive the otherwise applicable requirements in a general permit for a storm water discharge from construction activities that disturb less than five acres where:

(A) The value of the rainfall erosivity factor ("R" in the Revised Universal Soil Loss Equation) is less than five during the period of construction activity. The rainfall erosivity factor is determined in accordance with Chapter 2 of *Agriculture Handbook Number 703, Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE)*, pages 21–64, dated January 1997. The Director of the Federal Register approves this incorporation by reference in accordance with 5 U.S.C 552(a) and 1 CFR part 51. Copies may be obtained from EPA's Water Resource Center, Mail Code RC4100, 401 M St. S.W., Washington, DC 20460. A copy is also available for inspection at the U.S. EPA Water Docket , 401 M Street S.W., Washington, DC. 20460, or the Office of the Federal Register, 800 N. Capitol Street N.W. Suite 700, Washington, DC. An operator must certify to the Director that the construction activity will take place during a period when the value of the rainfall erosivity factor is less than five; or

(B) Storm water controls are not needed based on a "total maximum daily load" (TMDL) approved or established by EPA that addresses the pollutant(s) of concern or, for non-impaired waters that do not require TMDLs, an equivalent analysis that determines allocations for small construction sites for the pollutant(s) of concern or that determines that such allocations are not needed to protect water quality based on consideration of existing in-stream concentrations, expected growth in pollutant contributions from all sources, and a margin of safety. For the purpose of this paragraph, the pollutant(s) of concern include sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation) and any other pollutant that has been identified as a cause of impairment of any water body that will receive a discharge from the construction activity. The operator must certify to the Director that the construction activity will take place, and storm water discharges will occur, within the drainage area addressed by the TMDL or equivalent analysis.

(ii) Any other construction activity designated by the Director, or in States with approved NPDES programs either the Director or the EPA Regional Administrator, based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants to waters of the United States.

EXHIBIT 1 TO § 122.26(B)(15).—SUMMARY OF COVERAGE OF "STORM WATER DISCHARGES ASSOCIATED WITH SMALL CONSTRUCTION ACTIVITY" UNDER THE NPDES STORM WATER PROGRAM

Automatic Designation: Required Nationwide Coverage.	• Construction activities that result in a land disturbance of equal to or greater than one acre and less than five acres. • Construction activities disturbing less than one acre if part of a larger common plan of development or sale with a planned disturbance of equal to or greater than one acre and less than five acres. (see § 122.26(b)(15)(i).)
Potential Designation: Optional Evaluation and Designation by the NPDES Permitting Authority or EPA Regional Administrator..	• Construction activities that result in a land disturbance of less than one acre based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants. (see § 122.26(b)(15)(ii).)

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EXHIBIT 1 TO § 122.26(B)(15).—SUMMARY OF COVERAGE OF "STORM WATER DISCHARGES ASSOCIATED WITH SMALL CONSTRUCTION ACTIVITY" UNDER THE NPDES STORM WATER PROGRAM—Continued

Potential Waiver: Waiver from Requirements as Determined by the NPDES Permitting Authority..	Any automatically designated construction activity where the operator certifies: (1) A rainfa erosivity factor of less than five, or (2) That the activity will occur within an area where controls are not needed based on a TMDL or, for non-impaired waters that do not require a TMDL, an equivalent analysis for the pollutant(s) of concern. (see § 122.26(b)(15)(i).)

(16) *Small municipal separate storm sewer system* means all separate storm sewers that are:

(i) Owned or operated by the United States, a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges to waters of the United States.

(ii) Not defined as "large" or "medium" municipal separate storm sewer systems pursuant to paragraphs (b)(4) and (b)(7) of this section, or designated under paragraph (a)(1)(v) of this section.

(iii) This term includes systems similar to separate storm sewer systems in municipalities, such as systems at military bases, large hospital or prison complexes, and highways and other thoroughfares. The term does not include separate storm sewers in very discrete areas, such as individual buildings.

(17) *Small MS4* means a small municipal separate storm sewer system.

(18) *Municipal separate storm sewer system* means all separate storm sewers that are defined as "large" or "medium" or "small" municipal separate storm sewer systems pursuant to paragraphs (b)(4), (b)(7), and (b)(16) of this section, or designated under paragraph (a)(1)(v) of this section.

(19) *MS4* means a municipal separate storm sewer system.

* * * * *

(c) *Application requirements for storm water discharges associated with industrial activity and storm water discharges associated with small construction activity*—(1) *Individual application.* Dischargers of storm water associated with industrial activity and with small construction activity are required to apply for an individual permit or seek coverage under a promulgated storm water general permit. * * *

* * * * *

(ii) An operator of an existing or new storm water discharge that is associated with industrial activity solely under paragraph (b)(14)(x) of this section or is associated with small construction activity solely under paragraph (b)(15) of this section, is exempt from the requirements of § 122.21(g) and paragraph (c)(1)(i) of this section. * * *

* * * * *

(e) *Application deadlines.* Any operator of a point source required to obtain a permit under this section that does not have an effective NPDES permit authorizing discharges from its storm water outfalls shall submit an application in accordance with the following deadlines:

(1) *Storm water discharges associated with industrial activity.* (i) Except as provided in paragraph (e)(1)(ii) of this section, for any storm water discharge associated with industrial activity identified in paragraphs (b)(14)(i) through (xi) of this section, that is not part of a group application as described in paragraph (c)(2) of this section or that is not authorized by a storm water general permit, a permit application made pursuant to paragraph (c) of this section must be submitted to the Director by October 1, 1992;

(ii) For any storm water discharge associated with industrial activity from a facility that is owned or operated by a municipality with a population of less than 100,000 that is not authorized by a general or individual permit, other than an airport, powerplant, or uncontrolled sanitary landfill, the permit application must be submitted to the Director by March 10, 2003.

* * * * *

(5) A permit application shall be submitted to the Director within 180 days of notice, unless permission for a later date is granted by the Director (see § 124.52(c) of this chapter), for:

(i) A storm water discharge that the Director, or in States with approved NPDES programs, either the Director or the EPA Regional Administrator, determines that the discharge contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States (see paragraphs (a)(1)(v) and (b)(15)(ii) of this section);

* * * * *

(8) For any storm water discharge associated with small construction activity identified in paragraph (b)(15)(i) of this section, see § 122.21(c)(1). Discharges from these sources require permit authorization by March 10, 2003, unless designated for coverage before then.

(9) For any discharge from a regulated small MS4, the permit application made under § 122.33 must be submitted to the Director by:

(i) March 10, 2003 if designated under § 122.32(a)(1) unless your MS4 serves a jurisdiction with a population under 10,000 and the NPDES permitting authority has established a phasing schedule under § 123.35(d)(3) (see § 122.33(c)(1)); or

(ii) Within 180 days of notice, unless the NPDES permitting authority grants a later date, if designated under § 122.32(a)(2) (see § 122.33(c)(2)).

(f) * * *

(4) Any person may petition the Director for the designation of a large, medium, or small municipal separate storm sewer system as defined by paragraph (b)(4)(iv), (b)(7)(iv), or (b)(16) of this section.

(5) The Director shall make a final determination on any petition received under this section within 90 days after receiving the petition with the exception of petitions to designate a small MS4 in which case the Director shall make a final determination on the petition within 180 days after its receipt.

(g) *Conditional exclusion for "no exposure" of industrial activities and materials to storm water.* Discharges composed entirely of storm water are not storm water discharges associated with industrial activity if there is "no exposure" of industrial materials and activities to rain, snow, snowmelt and/or runoff, and the discharger satisfies the conditions in paragraphs (g)(1) through (g)(4) of this section. "No exposure" means that all industrial materials and activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snowmelt, and/or runoff. Industrial materials or activities include, but are not limited to, material handling equipment or activities, industrial machinery, raw materials, intermediate products, by-products, final products, or waste products. Material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, final product or waste product.

(1) *Qualification*. To qualify for this exclusion, the operator of the discharge must:

(i) Provide a storm resistant shelter to protect industrial materials and activities from exposure to rain, snow, snow melt, and runoff;

(ii) Complete and sign (according to § 122.22) a certification that there are no discharges of storm water contaminated by exposure to industrial materials and activities from the entire facility, except as provided in paragraph (g)(2) of this section;

(iii) Submit the signed certification to the NPDES permitting authority once every five years;

(iv) Allow the Director to inspect the facility to determine compliance with the "no exposure" conditions;

(v) Allow the Director to make any "no exposure" inspection reports available to the public upon request; and

(vi) For facilities that discharge through an MS4, upon request, submit a copy of the certification of "no exposure" to the MS4 operator, as well as allow inspection and public reporting by the MS4 operator.

(2) *Industrial materials and activities not requiring storm resistant shelter*. To qualify for this exclusion, storm resistant shelter is not required for:

(i) Drums, barrels, tanks, and similar containers that are tightly sealed, provided those containers are not deteriorated and do not leak ("Sealed" means banded or otherwise secured and without operational taps or valves);

(ii) Adequately maintained vehicles used in material handling; and

(iii) Final products, other than products that would be mobilized in storm water discharge (e.g., rock salt).

(3) *Limitations*. (i) Storm water discharges from construction activities identified in paragraphs (b)(14)(x) and (b)(15) are not eligible for this conditional exclusion.

(ii) This conditional exclusion from the requirement for an NPDES permit is available on a facility-wide basis only, not for individual outfalls. If a facility has some discharges of storm water that would otherwise be "no exposure" discharges, individual permit requirements should be adjusted accordingly.

(iii) If circumstances change and industrial materials or activities become exposed to rain, snow, snow melt, and/or runoff, the conditions for this exclusion no longer apply. In such cases, the discharge becomes subject to enforcement for un-permitted discharge. Any conditionally exempt discharger who anticipates changes in circumstances should apply for and obtain permit authorization prior to the change of circumstances.

(iv) Notwithstanding the provisions of this paragraph, the NPDES permitting authority retains the authority to require permit authorization (and deny this exclusion) upon making a determination that the discharge causes, has a reasonable potential to cause, or contributes to an instream excursion above an applicable water quality standard, including designated uses.

(4) *Certification*. The no exposure certification must require the submission of the following information, at a minimum, to aid the NPDES permitting authority in determining if the facility qualifies for the no exposure exclusion:

(i) The legal name, address and phone number of the discharger (see § 122.21(b));

(ii) The facility name and address, the county name and the latitude and longitude where the facility is located;

(iii) The certification must indicate that none of the following materials or activities are, or will be in the foreseeable future, exposed to precipitation:

(A) Using, storing or cleaning industrial machinery or equipment, and areas where residuals from using, storing or cleaning industrial machinery or equipment remain and are exposed to storm water;

(B) Materials or residuals on the ground or in storm water inlets from spills/leaks;

(C) Materials or products from past industrial activity;

(D) Material handling equipment (except adequately maintained vehicles);

(E) Materials or products during loading/unloading or transporting activities;

(F) Materials or products stored outdoors (except final products intended for outside use, e.g., new cars, where exposure to storm water does not result in the discharge of pollutants);

(G) Materials contained in open, deteriorated or leaking storage drums, barrels, tanks, and similar containers;

(H) Materials or products handled/stored on roads or railways owned or maintained by the discharger;

(I) Waste material (except waste in covered, non-leaking containers, e.g., dumpsters);

(J) Application or disposal of process wastewater (unless otherwise permitted); and

(K) Particulate matter or visible deposits of residuals from roof stacks/vents not otherwise regulated, i.e., under an air quality control permit, and evident in the storm water outflow;

(iv) All "no exposure" certifications must include the following certification statement, and be signed in accordance with the signatory requirements of § 122.22: "I certify under penalty of law that I have read and understand the eligibility requirements for claiming a condition of "no exposure" and obtaining an exclusion from NPDES storm water permitting; and that there are no discharges of storm water contaminated by exposure to industrial activities or materials from the industrial facility identified in this document (except as allowed under paragraph (g)(2)) of this section. I understand that I am obligated to submit a no exposure certification form once every five years to the NPDES permitting authority and, if requested, to the operator of the local MS4 into which this facility discharges (where applicable). I understand that I must allow the NPDES permitting authority, or MS4 operator where the discharge is into the local MS4, to perform inspections to confirm the condition of no exposure and to make such inspection reports publicly available upon request. I understand that I must obtain coverage under an NPDES permit prior to any point source discharge of storm water from the facility. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based upon my inquiry of the person or persons who manage the system, or those persons directly involved in gathering the information, the information submitted is to the best of my knowledge and belief true, accurate and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

4. Revise § 122.28(b)(2)(v) to read as follows:

§ 122.28 General permits (applicable to State NPDES programs, see § 123.25).

* * * * *

(b) * * *

(2) * * *

(v) Discharges other than discharges from publicly owned treatment works, combined sewer overflows, municipal separate storm sewer systems, primary industrial facilities, and storm water discharges associated with industrial activity, may, at the discretion of the Director, be authorized to discharge under a general permit without submitting a notice of intent where the Director finds that a notice of intent requirement would be inappropriate. In making such a finding, the Director shall consider: the type of discharge; the expected nature of the discharge; the potential for toxic and conventional pollutants in the discharges; the expected volume of the discharges; other means of identifying discharges covered by the permit; and the estimated number of discharges to be covered by the permit. The Director shall provide in the public notice of the general permit the reasons for not requiring a notice of intent.

* * * * *

5. Add §§ 122.30 through 122.37 to subpart B to read as follows:

§ 122.30 What are the objectives of the storm water regulations for small MS4s?

(a) Sections 122.30 through 122.37 are written in a "readable regulation" format that includes both rule requirements and EPA guidance that is not legally binding. EPA has clearly distinguished its recommended guidance from the rule requirements by putting the guidance in a separate paragraph headed by the word "guidance".

(b) Under the statutory mandate in section 402(p)(6) of the Clean Water Act, the purpose of this portion of the storm water program is to designate additional sources that need to be regulated to protect water quality and to establish a comprehensive storm water program to regulate these sources. (Because the storm water program is part of the National Pollutant Discharge Elimination System (NPDES) Program, you should also refer to § 122.1 which addresses the broader purpose of the NPDES program.)

(c) Storm water runoff continues to harm the nation's waters. Runoff from lands modified by human activities can harm surface water resources in several ways including by changing natural hydrologic patterns and by elevating pollutant concentrations and loadings. Storm water runoff may contain or mobilize high levels of contaminants, such as sediment, suspended solids, nutrients, heavy metals, pathogens, toxins, oxygen-demanding substances, and floatables.

(d) EPA strongly encourages partnerships and the watershed approach as the management framework for efficiently, effectively, and consistently protecting and restoring aquatic ecosystems and protecting public health.

§ 122.31 As a Tribe, what is my role under the NPDES storm water program?

As a Tribe you may:

(a) Be authorized to operate the NPDES program including the storm water program, after EPA determines that you are eligible for treatment in the same manner as a State under §§ 123.31 through 123.34 of this chapter. (If you do not have an authorized NPDES program, EPA implements the program for discharges on your reservation as well as other Indian country, generally.);

(b) Be classified as an owner of a regulated small MS4, as defined in § 122.32. (Designation of your Tribe as an owner of a small MS4 for purposes of this part is an approach that is consistent with EPA's 1984 Indian Policy of operating on a government-to-government basis with EPA looking to Tribes as the lead governmental authorities to address environmental issues on their reservations as appropriate. If you operate a separate storm sewer system that meets the definition of a regulated small MS4, you are subject to the requirements under §§ 122.33 through 122.35. If you are not designated as a regulated small MS4, you may ask EPA to designate you as such for the purposes of this part.); or

(c) Be a discharger of storm water associated with industrial activity or small construction activity under §§ 122.26(b)(14) or (b)(15), in which case you must meet the applicable requirements. Within Indian country, the NPDES permitting authority is generally EPA, unless you are authorized to administer the NPDES program.

§ 122.32 As an operator of a small MS4, am I regulated under the NPDES storm water program?

(a) Unless you qualify for a waiver under paragraph (c) of this section, you are regulated if you operate a small MS4, including but not limited to systems operated by federal, State, Tribal, and local governments, including State departments of transportation; and:

(1) Your small MS4 is located in an urbanized area as determined by the latest Decennial Census by the Bureau of the Census. (If your small MS4 is not located entirely within an urbanized area, only the portion that is within the urbanized area is regulated); or

(2) You are designated by the NPDES permitting authority, including where the designation is pursuant to §§ 123.35(b)(3) and (b)(4) of this chapter, or is based upon a petition under § 122.26(f).

(b) You may be the subject of a petition to the NPDES permitting authority to require an NPDES permit for your discharge of storm water. If the NPDES permitting authority determines that you need a permit, you are required to comply with §§ 122.33 through 122.35.

(c) The NPDES permitting authority may waive the requirements otherwise applicable to you if you meet the criteria of paragraph (d) or (e) of this section. If you receive a waiver under this section, you may subsequently be required to seek coverage under an NPDES permit in accordance with § 122.33(a) if circumstances change. (See also § 123.35(b) of this chapter.)

(d) The NPDES permitting authority may waive permit coverage if your MS4 serves a population of less than 1,000 within the urbanized area and you meet the following criteria:

(1) Your system is not contributing substantially to the pollutant loadings of a physically interconnected MS4 that is regulated by the NPDES storm water program (see § 123.35(b)(4) of this chapter); and

(2) If you discharge any pollutant(s) that have been identified as a cause of impairment of any water body to which you discharge, storm water controls are not needed based on wasteload allocations that are part of an EPA approved or established "total maximum daily load" (TMDL) that addresses the pollutant(s) of concern.

(e) The NPDES permitting authority may waive permit coverage if your MS4 serves a population under 10,000 and you meet the following criteria:

(1) The permitting authority has evaluated all waters of the U.S., including small streams, tributaries, lakes, and ponds, that receive a discharge from your MS4;

(2) For all such waters, the permitting authority has determined that storm water controls are not needed based on wasteload allocations that are part of an EPA approved or established TMDL that addresses the pollutant(s) of concern or, if a TMDL has not been developed or approved, an equivalent analysis that determines sources and allocations for the pollutant(s) of concern;

(3) For the purpose of this paragraph (e), the pollutant(s) of concern include biochemical oxygen demand (BOD), sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation), pathogens, oil and grease, and any pollutant that has been identified as a cause of impairment of any water body that will receive a discharge from your MS4; and

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(4) The permitting authority has determined that future discharges from your MS4 do not have the potential to result in exceedances of water quality standards, including impairment of designated uses, or other significant water quality impacts, including habitat and biological impacts.

§ 122.33 If I am an operator of a regulated small MS4, how do I apply for an NPDES permit and when do I have to apply?

(a) If you operate a regulated small MS4 under § 122.32, you must seek coverage under a NPDES permit issued by your NPDES permitting authority. If you are located in an NPDES authorized State, Tribe, or Territory, then that State, Tribe, or Territory is your NPDES permitting authority. Otherwise, your NPDES permitting authority is the EPA Regional Office.

(b) You must seek authorization to discharge under a general or individual NPDES permit, as follows:

(1) If your NPDES permitting authority has issued a general permit applicable to your discharge and you are seeking coverage under the general permit, you must submit a Notice of Intent (NOI) that includes the information on your best management practices and measurable goals required by § 122.34(d). You may file your own NOI, or you and other municipalities or governmental entities may jointly submit an NOI. If you want to share responsibilities for meeting the minimum measures with other municipalities or governmental entities, you must submit an NOI that describes which minimum measures you will implement and identify the entities that will implement the other minimum measures within the area served by your MS4. The general permit will explain any other steps necessary to obtain permit authorization.

(2)(i) If you are seeking authorization to discharge under an individual permit and wish to implement a program under § 122.34, you must submit an application to your NPDES permitting authority that includes the information required under §§ 122.21(f) and 122.34(d), an estimate of square mileage served by your small MS4, and any additional information that your NPDES permitting authority requests. A storm sewer map that satisfies the requirement of § 122.34(b)(3)(i) will satisfy the map requirement in § 122.21(f)(7).

(ii) If you are seeking authorization to discharge under an individual permit and wish to implement a program that is different from the program under § 122.34, you will need to comply with the permit application requirements of § 122.26(d). You must submit both Parts of the application requirements in §§ 122.26(d)(1) and (2) by March 10, 2003. You do not need to submit the information required by §§ 122.26(d)(1)(ii) and (d)(2) regarding your legal authority, unless you intend for the permit writer to take such information into account when developing your other permit conditions.

(iii) If allowed by your NPDES permitting authority, you and another regulated entity may jointly apply under either paragraph (b)(2)(i) or (b)(2)(ii) of this section to be co-permittees under an individual permit.

(3) If your small MS4 is in the same urbanized area as a medium or large MS4 with an NPDES storm water permit and that other MS4 is willing to have you participate in its storm water program, you and the other MS4 may jointly seek a modification of the other MS4 permit to include you as a limited co-permittee. As a limited co-permittee, you will be responsible for compliance with the permit's conditions applicable to your jurisdiction. If you choose this option you will need to comply with the permit application requirements of § 122.26, rather than the requirements of § 122.34. You do not need to comply with the specific application requirements of § 122.26(d)(1)(iii) and (iv) and (d)(2)(iii) (discharge characterization). You may satisfy the requirements in § 122.26 (d)(1)(v) and (d)(2)(iv) (identification of a management program) by referring to the other MS4's storm water management program.

(4) Guidance: In referencing an MS4's storm water management program, you should briefly describe how the existing plan will address discharges from your small MS4 or would need to be supplemented in order to adequately address your discharges. You should also explain your role in coordinating storm water pollutant control activities in your MS4, and detail the resources available to you to accomplish the plan.

(c) If you operate a regulated small MS4:

(1) Designated under § 122.32(a)(1), you must apply for coverage under an NPDES permit, or apply for a modification of an existing NPDES permit under paragraph (b)(3) of this section by March 10, 2003, unless your MS4 serves a jurisdiction with a population under 10,000 and the NPDES permitting authority has established a phasing schedule under § 123.35(d)(3) of this chapter.

(2) Designated under § 122.32(a)(2), you must apply for coverage under an NPDES permit, or apply for a modification of an existing NPDES permit under paragraph (b)(3) of this section, within 180 days of notice, unless the NPDES permitting authority grants a later date.

§ 122.34 As an operator of a regulated small MS4, what will my NPDES MS4 storm water permit require?

(a) Your NPDES MS4 permit will require at a minimum that you develop, implement, and enforce a storm water management program designed to reduce the discharge of pollutants from your MS4 to the maximum extent practicable (MEP), to protect water quality, and to satisfy the appropriate water quality requirements of the Clean Water Act. Your storm water management program must include the minimum control measures described in paragraph (b) of this section unless you apply for a permit under § 122.26(d). For purposes of this section, narrative effluent limitations requiring implementation of best management practices (BMPs) are generally the most appropriate form of effluent limitations when designed to satisfy technology requirements (including reductions of pollutants to the maximum extent practicable) and to protect water quality. Implementation of best management practices consistent with the provisions of the storm water management program required pursuant to this section and the provisions of the permit required pursuant to § 122.33 constitutes compliance with the standard of reducing pollutants to the "maximum extent practicable." Your NPDES permitting authority will specify a time period of up to 5 years from the date of permit issuance for you to develop and implement your program.

(b) *Minimum control measures*—(1) *Public education and outreach on storm water impacts.* (i) You must implement a public education program to distribute educational materials to the community or conduct equivalent outreach activities about the impacts of storm water discharges on water bodies and the steps that the public can take to reduce pollutants in storm water runoff.

(ii) Guidance: You may use storm water educational materials provided by your State, Tribe, EPA, environmental, public interest or trade organizations, or other MS4s. The public education program should inform individuals and households about the steps they can take to reduce storm water pollution, such as ensuring proper septic system maintenance, ensuring the proper use and disposal of landscape and garden chemicals including fertilizers and pesticides, protecting and restoring riparian vegetation, and properly disposing of used motor oil or household hazardous wastes. EPA recommends that the program inform individuals and groups how to become involved in local stream and beach restoration activities as well as activities that are coordinated by youth service and conservation corps or other citizen groups. EPA recommends that the public education program be tailored, using a mix of locally appropriate strategies, to target specific audiences and communities. Examples of strategies include distributing brochures or fact sheets, sponsoring speaking engagements before community groups, providing public service announcements, implementing educational programs targeted at school age children, and conducting community-based projects such as storm drain stenciling, and watershed and beach cleanups. In addition, EPA recommends that some of the materials or outreach programs be directed toward targeted groups of commercial, industrial, and institutional entities likely to have significant storm water impacts. For example, providing information to restaurants on the impact of grease clogging storm drains and to garages on the impact of oil discharges. You are encouraged to tailor your outreach program to address the viewpoints and concerns of all communities, particularly minority and disadvantaged communities, as well as any special concerns relating to children.

(2) *Public involvement/participation.* (i) You must, at a minimum, comply with State, Tribal and local public notice requirements when implementing a public involvement/participation program.

(ii) Guidance: EPA recommends that the public be included in developing, implementing, and reviewing your storm water management program and that the public participation process should make efforts to reach out and engage all economic and ethnic groups. Opportunities for members of the public to participate in program development and implementation include serving as citizen representatives on a local storm water management panel, attending public hearings, working as citizen volunteers to educate other individuals about the program, assisting in program coordination with other pre-existing programs, or participating in volunteer monitoring efforts. (Citizens should obtain approval where necessary for lawful access to monitoring sites.)

(3) *Illicit discharge detection and elimination.* (i) You must develop, implement and enforce a program to detect and eliminate illicit discharges (as defined at § 122.26(b)(2)) into your small MS4.

(ii) You must:

(A) Develop, if not already completed, a storm sewer system map, showing the location of all outfalls and the names and location of all waters of the United States that receive discharges from those outfalls;

(B) To the extent allowable under State, Tribal or local law, effectively prohibit, through ordinance, or other regulatory mechanism, non-storm water discharges into your storm sewer system and implement appropriate enforcement procedures and actions;

(C) Develop and implement a plan to detect and address non-storm water discharges, including illegal dumping, to your system; and

(D) Inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste.

(iii) You need address the following categories of non-storm water discharges or flows (i.e., illicit discharges) only if you identify them as significant contributors of pollutants to your small MS4: water line flushing, landscape irrigation, diverted stream flows, rising ground waters, uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20)), uncontaminated pumped ground water, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, springs, water from crawl space pumps, footing drains, lawn watering, individual residential car washing, flows from riparian habitats and wetlands, dechlorinated swimming pool discharges, and street wash water (discharges or flows from fire fighting activities are excluded from the effective prohibition against non-storm water and need only be addressed where they are identified as significant sources of pollutants to waters of the United States).

(iv) Guidance: EPA recommends that the plan to detect and address illicit discharges include the following four components: procedures for locating priority areas likely to have illicit discharges; procedures for tracing the source of an illicit discharge; procedures for removing the source of the discharge; and procedures for program evaluation and assessment. EPA recommends visually screening outfalls during dry weather and conducting field tests of selected pollutants as part of the procedures for locating priority areas. Illicit discharge education actions may include storm drain stenciling, a program to promote, publicize, and facilitate public reporting of illicit connections or discharges, and distribution of outreach materials.

(4) *Construction site storm water runoff control.* (i) You must develop, implement, and enforce a program to reduce pollutants in any storm water runoff to your small MS4 from construction activities that result in a land disturbance of greater than or equal to one acre. Reduction of storm water discharges from construction activity disturbing less than one acre must be included in your program if that construction activity is part of a larger common plan of development or sale that would disturb one acre or more. If the NPDES permitting authority waives requirements for storm water discharges associated with small construction activity in accordance with § 122.26(b)(15)(i), you are not required to develop, implement, and/or enforce a program to reduce pollutant discharges from such sites.

(ii) Your program must include the development and implementation of, at a minimum:

(A) An ordinance or other regulatory mechanism to require erosion and sediment controls, as well as sanctions to ensure compliance, to the extent allowable under State, Tribal, or local law;

(B) Requirements for construction site operators to implement appropriate erosion and sediment control best management practices;

(C) Requirements for construction site operators to control waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste at the construction site that may cause adverse impacts to water quality;

(D) Procedures for site plan review which incorporate consideration of potential water quality impacts;

(E) Procedures for receipt and consideration of information submitted by the public, and

(F) Procedures for site inspection and enforcement of control measures.

(iii) Guidance: Examples of sanctions to ensure compliance include non-monetary penalties, fines, bonding requirements and/or permit denials for non-compliance. EPA recommends that procedures for site plan review include the review of individual pre-construction site plans to ensure consistency with local sediment and erosion control requirements. Procedures for site inspections and enforcement of control measures could include steps to identify priority sites for inspection and enforcement based on the nature of the construction activity, topography, and the characteristics of soils and receiving water quality. You are encouraged to provide appropriate educational and training measures for construction site operators. You may wish to require a storm water pollution prevention plan for construction sites within your jurisdiction that discharge into your system. See § 122.44(s) (NPDES permitting authorities' option to incorporate qualifying State, Tribal and local erosion and sediment control programs into NPDES permits for storm water discharges from construction sites). Also see § 122.35(b) (The NPDES permitting authority may recognize that another government entity, including the permitting authority, may be responsible for implementing one or more of the minimum measures on your behalf.)

(5) *Post-construction storm water management in new development and redevelopment.*

(i) You must develop, implement, and enforce a program to address storm water runoff from new development and redevelopment projects that disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, that discharge into your small MS4. Your program must ensure that controls are in place that would prevent or minimize water quality impacts.

(ii) You must:

(A) Develop and implement strategies which include a combination of structural and/or non-structural best management practices (BMPs) appropriate for your community;

(B) Use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects to the extent allowable under State, Tribal or local law; and

(C) Ensure adequate long-term operation and maintenance of BMPs.

(iii) Guidance: If water quality impacts are considered from the beginning stages of a project, new development and potentially redevelopment provide more opportunities for water quality protection. EPA recommends that the BMPs chosen: be appropriate for the local community; minimize water quality impacts; and attempt to maintain pre-development runoff conditions. In choosing appropriate BMPs, EPA encourages you to participate in locally-based watershed lanning efforts which attempt to involve a diverse group of stakeholders including interested citizens. When developing a program that is consistent with this measure's intent, EPA recommends that you adopt a planning process that identifies the municipality's program goals (*e.g.*, minimize water quality impacts resulting from post-construction runoff from new development and redevelopment), implementation strategies (e.g., adopt a combination of structural and/or non-structural BMPs), operation and maintenance policies and procedures, and enforcement procedures. In developing your program, you should consider assessing existing ordinances, policies, programs and studies that address storm water runoff quality. In addition to assessing these existing documents and programs, you should provide opportunities to the public to participate in the development of the program. Non-structural BMPs are preventative actions that involve management and source controls such as: policies and ordinances that provide requirements and standards to direct growth to identified areas, protect sensitive areas such as wetlands and riparian areas, maintain and/or increase open space (including a dedicated funding source for open space acquisition), provide buffers along sensitive water bodies, minimize impervious surfaces, and minimize disturbance of soils and vegetation; policies or ordinances that encourage infill development in higher density urban areas, and areas with existing infrastructure; education programs for developers and the public about project designs that minimize water quality impacts; and measures such as minimization of percent impervious area after development and minimization of directly connected impervious areas. Structural BMPs include: storage practices such as wet ponds and extended-detention outlet structures; filtration practices such as grassed swales, sand filters and filter strips; and infiltration practices such as infiltration basins and infiltration trenches. EPA recommends that you ensure the appropriate implementation of the structural BMPs by considering some or all of the following: pre-construction review of BMP designs; inspections during construction to verify BMPs are built as designed; post-construction inspection and maintenance of BMPs; and penalty provisions for the noncompliance with design, construction or operation and maintenance. Storm water technologies are constantly being improved, and EPA recommends that your requirements be responsive to these changes, developments or improvements in control technologies.

(6) *Pollution prevention/good housekeeping for municipal operations.*

(i) You must develop and implement an operation and maintenance program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations. Using training materials that are available from EPA, your State, Tribe, or other organizations, your program must include employee training to prevent and reduce storm water pollution from activities such as park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and storm water system maintenance.

(ii) Guidance: EPA recommends that, at a minimum, you consider the following in developing your program: maintenance activities, maintenance schedules, and long-term inspection procedures for structural and non-structural storm water controls to reduce floatables and other pollutants discharged from your separate storm sewers; controls for reducing or eliminating the discharge of pollutants from streets, roads, highways, municipal parking lots, maintenance and storage yards, fleet or maintenance shops with outdoor storage areas, salt/sand storage locations and snow disposal areas operated by you, and waste transfer stations; procedures for properly disposing of waste removed from the separate storm sewers and areas listed above (such as dredge spoil, accumulated sediments, floatables, and other debris); and ways to ensure that new flood management projects assess the impacts on water quality and examine existing projects for incorporating additional water quality protection devices or practices. Operation and maintenance should be an integral component of all storm water management programs. This measure is intended to improve the efficiency of these programs and require new programs where necessary. Properly developed and implemented operation and maintenance programs reduce the risk of water quality problems.

(c) If an existing qualifying local program requires you to implement one or more of the minimum control measures of paragraph (b) of this section, the NPDES permitting authority may include conditions in your NPDES permit that direct you to follow that qualifying program's requirements rather than the requirements of paragraph (b) of this section. A qualifying local program is a local, State or Tribal municipal storm water management program that imposes, at a minimum, the relevant requirements of paragraph (b) of this section.

(d)(1) In your permit application (either a notice of intent for coverage under a general permit or an individual permit application), you must identify and submit to your NPDES permitting authority the following information:

(i) The best management practices (BMPs) that you or another entity will implement for each of the storm water minimum control measures at paragraphs (b)(1) through (b)(6) of this section;

(ii) The measurable goals for each of the BMPs including, as appropriate, the months and years in which you will undertake required actions, including interim milestones and the frequency of the action; and

(iii) The person or persons responsible for implementing or coordinating your storm water management program.

(2) If you obtain coverage under a general permit, you are not required to meet any measurable goal(s) identified in your notice of intent in order to demonstrate compliance with the minimum control measures in paragraphs (b)(3) through (b)(6) of this section unless, prior to submitting your NOI, EPA or your State or Tribe has provided or issued a menu of BMPs that addresses each such minimum measure. Even if no regulatory authority issues the menu of BMPs, however, you still must comply with other requirements of the general permit, including good faith implementation of BMPs designed to comply with the minimum measures.

(3) Guidance: Either EPA or your State or Tribal permitting authority will provide a menu of BMPs. You may choose BMPs from the menu or select others that satisfy the minimum control measures.

(e)(1) You must comply with any more stringent effluent limitations in your permit, including permit requirements that modify, or are in addition to, the minimum control measures based on an approved total maximum daily load (TMDL) or equivalent analysis. The permitting authority may include such more stringent limitations based on a TMDL or equivalent analysis that determines such limitations are needed to protect water quality.

(2) Guidance: EPA strongly recommends that until the evaluation of the storm water program in § 122.37, no additional requirements beyond the minimum control measures be imposed on regulated small MS4s without the agreement of the operator of the affected small MS4, except where an approved TMDL or equivalent analysis provides adequate information to develop more specific measures to protect water quality.

(f) You must comply with other applicable NPDES permit requirements, standards and conditions established in the individual or general permit, developed consistent with the provisions of §§ 122.41 through 122.49, as appropriate.

(g) *Evaluation and assessment*—(1) *Evaluation.* You must evaluate program compliance, the appropriateness of your identified best management practices, and progress towards achieving your identified measurable goals.

Note to Paragraph (g)(1): The NPDES permitting authority may determine monitoring requirements for you in accordance with State/Tribal monitoring plans appropriate to your watershed. Participation in a group monitoring program is encouraged.

(2) *Recordkeeping.* You must keep records required by the NPDES permit for at least 3 years. You must submit your records to the NPDES permitting authority only when specifically asked to do so. You must make your records, including a description of your storm water management program, available to the public at reasonable times during regular business hours (see § 122.7 for confidentiality provision). (You may assess a reasonable charge for copying. You may require a member of the public to provide advance notice.)

(3) *Reporting.* Unless you are relying on another entity to satisfy your NPDES permit obligations under § 122.35(a), you must submit annual reports to the NPDES permitting authority for your first permit term. For subsequent permit terms, you must submit reports in year two and four unless the NPDES permitting authority requires more frequent reports. Your report must include:

(i) The status of compliance with permit conditions, an assessment of the appropriateness of your identified best management practices and progress towards achieving your identified measurable goals for each of the minimum control measures;

(ii) Results of information collected and analyzed, including monitoring data, if any, during the reporting period;

(iii) A summary of the storm water activities you plan to undertake during the next reporting cycle;

(iv) A change in any identified best management practices or measurable goals for any of the minimum control measures; and

(v) Notice that you are relying on another governmental entity to satisfy some of your permit obligations (if applicable).

§ 122.35 As an operator of a regulated small MS4, may I share the responsibility to implement the minimum control measures with other entities?

(a) You may rely on another entity to satisfy your NPDES permit obligations to implement a minimum control measure if:

(1) The other entity, in fact, implements the control measure;

(2) The particular control measure, or component thereof, is at least as stringent as the corresponding NPDES permit requirement; and

(3) The other entity agrees to implement the control measure on your behalf. In the reports you must submit under § 122.34(g)(3), you must also specify that you rely on another entity to satisfy some of your permit obligations. If you are relying on another governmental entity regulated under section 122 to satisfy all of your permit obligations, including your obligation to file periodic reports required by § 122.34(g)(3), you must note that fact in your NOI, but you are not required to file the periodic reports. You remain responsible for compliance with your permit obligations if the other entity fails to implement the control measure (or component thereof). Therefore, EPA encourages you to enter into a legally binding agreement with that entity if you want to minimize any uncertainty about compliance with your permit.

(b) In some cases, the NPDES permitting authority may recognize, either in your individual NPDES permit or in an NPDES general permit, that another governmental entity is responsible under an NPDES permit for implementing one or more of the minimum control measures for your small MS4 or that the permitting authority itself is responsible. Where the permitting authority does so, you are not required to include such minimum control measure(s) in your storm water management program. (For example, if a State or Tribe is subject to an NPDES permit that requires it to administer a program to control construction site runoff at the State or Tribal level and that program satisfies all of the requirements of § 122.34(b)(4), you could avoid responsibility for the construction measure, but would be responsible for the remaining minimum control measures.) Your permit may be reopened and modified to include the requirement to implement a minimum control measure if the entity fails to implement it.

§ 122.36 As an operator of a regulated small MS4, what happens if I don't comply with the application or permit requirements in §§ 122.33 through 122.35?

NPDES permits are federally enforceable. Violators may be subject to the enforcement actions and penalties described in Clean Water Act sections 309 (b), (c), and (g) and 505, or under applicable State, Tribal, or local law. Compliance with a permit issued pursuant to section 402 of the Clean Water Act is deemed compliance, for purposes of sections 309 and 505, with sections 301, 302, 306, 307, and 403, except any standard imposed under section 307 for toxic pollutants injurious to human health. If you are covered as a co-permittee under an individual permit or under a general permit by means of a joint Notice of Intent you remain subject to the enforcement actions and penalties for the failure to comply with the terms of the permit in your jurisdiction except as set forth in § 122.35(b).

§ 122.37 Will the small MS4 storm water program regulations at §§ 122.32 through 122.36 and § 123.35 of this chapter change in the future?

EPA will evaluate the small MS4 regulations at §§ 122.32 through 122.36 and § 123.35 of this chapter after December 10, 2012 and make any necessary revisions. (EPA intends to conduct an enhanced research effort and compile a comprehensive evaluation of the NPDES MS4 storm water program. EPA will re-evaluate the regulations based on data from the NPDES MS4 storm water program, from research on receiving water impacts from storm water, and the effectiveness of best management practices (BMPs), as well as other relevant information sources.)

6. In § 122.44, redesignate paragraphs (k)(2) and (k)(3) as paragraphs (k)(3) and (k)(4), remove the comma at the end of newly redesignated paragraph (k)(3) and add a semicolon in its place, and add new paragraphs (k)(2) and (s) to read as follows:

§ 122.44 Establishing limitations, standards, and other permit conditions (applicable to State NPDES programs, see § 123.25).

* * * * *

(k) * * *

(2) Authorized under section 402(p) of CWA for the control of storm water discharges;

* * * * *

(s) *Qualifying State, Tribal, or local programs.* (1) For storm water discharges associated with small construction activity identified in § 122.26(b)(15), the Director may include permit conditions that incorporate qualifying State, Tribal, or local erosion and sediment control program requirements by reference. Where a qualifying State, Tribal, or local program does not include one or more of the elements in this paragraph (s)(1), then the Director must include those elements as conditions in the permit. A qualifying State, Tribal, or local erosion and sediment control program is one that includes:

(i) Requirements for construction site operators to implement appropriate erosion and sediment control best management practices;

(ii) Requirements for construction site operators to control waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste at the construction site that may cause adverse impacts to water quality;

(iii) Requirements for construction site operators to develop and implement a storm water pollution prevention plan. (A storm water pollution prevention plan includes site descriptions, descriptions of appropriate control measures, copies of approved State, Tribal or local requirements, maintenance procedures, inspection procedures, and identification of non-storm water discharges); and

(iv) Requirements to submit a site plan for review that incorporates consideration of potential water quality impacts.

(2) For storm water discharges from construction activity identified in § 122.26(b)(14)(x), the Director may include permit conditions that incorporate qualifying State, Tribal, or local erosion and sediment control program requirements by reference. A qualifying State, Tribal or local erosion and sediment control program is one that includes the elements listed in paragraph (s)(1) of this section and any additional requirements necessary to achieve the applicable technology-based standards of "best available technology" and "best conventional technology" based on the best professional judgment of the permit writer.

7. Add § 122.62(a)(14) to read as follows:

§ 122.62 Modification or revocation and reissuance of permits (applicable to State programs, see § 123.25).

* * * * *

(a) * * *

(14) For a small MS4, to include an effluent limitation requiring implementation of a minimum control measure or measures as specified in § 122.34(b) when:

(i) The permit does not include such measure(s) based upon the determination that another entity was responsible for implementation of the requirement(s); and

(ii) The other entity fails to implement measure(s) that satisfy the requirement(s).

* * * * *

8. Revise Appendices F, G, H, and I to Part 122 to read as follows:

APPENDIX F TO PART 122.—INCORPORATED PLACES WITH POPULATIONS GREATER THAN 250,000 ACCORDING TO THE 1990 DECENNIAL CENSUS BY THE BUREAU OF THE CENSUS

State	Incorporated Place
Alabama	Birmingham.
Arizona	Phoenix.
	Tucson.
California	Long Beach.
	Los Angeles.
	Oakland.
	Sacramento.
	San Diego.
	San Francisco.
	San Jose.
Colorado	Denver.
District of Columbia	
Florida	Jacksonville.
	Miami.
	Tampa.
Georgia.	Atlanta.
Illinois	Chicago.
Indiana	Indianapolis.
Kansas	Wichita.
Kentucky	Louisville.
Louisiana	New Orleans.
Maryland	Baltimore.
Massachusetts	Boston.
Michigan	Detroit.
Minnesota	Minneapolis.
	St. Paul.
Missouri	Kansas City.
	St. Louis.
Nebraska	Omaha.
New Jersey	Newark.
New Mexico	Albuquerque.
New York	Buffalo.
	Bronx Borough.
	Brooklyn Borough.
	Manhattan Borough.
	Queens Borough.
	Staten Island Borough.
North Carolina	Charlotte.
Ohio	Cincinnati.
	Cleveland.
	Columbus.
	Toledo.
Oklahoma	Oklahoma City.
	Tulsa.
Oregon	Portland.
Pennsylvania	Philadelphia.
	Pittsburgh.
Tennessee	Memphis.
	Nashville/Davidson.
Texas	Austin.
	Dallas.
	El Paso.
	Fort Worth.
	Houston.

APPENDIX F TO PART 122.—INCORPORATED PLACES WITH POPULATIONS GREATER THAN 250,000 ACCORDING TO THE 1990 DECENNIAL CENSUS BY THE BUREAU OF THE CENSUS—Continued

State	Incorporated Place
	San Antonio.
Virginia	Norfolk.
	Virginia Beach.
Washington	Seattle.
Wisconsin	Milwaukee.

APPENDIX G TO PART 122.—INCORPORATED PLACES WITH POPULATIONS GREATER THAN 100,000 BUT LESS THAN 250,000 ACCORDING TO THE 1990 DECENNIAL CENSUS BY THE BUREAU OF THE CENSUS

State	Incorporated place
Alabama	Huntsville.
	Mobile.
	Montgomery.
Alaska	Anchorage.
Arizona	Mesa.
	Tempe.
Arkansas	Little Rock.
California	Anaheim.
	Bakersfield.
	Berkeley.
	Chula Vista.
	Concord.
	El Monte.
	Escondido.
	Fremont.
	Fresno.
	Fullerton.
	Garden Grove.
	Glendale.
	Hayward.
	Huntington Beach.
	Inglewood.
	Irvine.
	Modesto.
	Moreno Valley.
	Oceanside.
	Ontario.
	Orange.
Colorado	Aurora.

APPENDIX G TO PART 122.—INCORPORATED PLACES WITH POPULATIONS GREATER THAN 100,000 BUT LESS THAN 250,000 ACCORDING TO THE 1990 DECENNIAL CENSUS BY THE BUREAU OF THE CENSUS—Continued

State	Incorporated place
	Colorado Springs.
	Lakewood.
	Pueblo.
Connecticut	Bridgeport.
	Hartford.
	New Haven.
	Stamford.
	Waterbury.
Florida	Fort Lauderdale.
	Hialeah.
	Hollywood.
	Orlando.
	St. Petersburg.
	Tallahassee.
Georgia	Columbus.
	Macon.
	Savannah.
Idaho	Boise City.
Illinois	Peoria.
	Rockford.
Indiana	Evansville.
	Fort Wayne.
	Gary.
	South Bend.
Iowa	Cedar Rapids.
	Davenport.
	Des Moines.
Kansas	Kansas City.
	Topeka.
Kentucky	Lexington-Fayette.
Louisiana	Baton Rouge.
	Shreveport.
Massachusetts	Springfield.
	Worcester.
Michigan	Ann Arbor.
	Flint.
	Grand Rapids.
	Lansing.
	Livonia.
	Sterling Heights.
	Warren.
Mississippi	Jackson.
Missouri	Independence.
	Springfield.
Nebraska	Lincoln.
Nevada	Las Vegas.
	Reno.

APPENDIX G TO PART 122.—INCORPORATED PLACES WITH POPULATIONS GREATER THAN 100,000 BUT LESS THAN 250,000 ACCORDING TO THE 1990 DECENNIAL CENSUS BY THE BUREAU OF THE CENSUS—Continued

State	Incorporated place
New Jersey	Elizabeth.
	Jersey City.
	Paterson.
New York	Albany.
	Rochester.
	Syracuse.
	Yonkers.
North Carolina	Durham.
	Greensboro.
	Raleigh.
	Winston-Salem.
Ohio	Akron.
	Dayton.
	Youngstown.
Oregon	Eugene.
Pennsylvania	Allentown.
	Erie.
Rhode Island	Providence.
South Carolina	Columbia.
Tennessee	Chattanooga.
	Knoxville.
Texas	Abilene.
	Amarillo.
	Arlington.
	Beaumont.
	Corpus Christi.
	Garland.
	Irving.
	Laredo.
	Lubbock.
	Mesquite.
	Pasadena.
	Plano.
	Waco.
Utah	Salt Lake City.
Virginia	Alexandria.
	Chesapeake.
	Hampton.
	Newport News.
	Portsmouth.
	Richmond.
	Roanoke.
Washington	Spokane.
	Tacoma.
Wisconsin	Madison.

APPENDIX H TO PART 122.—COUNTIES WITH UNINCORPORATED URBANIZED AREAS WITH A POPULATION OF 250,000 OR MORE ACCORDING TO THE 1990 DECENNIAL CENSUS BY THE BUREAU OF THE CENSUS

State	County	Unincorporated urbanized population
California	Los Angeles	886,780
	Sacramento	594,889
	San Diego	250,414
Delaware	New Castle	296,996
Florida	Dade	1,014,504
Georgia	DeKalb	448,686
Hawaii	Honolulu [1]	114,506
Maryland	Anne Arundel	344,654
	Baltimore	627,593
	Montgomery	599,028

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APPENDIX H TO PART 122.—COUNTIES WITH UNINCORPORATED URBANIZED AREAS WITH A POPULATION OF 250,000 OR MORE ACCORDING TO THE 1990 DECENNIAL CENSUS BY THE BUREAU OF THE CENSUS—Continued

State	County	Unincorporated urbanized population
	Prince George's	494,369
Texas	Harris	729,206
Utah	Salt Lake	270,989
Virginia	Fairfax	760,730
Washington	King	520,468

[1] County was previously listed in this appendix; however, population dropped to below 250,000 in the 1990 Census.

APPENDIX I TO PART 122.—COUNTIES WITH UNINCORPORATED URBANIZED AREAS GREATER THAN 100,000 BUT LESS THAN 250,000 ACCORDING TO THE 1990 DECENNIAL CENSUS BY THE BUREAU OF THE CENSUS

State	County	Unincorporated urbanized population
Alabama	Jefferson	78,608
Arizona	Pima	162,202
California	Alameda	115,082
	Contra Costa	131,082
	Kern	128,503
	Orange	223,081
	Riverside	166,509
	San Bernardino	162,202
Colorado	Arapahoe	103,248
Florida	Broward	142,329
	Escambia	167,463
	Hillsborough	398,593
	Lee	102,337
	Manatee	123,828
	Orange	378,611
	Palm Beach	360,553
	Pasco	148,907
	Pinellas	255,772
	Polk	121,528
	Sarasota	172,600
	Seminole	127,873
Georgia	Clayton	133,237
	Cobb	322,595
	Fulton	127,776
	Gwinnett	237,305
	Richmond	126,476
Kentucky	Jefferson	239,430
Louisiana	East Baton Rouge	102,539
	Parish	331,307
	Jefferson Parish	
Maryland	Howard	157,972
North Carolina	Cumberland	146,827
Nevada	Clark	327,618
Oregon	Multnomah [1]	52,923
	Washington	116,687
South Carolina	Greenville	147,464
	Richland	130,589
Virginia	Arlington	170,936
	Chesterfield	174,488
	Henrico	201,367
	Prince William	157,131
Washington	Pierce	258,530
	Snohomish	157,218

[1] County was previously listed in this appendix; however, population dropped to below 100,000 in the 1990 Census.

PART 123—STATE PROGRAM REQUIREMENTS

1. The authority citation for part 123 continues to read as follows:

Authority: The Clean Water Act, 33 U.S.C. 1251 *et seq.*

2. Amend § 123.25 by removing the word "and" at the end of paragraph (a)(37), by removing the period at the end of paragraph (a)(38) and adding a semicolon in its place, and by adding paragraphs (a)(39) through (a)(45) to read as follows:

§ 123.25 Requirements for permitting.

(a) * * *

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(39) § 122.30 (What are the objectives of the storm water regulations for small MS4s?);

(40) § 122.31 (For Indian Tribes only) (As a Tribe, what is my role under the NPDES storm water program?);

(41) § 122.32 (As an operator of a small MS4, am I regulated under the NPDES storm water program?);

(42) § 122.33 (If I am an operator of a regulated small MS4, how do I apply for an NPDES permit? When do I have to apply?);

(43) § 122.34 (As an operator of a regulated small MS4, what will my NPDES MS4 storm water permit require?);

(44) § 122.35 (As an operator of a regulated small MS4, may I share the responsibility to implement the minimum control measures with other entities?); and

(45) § 122.36 (As an operator of a regulated small MS4, what happens if I don't comply with the application or permit requirements in §§ 122.33 through 122.35?).

* * * * *

3. Add § 123.35 to subpart B to read as follows:

§ 123.35 As the NPDES Permitting Authority for regulated small MS4s, what is my role?

(a) You must comply with the requirements for all NPDES permitting authorities under Parts 122, 123, 124, and 125 of this chapter. (This section is meant only to supplement those requirements and discuss specific issues related to the small MS4 storm water program.)

(b) You must develop a process, as well as criteria, to designate small MS4s other than those described in § 122.32(a)(1) of this chapter, as regulated small MS4s to be covered under the NPDES storm water discharge control program. This process must include the authority to designate a small MS4 waived under paragraph (d) of this section if circumstances change. EPA may make designations under this section if a State or Tribe fails to comply with the requirements listed in this paragraph. In making designations of small MS4s, you must:

(1)(i) Develop criteria to evaluate whether a storm water discharge results in or has the potential to result in exceedances of water quality standards, including impairment of designated uses, or other significant water quality impacts, including habitat and biological impacts.

(ii) Guidance: For determining other significant water quality impacts, EPA recommends a balanced consideration of the following designation criteria on a watershed or other local basis: discharge to sensitive waters, high growth or growth potential, high population density, contiguity to an urbanized area, significant contributor of pollutants to waters of the United States, and ineffective protection of water quality by other programs;

(2) Apply such criteria, at a minimum, to any small MS4 located outside of an urbanized area serving a jurisdiction with a population density of at least 1,000 people per square mile and a population of at least 10,000;

(3) Designate any small MS4 that meets your criteria by December 9, 2002. You may wait until December 8, 2004 to apply the designation criteria on a watershed basis if you have developed a comprehensive watershed plan. You may apply these criteria to make additional designations at any time, as appropriate; and

(4) Designate any small MS4 that contributes substantially to the pollutant loadings of a physically interconnected municipal separate storm sewer that is regulated by the NPDES storm water program.

(c) You must make a final determination within 180 days from receipt of a petition under § 122.26(f) of this chapter (or analogous State or Tribal law). If you do not do so within that time period, EPA may make a determination on the petition.

(d) You must issue permits consistent with §§ 122.32 through 122.35 of this chapter to all regulated small MS4s. You may waive or phase in the requirements otherwise applicable to regulated small MS4s, as defined in § 122.32(a)(1) of this chapter, under the following circumstances:

(1) You may waive permit coverage for each small MS4s in jurisdictions with a population under 1,000 within the urbanized area where all of the following criteria have been met:

(i) Its discharges are not contributing substantially to the pollutant loadings of a physically interconnected regulated MS4 (see paragraph (b)(4) of this section); and

(ii) If the small MS4 discharges any pollutant(s) that have been identified as a cause of impairment of any water body to which it discharges, storm water controls are not needed based on wasteload allocations that are part of an EPA approved or established "total maximum daily load" (TMDL) that address the pollutant(s) of concern.

(2) You may waive permit coverage for each small MS4 in jurisdictions with a population under 10,000 where all of the following criteria have been met:

(i) You have evaluated all waters of the U.S., including small streams, tributaries, lakes, and ponds, that receive a discharge from the MS4 eligible for such a waiver.

(ii) For all such waters, you have determined that storm water controls are not needed based on wasteload allocations that are part of an EPA approved or established TMDL that addresses the pollutant(s) of concern or, if a TMDL has not been developed or approved, an equivalent analysis that determines sources and allocations for the pollutant(s) of concern.

(iii) For the purpose of paragraph (d)(2)(ii) of this section, the pollutant(s) of concern include biochemical oxygen demand (BOD), sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation), pathogens, oil and grease, and any pollutant that has been identified as a cause of impairment of any water body that will receive a discharge from the MS4.

(iv) You have determined that current and future discharges from the MS4 do not have the potential to result in exceedances of water quality standards, including impairment of designated uses, or other significant water quality impacts, including habitat and biological impacts.

(v) Guidance: To help determine other significant water quality impacts, EPA recommends a balanced consideration of the following criteria on a watershed or other local basis: discharge to sensitive waters, high growth or growth potential, high population or commercial density, significant contributor of pollutants to waters of the United States, and ineffective protection of water quality by other programs.

(3) You may phase in permit coverage for small MS4s serving jurisdictions with a population under 10,000 on a schedule consistent with a State watershed permitting approach. Under this approach, you must develop and implement a schedule to phase in permit coverage for approximately 20 percent annually of all small MS4s that qualify for such phased-in coverage. Under this option, all regulated small MS4s are required to have coverage under an NPDES permit by no later than March 8, 2007. Your schedule for phasing in permit coverage for small MS4s must be approved by the Regional Administrator no later than December 10, 2001.

(4) If you choose to phase in permit coverage for small MS4s in jurisdictions with a population under 10,000, in accordance with paragraph (d)(3) of this section, you may also provide waivers in accordance with paragraphs (d)(1) and (d)(2) of this section pursuant to your approved schedule.

(5) If you do not have an approved schedule for phasing in permit coverage, you must make a determination whether to issue an NPDES permit or allow a waiver in accordance with paragraph (d)(1) or (d)(2) of this section, for each eligible MS4 by December 9, 2002.

(6) You must periodically review any waivers granted in accordance with paragraph (d)(2) of this section to determine whether any of the information required for granting the waiver has changed. At a minimum, you must conduct such a review once every five years. In addition, you must consider any petition to review any waiver when the petitioner provides evidence that the information required for granting the waiver has substantially changed.

(e) You must specify a time period of up to 5 years from the date of permit issuance for operators of regulated small MS4s to fully develop and implement their storm water program.

(f) You must include the requirements in §§ 122.33 through 122.35 of this chapter in any permit issued for regulated small MS4s or develop permit limits based on a permit application submitted by a regulated small MS4. (You may include conditions in a regulated small MS4 NPDES permit that direct the MS4 to follow an existing qualifying local program's requirements, as a way of complying with some or all of the requirements in § 122.34(b) of this chapter. See § 122.34(c) of this chapter. Qualifying local, State or Tribal program requirements must impose, at a minimum, the relevant requirements of § 122.34(b) of this chapter.)

(g) If you issue a general permit to authorize storm water discharges from small MS4s, you must make available a menu of BMPs to assist regulated small MS4s in the design and implementation of municipal storm water management programs to implement the minimum measures specified in § 122.34(b) of this chapter. EPA plans to develop a menu of BMPs that will apply in each State or Tribe that has not developed its own menu. Regardless of whether a menu of BMPs has been developed by EPA, EPA encourages State and Tribal permitting authorities to develop a menu of BMPs that is appropriate for local conditions. EPA also intends to provide guidance on developing BMPs and measurable goals and modify, update, and supplement such guidance based on the assessments of the NPDES MS4 storm water program and research to be conducted over the next thirteen years.

(h)(1) You must incorporate any additional measures necessary to ensure effective implementation of your State or Tribal storm water program for regulated small MS4s.

(2) Guidance: EPA recommends consideration of the following:

(i) You are encouraged to use a general permit for regulated small MS4s;

(ii) To the extent that your State or Tribe administers a dedicated funding source, you should play an active role in providing financial assistance to operators of regulated small MS4s;

(iii) You should support local programs by providing technical and programmatic assistance, conducting research projects, performing watershed monitoring, and providing adequate legal authority at the local level;

(iv) You are encouraged to coordinate and utilize the data collected under several programs including water quality management programs, TMDL programs, and water quality monitoring programs;

(v) Where appropriate, you may recognize existing responsibilities among governmental entities for the control measures in an NPDES small MS4 permit (see § 122.35(b) of this chapter); and

(vi) You are encouraged to provide a brief (e.g., two page) reporting format to facilitate compiling and analyzing data from submitted reports under § 122.34(g)(3) of this chapter. EPA intends to develop a model form for this purpose.

PART 124—PROCEDURES FOR DECISIONMAKING

1. The authority citation for part 124 continues to read as follows:

Authority: Resource Conservation and Recovery Act, 42 U.S.C. 6901 *et seq.*; Safe Drinking Water Act, 42 U.S.C. 300(f) *et seq.*; Clean Water Act, 33 U.S.C. 1251 *et seq.*; Clean Air Act, 42 U.S.C. 7401 *et seq.*

2. Revise § 124.52(c) to read as follows:

§ 124.52 Permits required on a case-by-case basis.

* * * * *

(c) Prior to a case-by-case determination that an individual permit is required for a storm water discharge under this section (see § 122.26(a)(1)(v), (c)(1)(v), and (a)(9)(iii) of this chapter), the Regional Administrator may require the discharger to submit a permit application or other information regarding the discharge under section 308 of the CWA. In requiring such information, the Regional Administrator shall notify the discharger in writing and shall send an application form with the notice. The discharger must apply for a permit within 180 days of notice, unless permission for a later date is granted by the Regional Administrator. The question whether the initial designation was proper will remain open for consideration during the public comment period under § 124.11 or § 124.118 and in any subsequent hearing.

[FR Doc. 99–29181 Filed 12–7–99; 8:45 am]
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ENVIRONMENTAL PROTECTION AGENCY

[FRL-6472-8]

Report to Congress on the Phase II Storm Water Regulations

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice of availability of Report to Congress.

SUMMARY: EPA submitted a Report to Congress prior to promulgation of the new Phase II storm water regulations. The Report was required in the Agency's appropriation legislation for fiscal year 2000. The appropriation legislation also requires that USEPA invite public comment on the Report. By this notice, USEPA invites public comment.

DATES: Written comments on this notice and the Report to Congress must be submitted on or before January 7, 2000.

ADDRESSES: The Report to Congress on the Phase II Storm Water Regulations is available through the Internet on the EPA Office of Wastewater Management web site at http://www.epa.gov/owm/sw/phase2. Hard copies may be obtained by contacting the U.S. EPA Water Resource Center, 401 M Street, S.W., Washington, D.C. 20460; telephone: (202) 260-7786 (24-hour voice mail), fax: (202) 260-0386, e-mail: center.resource@epa.gov. Comments should be mailed to George Utting, USEPA, Office of Wastewater Management, Mail Code 4203, 401 M Street, S.W., Washington, D.C. 20460. Comments also may be faxed to (202) 260-1460 or submitted via the Internet to sw2@epamail.epa.gov.

FOR FURTHER INFORMATION CONTACT: George Utting, Office of Wastewater Management, Mail Code 4203, 401 M Street, S.W., Washington, D.C. 20460; telephone (202) 260-9530; email: sw2@epamail.epa.gov.

SUPPLEMENTARY INFORMATION: On October 29, 1999, the Administrator of EPA signed a regulation that implements Section 402(p)(6) of the Clean Water Act. This rulemaking is referred to as the final Phase II storm water rule and is also published in today's **Federal Register**.

The Phase II storm water rule expands the existing National Pollutant Discharge Elimination System (NPDES) permitting program to address storm water runoff from construction sites between one and five acres and municipal separate storm sewer systems in urbanized areas serving populations of less than 100,000. The Phase II rule builds on the existing Phase I program, which controls storm water runoff from municipalities with populations greater than 100,000 and 11 industrial categories, including construction disturbing over five acres.

Statutory Authority

The Report to Congress on the Phase II Storm Water Regulations was required by section 431(a) of the Departments of Veterans Affairs and Housing and Urban Development and Independent Agencies Appropriations Act of 2000, Public Law 106-74 (1999) (Appropriations Act). Section 431(a) of the Appropriations Act directed EPA to submit a report that addresses the following issues with respect to the Phase II Storm Water Rule: (1) An analysis of the impact of the rule on local governments, (2) an explanation of the rationale for lowering the threshold for regulation of construction sites from 5 acres to 1 acre, (3) an explanation of why the coverage of the regulation is based on a census-determined population instead of a water quality threshold and documentation that storm water runoff is generally a problem in communities with populations of 50,000 to 100,000, and (4) information that supports the position of the Administrator that the Phase II storm water program should be administered as part of the NPDES permit program.

On October 28, 1999, EPA delivered to the Committee on Environment and Public Works in the Senate and the Committee on Transportation and Infrastructure in the House of Representatives a report that satisfied the mandate of section 431(a). Section 431(c) of the Appropriations Act directs EPA to publish the report in the **Federal Register** for public comment. By today's notice, EPA invites public comment by January 7, 2000. EPA will carefully review and evaluate comments received and determine whether the comments warrant further action.

Dated: November 4, 1999.

J. Charles Fox,

Assistant Administrator, Office of Water.

[FR Doc. 99-29301 Filed 12-7-99; 8:45 am]

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R0018224

FINAL REPORT

Benchmarking Decision Criteria for Urban Wet Weather Abatement

Combined Sewer Overflow

Sanitary Sewer Overflow

Stormwater

Abatement

Decision Criteria Benchmarking

Project 97-CTS-6
1999

Water Environment Research Foundation

Urban wet weather pollution manifests itself in three different ways: combined sewer overflow (CSO), sanitary sewer overflows (SSO), and stormwater runoff (SW). Urban wet weather pollution is a reflection of the watershed or sewershed from which it is generated and the climatic patterns the area experiences. The result is a wide-scale challenge that requires very site-specific solutions.

This report presents data from CSO and SSO and SW communities. The major data categories include public participation, issues driving technical considerations, financial considerations, watershed approach and water quality issues. The data is presented in such a way as to facilitate benchmarking. This report also presents guidance issues including public participation, watershed framework approach, receiving water impacts, monitoring / modeling of impacts, and cost effectiveness analysis.

Twenty-six CSO, sixteen SSO, and fourteen SW communities participated in this project. The findings suggest that; (1) since the publication of the Federal CSO policy in 1994, many CSO communities have begun the process of CSO abatement, (2) while SSOs are common, the lack of federal guidance has dulled the initiative for SSO abatement and (3) communities using the watershed approach have moved forward with SW abatement.

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PROJECT 97-CTS-6

BENCHMARKING DECISION CRITERIA FOR URBAN WET WEATHER ABATEMENT

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Water Environment Research Foundation

R0018227

Environmental Stewardship Through Innovative Science and Technology

The Water Environment Research Foundation (WERF) was established to advance science and technology for the benefit or the water quality profession and its customers. Funded through voluntary contributions, WERF manages research under three major thrust areas: Collection and Treatment Systems, Human Health Effect and Products, and Watershed and Ecosystem Management. WERF seeks cost-effective, publicly acceptable, environmentally sound solutions to water pollution control problems. A 15-member Board of Directors composed of water quality professionals; volunteers from utilities, academia, consulting firms, and industry; a Utility Council and Corporate Council composed of subscribing entities; and a Research Council of knowledgeable leaders in environmental sciences and engineering are actively involved in applied and basic research program management.

While WERF manages the research and coordinates with the parties involved, the actual work is carried out by individual organizations, primarily utilities, universities, and industrial and commercial firms. To ensure objectivity, an independent advisory group (the Project Subcommittee) of distinguished scientists and engineers helps select researchers, oversees the studies, and provides periodic technical peer review and advice. Benefits accrue in the form of services, technological advances, and information for direct application by the profession for its customers.

The Water Environment Research Foundation is successfully building a cooperative research and development program serving the water quality profession. The Foundation's goal is to apply sound and objective scientific information to better serve the public.

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SSO Case Histories:

The following SSO case histories were used with authorization of EPA Office of Water.

Houston, Texas
Johnson County, Kansas
Oklahoma City, Okla.
Wayne County (Downriver Communities), Mich.

These SSO case histories will be published in an EPA report entilted, *Developing Case Studies on Sanitary Sewer Overflow Abatement Programs,* by Limno-Tech Inc. as a sub-contractor to Parsons Engineering Science.

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BENEFITS

- Presents the most current federal combined sewer overflow, sanitary sewer overflow, and stormwater policies.
- Provides communities essential criteria to use as guidance for wet weather pollution abatement. These criteria include public participation, technical considerations, financial considerations, watershed approach, and water quality.
- Benchmarks policy interpretations and progress of various municipalities in achieving water quality goals.
- Provides communities with data that may be useful for wet weather pollution stakeholders engaging in self-evaluation activities.
- Provides cost-benefit analysis procedures.
- Presents a history of wet weather pollution management control strategies.

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EXECUTIVE SUMMARY

Criteria by which municipalities make decisions for abatement of wet-weather pollution are as variable as the very subject itself. This variability is due to the site specific nature of the tributary area as it relates to the receiving-water in question; interpretation of regulations which can differ among U.S. Environmental Protection Agency (U.S. EPA) regions as well as states; and sense of urgency which may be permit related or related to a particular episode. Wet weather pollution manifests itself as combined sewer overflow (CSO), sanitary sewer overflow (SSO), and stormwater (SW). Although these wet weather discharges can affect receiving waters in a similar way, each is distinctly different in the manner in which it is regulated, how the regulations are enforced, and the sense of urgency to abate the related pollution.

This report identifies the experiences of municipalities as well as regulatory agencies in dealing with wet weather issues. The data are presented in such a way as to facilitate benchmarking of decision criteria. Benchmarking, as used in this report, identifies the status of various municipalities and their progress toward achieving water quality objectives; such benchmarking can provide to any municipality the benefit of real experience.

CSOs generally were recognized as a significant source of pollution in the late 1960s and specifically identified at the federal level through the landmark 1972 Amendments to the Federal Water Pollution Control Act. Much of the CSO work was started through federal R & D programs initiated in the early 1970s. These programs were also instrumental in identifying SSOs as a pollution source. Subsequent sewer system evaluations revealed SSOs as a real, but illegal, component of sewer systems.

The activity directed toward CSOs has been greater than SSOs and SW owing to the earlier awareness and recognition of this type of pollution and, perhaps more important, the urgency associated with the health risks stemming from the sewage component. The intensity of regulatory and municipal activities sharply increased in September 1989 when U.S. EPA published the draft National CSO Control Strategy. Until then, in the absence of clear guidelines, most municipalities were unwilling to forge ahead.

SSOs were specifically identified as part of the facility planning required under the 1972 amendments. However, remediation of many SSOs has been slow due to the lack of a definite federal policy or state guidelines. In many cases, the demand by regulatory agencies that SSOs simply be eliminated has met with resistance and active debate. One of the major issues has been whether or not SSOs that react directly to rainfall could or should in fact be treated as CSOs.

It wasn't until some years later after CSO and SSO problems were addressed by the regulating community that SW became a focus. The significance of SW pollution was understood as an outgrowth of many CSO characterization studies. In a similar manner to CSO, SW activities increased sharply with the release of federal regulations on Nov. 16, 1990. Nevertheless, SW abatement activities on a national scale have been spotty owing largely to variability in enforcement. In those EPA regions and states where CSOs have been a major problem, SW has taken a back seat. In those EPA regions and states where there is a prevalence of separately sewered areas, SW activities have been greater.

In consideration of the above-stated differences, this report categorizes the CSO, SSO and SW experiences separately. As expected, the CSO activity and number of municipalities reported are by far greater than either the SSO or SW activities reported: 26 CSO communities versus 16 SSO communities and 14 SW communities.

SSO activities may be far more numerous than has been recorded, since such discharges are viewed as illegal and are not always openly acknowledged. Also, virtually all moderately aged separated sanitary sewers will overflow a during severe, infrequent storm event, and this phenomenon probably will continue. Stormwater activities are more openly documented; limitations in activity are more a reflection of other factors such as regulatory pressure and specific water quality needs.

ES.1 CSO

The communities included in this CSO benchmarking survey represent a range of geographic locations, population, demographics, CSO system sizes, abatement strategies and schedules. Annual rainfall for these communities ranged from 20 in. to more than 40 in.; however, the majority had annual rainfall greater than 30 in. Most discharge CSO into rivers.

The data collected show that public concern for water quality expressed through state initiatives started the abatement process for many communities. Such initiatives took the form of requirements for CSO facility planning which included alternative and cost-benefit analyses. The most prevalent parameters were and continue to be bacteria and floatables. Solids, biological oxygen demand (BOD) and nutrients are of some concern, with dissolved oxygen and metals being the parameters least of concern.

Upon the release of the Draft National CSO Control Policy in 1994, many CSO facility plans were revisited to determine compliance with either "presumption" or "demonstration" provisions and to develop the required long term control plan (LTCP). The same number of communities followed the presumption approach as followed the demonstration approach; however, the majority of smaller communities followed the presumption approach.

The most prevalent form of implementation has been best management practices (BMP) due to the "housekeeping" nature of such steps and the low cost-to-benefit relationship. Reductions of annual CSO volume from BMPs were reported as high as 90%.

Abatement beyond BMPs was implemented by only a limited number of communities prior to the national policy. In some cases, communities with high enough state priorities were able to take advantage of federally available grant funds. For the most part, however, abatement has taken place after 1994 and has not included federal grants. State revolving funds have become available in place of the previous U.S. EPA Construction Grants Program.

As a consequence of little or no federal or state funding currently available for design and construction, financial considerations have become that much more important, resulting in a greater emphasis on cost-benefit evaluations and reviewing the affordability guidelines within the policy.

The watershed perspective has been introduced only in the last few years. States have embraced this approach largely upon the release of U.S. EPA's total maximum daily load (TMDL) guidelines, which relate to a watershed approach. The TMDL guidelines provide a basis for proceeding in the absence of a basin-wide wet weather plan which is the responsibility of states to develop. However, almost no communities used a watershed approach to determine CSO abatement needs. A limited number of communities have recently started either a watershed or TMDL approach to verify total wet weather readings and identify needs to achieve water quality goals.

Most communities acted to abate their CSOs due to regulatory requirements which can take the form of permit renewals, administrative orders or consent orders. Generally communities acted upon requirements more or less in that order. Most responding communities have completed their LTCP. However, only 20% of the responding communities have completed abatement, and only one, Rochester, N.Y., completed abatement through the construction grant monies made available in the 1970s. Most responding communities received funding from one or more of a variety of sources, including construction grants, state revolving funds and increased taxes.

Two parameters that are serving as the focus for abatement and permits are floatables and bacteria. Concerns are often expressed for other parameters, such as solids, BOD, nutrients, and heavy metals, but limits can and have been challenged, and in some cases watershed efforts are being undertaken. Floatables limits have taken the form of substantial removal or capture up to a specific size storm, for example a one-year frequency. Generally bacteria are specified as a maximum or average concentration for a specific event or monthly basis.

In setting permit parameters, little consistency exists from case to case, which is understandable in light of their site-specific nature and related health risks. States prefer to await site-specific information so that the most practical permit limits can be established. The most notable parameters that vary are:

- design storm frequency;
- bacteria type, concentration and violation frequency; and
- methodology for assessing annual impacts.

ES.2 SSO

The Urban Institute (1984) estimated that as an annual average there are 825 sewer backups and 140 sewer breaks every year for every 1,000 miles of sewer. The Urban Institute survey attributed backups to a variety of factors: the location of pipe in trouble-prone areas, the pipe material, the size of pipes, the material, construction methods, local soils, and maintenance practices.

In 1994, the Civil Engineering Research Foundation found that three-quarters of the sanitary sewer systems function at 50% of capacity or less. Root penetration, corrosion, soil movement and inadequate construction are the cause of most structural failures.

As a result of reduced sewer capacity and failures, SSOs during wet and dry weather are a reality. The Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) found that 3% of municipal systems have at least an occasional dry weather SSO.

In a Water Pollution Control Federation study (1989), 1,003 wastewater treatment plants identified facility performance problems. Infiltration and inflow (I/I) was the most frequent performance problem cited.

Different National Pollution Discharge Elimination System (NPDES) authorities have historically provided different emphasis on oversight of sanitary sewer collection systems. In addition, some of the NPDES regulatory provisions addressing sanitary sewer collection systems are unclear, and different NPDES authorities have provided different interpretations regarding SSOs. For example, the ASIWPCA (1996) study found that many states do not issue permits for smaller sanitary sewer systems that discharge into a larger system; however, some states issue permits to all sanitary sewer systems. The ASIWPCA study also found that some states authorize wet weather control facilities that provide some level of treatment or flow control, while other states do not authorize such facilities.

The communities included in this SSO benchmarking survey represent a range of geographic locations, demographics, abatement strategies and schedules. The majority of responding communities serve a population of less than 500,000 and manage total drainage areas of more than 55,000 acres. Annual rainfall for these communities ranged from 20 in. to more than 40 in. Most discharge SSO into rivers or streams.

Most communities have not defined their annual discharge quantity, unlike the case of CSO. Wayne County, Mich., was one of the few exceptions. Flow monitoring in 13 Wayne County communities was used to evaluate the relative contribution of each to the wet weather pollution.

Public participation has been minimal compared to CSO and SW. Public concerns have ranged from aesthetics and water quality to flooding. The major water quality parameters of concern have been bacteria, BOD and dissolved oxygen.

The major abatement solution has been I/I reductions at the source based upon cost-benefit analysis. In a few select cases, such as Johnson County, Kan., and Houston, Texas, satellite treatment of SSOs has been approved. Satellite treatment technology included screening, settling tanks or ponds, and disinfection. Such an approach provided a cost-effective means of complying with water quality requirements.

ES.3 Stormwater

In most cities, very little has been done beyond basic SW drainage. In a few communities (as this report documents), early concerns by the public on declining water quality resulted in attempts to manage SW quality. After drainage problems were brought under control, usually through master planning and the construction of large-scale facilities, construction-erosion control was usually implemented in those communities. With these important considerations addressed, some of the communities were able to address SW quality. Some stressed controls with new development, while a very few examined retrofit opportunities.

With the SW NPDES permit program in place, SW quality management has been brought to the attention of most medium and large cities in the country (communities > 100,000). In October 1999, the permit program will be expanded to smaller municipalities (< 100,000).

Because of the large number of communities involved in the first and second phases of the NPDES SW permit program, the federal and state approach has been to define basic requirements for the permits, with little specified in the way of controls. Obviously, the submission of all the municipal industrial SW permits has produced a financial, logistic, and management problem for the state agencies and EPA regions.

The requirements included in the issued permits rarely specified any control or management needs beyond conducting an outfall monitoring program of about three storms a year at about five land use sites. The permits are generally issued for five years, with the expectation that specific control requirements would be added during later permitting periods as local problems become better defined. However, after almost ten years of the SW NPDES program, medium sized cities have also submitted permit applications; most have received their initial permits, and some small communities will be included in the program within a year. Therefore, the SW permit program has increased the burden on regulatory agencies. This has resulted in little opportunity for increased site-specific control objectives to be included in the permits.

Most of the specific accomplishments of improved SW quality have occurred in communities with flooding/drainage problems, scarce water resources, and the financial ability (usually through local funding). Specific requirements by local communities, and some state agencies, are the driving force behind these major accomplishments.

Decision criteria are usually expressed as meeting the federal SW regulations, with only a few exceptions where local residents expressed early and loud concerns over declining water quality.

In general, monitoring of urban SW runoff has indicated that the biological beneficial uses of urban receiving waters are most likely affected in terms of habitat destruction and contaminated sediment, while documented effects associated from acute exposures to toxicants in the water column are rare. Receiving-water investigations of runoff events have not indicated significant short-term receiving water problems, but long-term problems are common.

It is therefore difficult to relate such pollution to conventional numerical standards. Nevertheless there is interest in developing special wet weather standards.

In order to investigate the current state of thinking in SW design, in 1997 University of Alabama at Birmingham distributed a survey to which 85 communities responded. About 75% of the respondents indicated that local or county authorities specified drainage system levels of service (design storms). The most common design storm was a 10-year storm (10% probability of occurrence in any one year) for all land uses (42%). Several responses also indicated that most systems were checked for flooding with respect to the 100-year storm. About 86% of all survey respondents routinely used computerized tools for storm drainage design. The respondents also identified water quality concerns that were associated with SW runoff. More than 60% of the participants indicated sediment as a pollutant of concern. Nutrients (35%) and metals (34%) were the other most frequent answers. Other common answers were oils and grease, bacteria, toxicants, floatables, and salts.

The communities included in this SW benchmarking survey represent a range of geographic locations, demographics, abatement strategies and schedules. All the responding communities manage total drainage areas of more than 1,000 acres and had more than 50 outfalls. Annual rainfall for these communities ranged from 20 in. to more than 40 in. Most discharge SW into rivers or streams.

Most communities indicated a public participation program. General water quality, along with basement flooding, were the most commonly listed public concerns.

Almost all the communities had completed a SW facility plan or are currently developing one. Almost all respondents indicated that regulatory requirements were the main driving force in their SW quality management efforts. A wide range of technologies was considered by these communities, including construction site erosion controls, public works practices, infiltration, and sedimentation.

Most SW communities did not have significant past investments in a SW abatement infrastructure. However, there is some indication that more money will be spent in the future. The funding sources were varied, with fees from utility districts being most common, followed by federal grant money, state grant money, and increased taxes.

About one-half of the responding communities used mathematical models of their SW systems and almost all indicated that a watershed approach has been taken or is in progress.

CHAPTER 1.0

INTRODUCTION

1.1 Introduction

Urban wet weather pollution manifests itself in three different ways: combined sewer overflow (CSO), sanitary sewer overflows (SSO), and stormwater runoff (SW). CSOs are the result of the "designed" relief of a sewer system that intentionally carries SW and sanitary sewage. SSOs, on the other hand, are the result of the unplanned relief of a sewer system intended only for sanitary sewage but also carrying rainfall-induced infiltration, illegal SW connections, and invasions of SW. Stormwater runoff discharges include flows that have been collected in a separate storm sewer system or a surface drainage system.

Urban wet weather pollution is a reflection of the watershed or sewershed from which it is generated and the climatic patterns the area experiences. The impacts of wet weather discharges are determined by a variety of complex relationships. These relationships include the type and magnitude of pollutant loads being transported, the ecological and hydraulic nature of the receiving water, as well as the designated beneficial uses, and the desires and expectations of stakeholders. The result is a wide-scale challenge that requires very site-specific solutions.

Solutions to wet weather pollution require investigation of a wide variety of management options and the relationship between the costs of management and water quality benefits. Benchmarks for effectiveness are also useful to determine if the control program is working. The most successful control programs are often part of an overall watershed management strategy.

Benchmarking as used in this report identifies the status of various municipalities (to include sewerage agencies) and their progress in achieving water quality objectives.

1.2 Objectives

The objective of this project is to document federal regulations and benchmark policy interpretations of U.S. Environmental Protection Agency (U.S. EPA) and select state regulatory agencies, and to document the progress of various municipalities in achieving water quality goals. Information is presented in case histories and summarized in matrices. Such benchmarking information can provide municipalities with real experiences to better develop solutions to their own CSO, SSO, and SW challenges. This report identifies where municipalities are, what has been achieved, and where they are going; but it must be recognized that each municipality reflects site-specific conditions and any comparisons are highly dependent on such conditions.

CHAPTER 2.0

BACKGROUND

2.1 Chronicle of Water Pollution Regulations

The first comprehensive federal involvement in controlling water pollution was the Water Pollution Control Act of 1948 (PL 80-845). It required the Surgeon General to develop programs to eliminate or reduce the pollution of interstate waters and was the first statute to provide federal financial assistance to state and local governments for water pollution control programs. This law was specific in limiting federal enforcement activities to involvement in pollution of interstate waters.

Federal interest in controlling water pollution increased through the 1960s. The Federal Water Pollution Control Act of 1956 (PL 84-660), the 1961 amendments to that act (PL 87-88), the Water Quality Act of 1965 (PL 89-234), and the Clean Water Restoration Act of 1966 (PL 89-753) all resulted in increased federal funding of water pollution control efforts and in the enforcement of environmental laws. The Water Quality Act of 1965 created the Federal Water Pollution Control Administration, the predecessor of U.S. EPA. Water quality standards also were a prominent feature of that law and were used to define actual occurrences of water pollution in interstate waters.

Throughout the 1960s public interest in environmental affairs heightened as the seriousness of pollution became painfully evident when the Cuyahoga River caught fire. The Cuyahoga River fire, along with the pesticide dangers documented in Rachel Carson's Silent Spring, President Lyndon Johnson's declaration that the Potomac River near Washington, D.C., was a "national disgrace," and a major oil spill off the coast of Santa Barbara, Calif., influenced people to take action to protect the environment.

In the 1970s, increased environmental awareness resulted in mounting public frustration over the slow pace of cleanup efforts. Congress overrode a presidential veto to enact the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500). While the title implied that it amended the previous legislation, it actually represented a fundamental change in the structure and organization of U.S. water pollution control programs. The 1972 Amendments brought a shift of program responsibility from the states to the federal government.

The major provisions of PL 92-500 state that all discharges are illegal unless they are in compliance with requirements set forth by the act and that all point source discharges must obtain a permit. This permitting requirement encouraged the formation of the National Pollutant Discharge Elimination System (NPDES). The purpose of these authorities is to administer permits establishing pollution limits, and specifying monitoring and reporting requirements for point source pollution. The objective of the act was to restore and maintain the physical, chemical, and biological integrity of the nation's waters, the so-called "swimmable-fishable designation." The act was notable in terms of both its national comprehensiveness and its specificity; virtually all forms of pollution were recognized. The act also provided citizens the right to bring a civil action against any person in violation of an effluent standard.

In the early '70s, attempts were made to identify and prioritize pollution sources and their relative importance through a national "needs surveys" required of all municipalities by the federal government. These surveys served as the basis for planning the Federal Construction Grants Program. This resulted in a special report to Congress on CSOs (EPA -430/9-78-006), as well as in a 1978 needs survey entitled *Cost Methodology for Control of Combined Sewer Overflow and Stormwater Discharge* (EPA -430/9-79-003). The latter estimated the capital costs to meet the "swimmable" goal to be $61.7 billion (in year 2000 dollars).

In the 1970s, funding assistance was increased to municipalities; but with the increased funding came more program requirements and involvement of federal and state regulators. The U.S. EPA , through numerous research and demonstration grants to municipalities, made significant advances in the areas of receiving water/water impact analysis, impact analysis, sewer-system characterization, control and treatment technology, and cost effectiveness analysis. As a result of these studies, technology-based effluent limits were established.

The Clean Water Act of 1977 (PL 95-217) included revisions in the areas of construction grants funding and the definition of conventional, unconventional, and toxic pollutants. It also allowed states to assume responsibility for federal programs, thereby encouraging the formation of the State Pollutant Discharge Elimination System (SPDES) Authority.

The "208" planning studies were an incentive to local governments to develop their own plans, with minimal federal input. These plans were to characterize all point and nonpoint pollutant discharges in designated areas and to develop treatment schemes that would allow the goals to be met. Unfortunately, most of these plans were conducted in short time periods with limited technical success. Control measures were recommended with few local demonstrations of their potential success. Recognizing these technical shortcomings, Congress authorized the Nationwide Urban Runoff Program (NURP) to demonstrate the applicability of various urban runoff control measures in about 30 cities. These studies were completed in 1983 (EPA , 1983).

In 1981, Congress revised the municipal construction grants program as part of the Construction Grant Amendments of 1981 (PL 97-117). This law marked the beginning of the end of the grants program, with limitations on grant-eligible categories and a reduction in the level of grant assistance for eligible projects. The Construction Grant Amendments of 1981 empowered state governors to use 20% of the states' federal allotment of construction grant funds for the correction of CSOs, if deemed a major priority. Also, a separate material fund of $200 million annually was established for marine bays and estuaries. The Water Quality Act of 1987 (PL 100-4) established the revolving loan program as the successor to the grants program. This law also continued the efforts to address controlling toxins in wet weather pollution and designated water use, and began efforts to address nonpoint sources of pollution.

After the 1987 Water Quality Act amendments, the U.S. EPA issued new regulations that required states to provide scientific justification if surface water was not designated to protect aquatic life and recreational uses. In the event that the designation turned out to be inappropriate, the U.S. EPA provided the means for making adjustments by way of the Use Attainability Analysis (UAA). UAA is a structured scientific assessment of the chemical, physical, and biological conditions in a water body. The comprehensive evaluation focuses on water quality, available habitat, and flow regimes. The UAA offers the best potential to direct scarce resources where they will provide the greatest environmental benefits. However, this process is time-consuming, expensive, and potentially controversial because of the lack of clear legal and scientific decision criteria.

U.S. EPA regulations to control SW runoff were first published in the Dec. 7, 1988 issue of the Federal Register. These regulations initiated a permit process for urban runoff, but the reporting information required and the schedules vary depending on the land use and the size of the community. Large- and medium-sized communities are currently developing SW permits under the Phase I SW policy, and small communities will be targeted in the future under the Phase II SW policy. The general application requirements stress descriptive information concerning the drainage area, with minimal runoff monitoring requirements.

Throughout the 1980s many citizens exercised their right to bring a civil action against persons in violation of effluent standards. In 1987, the number of civil actions increased, partly due to the publicity produced by the *Gwaltney of Smithfield, Ltd. v. Chesapeake Bay Foundation Inc.*, U.S. Supreme Court decision. The court ruled that citizens may bring civil action in federal court if they make a good faith allegation of continuous or intermittent violation. The plaintiffs need not prove their allegations of ongoing noncompliance before the civil action, since the statute does not require that a defendant "be in violation" at the commencement of the suit, but only that the defendant be "alleged to be in violation." The public realized that these suits are an effective deterrent against polluters and provide additional enforcement power to that of the regulatory agencies.

In 1989, U.S. EPA published the draft National CSO Control Strategy that established the foundation for states to develop their own strategies and for communities to begin to appreciate the ramifications of CSO abatement. Following extensive review by several "stakeholder" groups, U.S. EPA published the Final CSO Control Policy in April 1994. Very few states were willing to embark upon their own requirements until the federal government issued its own policy. Some communities did proceed with CSO abatement planning and certain best management practices (BMP) in the early 1980s but at the risk of not complying with forthcoming requirements. Generally, communities were concerned that if they forged ahead, they would be required to change their approach if it did not meet the forthcoming requirements. The national strategy served to initiate dialogue and to some extent accommodate such concerns.

The CSO policy was developed as the result of input from individuals, communities, public interest groups, regulatory agencies, and professional organizations such as the Water Environment Federation, CSO Partnership, and Association of Municipal Sewerage Agencies. Consequently, it evolved into a document that accommodates the latest technological approaches to defining the pollution and associated impacts, and at the same time addresses the needs of communities both large and small. Most important, it recognizes the site-specific nature of CSOs.

In 1992, the U.S. EPA initiated a consultative process to help develop framework documents for controlling CSOs. A work group was established with membership from public interest groups such as the National League of Cities, Environmental Defense Fund, and Lower James River Association. The objective of the group was to develop a set of criteria to be used in determining long-term CSO control programs and implementing NPDES permits.

In 1994, the general lack of clarity and consistency in the nationwide approach to SSOs led a number of municipalities to approach the U.S. EPA Office of Water and ask that an advisory committee be formed to make recommendations on how to apply the NPDES program to SSOs (SSO Federal Advisory Subcommittee, 1996). As a result, the SSO Federal Advisory Subcommittee was formed and began meeting in late 1994. The subcommittee was instrumental in developing draft federal policy and this is acknowledged in the March 7, 1996 memorandum accompanying a new addition to the Enforcement Management System (EMS) Guide. The EMS Guide establishes guiding principles and priorities for the various U.S. EPA regions and NPDES states in responding to separate sanitary sewer discharge violations (U.S. EPA , 1996a).

In 1996, more than 1,100 viewers participated in the live satellite seminar, "The Clean Water Act: New Directions." Experts noted that more collaboration among regulators, the regulated community, and the public could produce cleaner water more cost effectively while addressing the needs of individual communities. As a result of the 1996 seminar, the U.S. EPA is leading an "Adopt Your Watershed" campaign. Through this effort, U.S. EPA challenges citizens to join together to protect and restore our water resources.

2.2 Combined Sewer Overflow

CSOs originate from sewer systems that collect both SW runoff and sanitary sewage in the same pipe. During dry weather, these sewer systems convey sanitary sewage directly to a wastewater treatment plant (WWTP). However, during wet weather events the volume of SW runoff and sanitary sewage can exceed the capacity of the sewer system or WWTP. Under these conditions the combined sewer systems are designed to overflow and discharge excess SW runoff and sanitary sewage into streams, rivers, lakes, or estuary receiving waters.

Overflows from combined sewers during storm events result in the discharges to receiving waters of untreated sanitary sewage, which also may contain pre-treated industrial wastewater and untreated SW. Combined sewer overflows contain pollutants that are present in the domestic and industrial wastewater, as well as pollutants in the urban SW runoff that enters the combined sewer system. CSOs are among the major sources responsible for beach closings, shellfishing restrictions, and other water body impairments

In many cases, these discharges have an adverse effect on receiving water quality and attainment of designated uses. In recent years, there has been an enhanced regulatory focus on CSOs and their control, and communities with combined sewer systems are being called upon to develop and implement programs for control of CSOs.

Combined sewer systems serve roughly 950 communities throughout the U.S. with about 40 million people. Most communities with CSOs are located in the Northeast and Great Lakes regions, particularly in New England, Pennsylvania, Indiana, Ohio, Illinois, Michigan, New York and West Virginia. Although large cities like New York, Philadelphia, and Atlanta have combined sewer systems, most communities with combined sewer systems have fewer than 10,000 people.

2.2.1 U.S. Combined Sewer Overflow Policy

The National CSO Control Policy was signed by Carol Browner, the Administrator of the U.S. EPA , on April 8, 1994. This signing culminated a lengthy process of policy development and negotiation among CSO communities, U.S. EPA , the states, and environmental groups. Based upon the NPDES program, the CSO policy establishes a consistent national approach for controlling CSOs.

Consistency within the CSO policy is established by requirements for all CSO communities to implement Nine Minimum Controls (NMCs). The NMCs are technology-based controls that can be used to abate CSO impacts without extensive engineering studies or substantial construction costs. The NMCs place emphasis on maintenance and proper operation of the combined sewer system to ensure maximum use of the collection system and treatment capacity of the WWTP. The NMCs are documented in Appendix A. Consistency is also established by requiring CSO communities to develop comprehensive long term control plans (LTCP) tailored to site-specific conditions. The development of LTCPs is a comprehensive effort that leads to the identification and implementation of technically feasible, effective and affordable controls. Key principles of the LTCP are documented in Appendix A.

The significance of the CSO policy is its recognition of the site-specific nature of combined sewer systems and the variability of receiving water conditions and impacts. Non- and low-structurally intensive pollution controls (i.e., BMPs) are normally the first item that has to be addressed in accordance with best professional judgment. Communities unable to mitigate serious water quality impacts with the implementation of BMPs alone are normally required to provide additional control measures based on water quality requirements.

The features of the CSO policy that can be considered perhaps the most helpful in assisting communities to address their CSO challenges are:

- identification of the presumption and demonstration approaches, and
- guidance on affordability.

The presumption and demonstration approaches provide CSO communities with targets for controls that achieve compliance with the Clean Water Act, particularly the protection of designated uses. Under the demonstration approach, water quality modeling or other tools are used to demonstrate that predicted CSO discharges resulting from the LTCP would be sufficient to attain water quality standards. The presumption approach is based on the premise that a LTCP that meets certain minimum defined performance criteria in terms of expected frequency of overflow, or percent capture of the CSO pollutant load would be presumed to provide an adequate level of control to meet the water quality-based requirements of the Clean Water Act. Key principles of the presumption and demonstration approaches are documented in Appendix A.

The purpose of guidance on affordability is to provide criteria for assessing financial capability and to relate that capability to an appropriate compliance schedule. Its goal is to provide general boundaries to aid all parties in negotiating reasonable and effective schedules for implementing CSO controls. Key principles of the guidance on affordability are documented in Appendix A.

The CSO policy also provides flexibility to CSO communities so that control programs can be developed to fit local needs. The policy contains specific considerations for small municipalities. For example, populations under 75,000 may only need to comply with the nine minimum controls, public participation, and sensitive areas portions of the policy.

2.2.1.1 U.S. EPA Regional Combined Sewer Overflow Policy Interpretation

Some variability exists among U.S. EPA regions with respect to CSO policy interpretation; however, much of the variability may be from the interpretation of the federal CSO policy by delegated states. For example, 91% of the CSO discharges throughout the U.S. are in EPA Regions 1, 2, 3 and 4; all of these CSO states have delegated program authority. However, the EPA regions are required to oversee these states, so it is likely that these regions generally acknowledge and try to accommodate the states' interpretation of the federal CSO policy. For example, within Region 1 there is significant variability in state interpretation. Maine and Massachusetts, for example, do not recognize the presumptive approach. Some of the more obvious differences among the EPA regions are with respect to the use of modeling and certain control technologies and in the implementation of the NMCs versus a LTCP. These differences are often dependent upon the individuals involved and their comfort level with approaches and technologies. To reduce this variability, U.S. EPA produced a memorandum for the purpose of discussing the federal CSO policy and identifying areas where heightened efforts are needed. This memorandum can be found in Appendix B.

2.2.2 States Combined Sewer Overflow Policy

The federal CSO policy has shifted the burden of implementation from the federal government to the states. Of the 33 CSO states and Washington D.C., 30 states submitted CSO permitting strategies consistent with the 1989 federal draft CSO policy and received U.S. EPA approval, while one state received conditional approval. U.S. EPA serves an oversight role for these delegated states, and EPA regional offices bear the burden of permitting for non-delegated states.

The delegated states and U.S. EPA regional offices, as appropriate, are designated authority to implement the CSO policy. In the case of the delegated states, CSOs are permitted through a SPDES that follows the federal CSO policy and additional state requirements. It is the responsibility of SPDES authorities to ensure permits meet the requirements of the Clean Water Act, and that CSO permittees develop long-term CSO control plans, where appropriate. Additionally, they are responsible for coordinating review of the long-term CSO control plan and permit development in association with the states authority to determine if specific revisions to water quality standards are needed. Water quality standards are state or federal requirements which serve as the legal basis for the water quality- based NPDES permit requirements under the Clean Water Act. Water quality standards consist of state-designated uses for water bodies and the criteria to protect these uses.

A summary of several of the state and EPA region CSO requirements is provided below. This summary is not intended to address all CSO programs, but rather to provide the reader with an idea of the federal policy implementation variability throughout the United States.

New York is a delegated NPDES state; therefore, SPDES permits are issued in accordance with the state's CSO control strategy and the federal CSO policy. The state's CSO control strategy encompasses two major elements, BMPs and additional control measures. New York has 13 BMPs that are equivalent to the NMC measures specified in the federal CSO policy. Additional control measures are water quality-based permit requirements that are necessary for SPDES permittees unable to mitigate serious water quality problems through the BMPs alone. These measures are equivalent to the LTCPs specified in the federal policy.

Indiana has three submittal requirements for its CSO discharge permit requirements that include (1) technology-based controls that meet the requirement of the federal NMC measures, (2) a stream reach characterization that exceeds the NMC measures, and (3) a cost-benefit analysis of alternative CSO abatement controls. The use determination in Indiana is "fishable and swimmable."

Illinois has a CSO policy more stringent than the federal presumption or demonstration approaches. Complete treatment is required for flows produced by the 1-year, 1-hour storm with a peak of 1.2 inches per hour (in./hr). Flows in excess of the specified storm must receive primary treatment sized at 10 times the dry-weather capacity. Illinois was very progressive; CSO regulations have existed there since 1962, and many of the CSO communities used Construction Grant monies to fund their CSO abatement in the 1970s.

Ohio also is implementing the federal CSO policy through the NPDES permit program. Ohio has 92 CSO communities, of which 70 have populations of less than 10,000. Most Ohio CSO communities are required to implement the NMC measures; however, several small communities are spending their money on sewer separation projects instead of implementing the NMCs. Approximately 50% of Ohio's CSO communities have implemented LTCPs, are in the process of implementing them, or have requirements to do so in their permits. Many communities are being asked to characterize and monitor before developing a LTCP (Hun, 1998).

Some delegated states have very few CSO communities. For example, California has two CSO communities (Sacramento and San Francisco) and Virginia has four CSO communities. California's CSO policy was developed solely for San Francisco and included control of CSOs to specified frequencies, capture of floatables, measuring water quality, and implementation of the NMC measures. Virginia's CSO communities were only required to implement the NMC measures.

In contrast to these other states, Iowa, Kansas, Missouri, and Nebraska are not delegated states and are therefore represented by EPA Region 4. Most cities in Region 4 have separated sewer systems; therefore none of the states accepted the responsibilities of program authority. Because CSOs are not an extensive problem, Region 4 has focused most of its efforts on WWTPs. The only CSO requirement is to provide technology-based controls. No LTCPs are required.

2.2.3 Canada Combined Sewer Overflow Policy

The Ministry of Environment and Energy CSO regulations is entitled *Determination of Treatment Requirements for Municipal and Private Combined and Partially Separated Sewer Systems*. These regulations are similar to those set forth in U.S. CSO policy. The Ministry of Environment and Energy regulations require a pollution prevention and control plan which is similar to the LTCP, implementation of minimum SSO controls that are similar to the NMCs, and a minimal level of treatment.

2.3 Sanitary Sewer Overflows

Sanitary sewer overflows are the result of the unplanned relief of a sewer system intended only for sanitary sewage. An SSO typically occurs when the flow exceeds the carrying capacity of the system, and although SSOs can, and do, occur during dry weather, they are most commonly associated with wet weather events. SSOs are caused by a variety of system faults, exacerbated by excess wet weather flows. These causes include (EPA, 1996b):

- rainfall or snowmelt entering the subsurface and subsequently entering the sewer system through defective or deteriorated pipes, joints, manholes, or connections. This is known as infiltration;
- stormwater entering the sewer system through illegal or unintentional connections. This is known as inflow. Together infiltration and inflow are referred to as rainfall-induced infiltration and inflow (I/I);
- pumps and sewers too small to handle the increased flows created by urbanization; and
- faulty equipment, power failures, blocked or broken sewers, and other acute system failures.

Although a large number of SSOs occur in the collection system, they may also occur at the WWTP. Wastewater treatment plants are often not capable of handling the excess flows that occur during large storms. As a result, the WWTP must allow some of the flow to bypass treatment and discharge directly into the receiving waters.

Regardless of the cause or location of the SSO, the end result is that untreated sewage is introduced in an uncontrolled manner into the environment, leading to concerns for public health and safety. The health, social, and economic costs of SSOs are significant. The health and environmental risks attributed to SSOs are a function of several factors including location and season, discharge frequency, discharge volume, the amount and type of pollutants present in the discharge, and the uses, conditions, and characteristics of the receiving waters (SSO Federal Advisory Subcommittee, 1996). The most serious health risks associated with SSOs involve discharges to water bodies and other areas with a potential for human contact. In addition, SSOs, along with other sources of pollution, impair or damage water bodies for one or more uses such as drinking water, swimming, fish and wildlife habitat, and non-contact recreation. Areas heavily affected by chronic and uncorrected SSOs can experience social and economic losses due to widespread health issues, beach closures, reduced property values, a reduced sense of community, reduced tourism, and loss of recreational opportunities, among others.

There are more than 18,500 sanitary sewer systems in the U.S.. All are capable, under the right circumstances, of producing SSOs (EPA , 1996a). In a 1994 survey conducted by the Association of Metropolitan Sewerage Agencies, 79 members reported SSO problems (AMSA, 1994). Another study estimated that SSOs closed beaches for 300 days in the U.S. during 1994 (National Resources Defense Council, 1995). The U.S. EPA noted that over 1,000 systems in the U.S. experience SSOs (EPA , 1997). While difficult to quantify precisely, it is clear that the sanitary sewer overflows are a widespread issue.

2.3.1 Federal Sanitary Sewer Overflow Policy

The Clean Water Act is the central piece of legislation governing the quality of the nation's waters, including SSOs (EPA , 1999). SSOs are point source discharges of pollutants and must be permitted. This is true for overflows that are released directly into a surface water or indirectly through subsurface flows or through streets and then into a storm drainage system. Operators of systems with SSOs not authorized by an NPDES permit must either eliminate the SSOs or seek a permit.

At this time standards for controlling SSOs are uncertain (EPA , 1999). The Clean Water Act requires secondary treatment for all publicly owned treatment works (POTWs) (i.e., WWTP). For all other point-source discharges, the Clean Water Act requires "best available technology economically achievable" for toxic and non-conventional pollutants and "best conventional pollutant control technology" for conventional pollutants. The system that conveys wastewater to a WWTP is included in the regulatory definition of a POTW, and thus it could be inferred that SSOs from these systems must meet the secondary treatment standard. However, the U.S. EPA has decided that for combined sewer systems, "bypasses" can occur at a WWTP after primary treatment; thus CSOs are not subject to the secondary treatment standard. Where SSOs fall in this quandary has not been decided.

A logical SSO control policy might be based on current CSO control policy. However, there are significant differences between CSOs and SSOs that preclude the direct application of the CSO Control Policy. The key differences are (U.S. EPA , Region 6, 1995):

- sanitary sewers have no diversion and discharge structures designed into the system to release the excess flows to receiving water bodies at controlled discharge locations; and
- the overflows in sanitary systems occur through manholes and defective lines, releasing the flows indiscriminately throughout the system.

Since there are no centralized discharge points in a sanitary system, the application of the technology-based and water quality-based standards of the Clean Water Act is difficult. However, if system improvements can be implemented to contain and divert SSOs to centralized locations, the differences between SSOs and CSOs lessen and a CSO-type approach becomes feasible. (The National CSO Control Policy is described in Section 2.2.1)

In 1994, the general lack of clarity and consistency in the nationwide approach to SSOs led a number of municipalities to approach the U.S. EPA Office of Water and ask that an advisory committee be formed to make recommendations on how to apply the NPDES program to SSOs. As a result, the SSO Federal Advisory Subcommittee was formed and began meeting in late 1994. The subcommittee was instrumental in developing draft federal SSO policy. This policy was documented as a new chapter in the EMS Guide on March 7, 1996. This chapter, "Setting Priorities for Addressing Discharges from Separate Sanitary Sewers," established guiding principles and priorities for the various EPA regions and NPDES delegated states in responding to separate sanitary sewer discharge violations (EPA, 1996a). This chapter is presented in Appendix C.

2.4 Stormwater

Stormwater is water from precipitation that flows across the ground and pavement when it rains or when snow and ice melt. The water seeps into the ground or drains into a storm drain system and discharges without treatment into streams, lakes, and estuary ecosystems.

Stormwater runoff contains pollutants that are collected as rainwater or snowmelt flow across the ground surface. Such pollutants include oil and grease, chemicals, nutrients, heavy metals, bacteria, viruses, and oxygen-demanding compounds.

Stormwater pollution has many sources. Three general source types are residential, industrial, and construction. The most common residential sources are from building materials (especially metal flashing), fertilizer and other landscape chemicals, pet waste, and pollutants associated with the use of automobiles. At industrial sites, chemical spills that contain toxic substances and uncovered or unprotected outdoor storage or waste areas can contribute pollutants to SW runoff. During construction, chemicals and materials can wash into ditches leading to waterbodies during rainy weather. Inappropriate discharge of sanitary and industrial wastewaters into storm drains can also contribute to the pollutant load of SW flows during dry periods. Environmental degradation associated with SW runoff may be magnified due to hydraulic changes in a developed area. When undeveloped land is urbanized, much of the land surface is paved with impervious materials (buildings, asphalt, and concrete). This increases the runoff volumes and rates during rains and decreases the receiving water flow during dry weather.

Regardless of the source of SW, the end result is that polluted water is introduced into the environment and leads to concerns for public health and safety. The U.S. EPA has identified urban runoff as one of several potential sources of more than 1,000 toxic organics that have been detected in drinking water supplies (45 FR 77870). Studies have also detected increased salt concentrations in shallow groundwater in areas where large quantities of salts are used on roads for ice control (Terry, 1974).

2.4.1 Federal Stormwater Policy

In 1973, U.S. EPA promulgated its first SW regulations in the form of an exemption. Any conveyances carrying SW runoff uncontaminated by industrial or commercial activity were exempt from the NPDES regulations. However, the Natural Resources Defense Council brought suit in the U.S. District Court for the District of Columbia, challenging the agency's authority to create such exemptions. The court ultimately held that U.S. EPA could not exempt discharges identified as point sources from regulations under the NPDES permit program.

Subsequently, U.S. EPA issued a rule in 1976 establishing a permit program for all SW discharges except for rural runoff uncontaminated by industrial or commercial activity. What followed was a series of suits brought by major trade associations and their member companies, a process that culminated in the NPDES Settlement Agreement in 1982.

During U.S. EPA 's evaluation of appropriate changes, Congress passed the Water Quality Act of 1987 (WQA) which amended the Clean Water Act of 1977 and included specific provisions related to SW.

The directives of the 1987 WQA were threefold. First, Congress specifically directed U.S. EPA to address SW discharges under the NPDES program and established statutory deadlines for the initial phases of the program. Second, Congress affirmed that SW discharges from industrial sites must be issued NPDES permits, and that the full panoply of traditional NPDES permit requirements, including technology-based and water quality-based standards, must be applied. Third, Congress established slightly different permitting requirements and standards for municipal SW discharges than for industrial SW discharges, including the new "maximum extent practicable" standard.

Through the WQA and amendments to the Clean Water Act, a two-phased approach addressing SW discharges was developed. A brief summary of the municipal SW portion of this policy can be found in Appendix D. Phase I, currently being implemented, requires permits for separate SW systems serving large- and medium-sized communities (those with over 100,000 inhabitants), and for SW discharges associated with industrial and construction activity involving at least five acres.

Phase II, which is currently under development (finalized Oct. 29, 1999), would expand this existing national program to smaller municipalities and construction sites that disturb 1 to 5 acres. In this expansion, U.S. EPA is proposing to allow certain sources to be excluded from the national program based on the lack of impact on water quality, as well as to pull in other sources not regulated on a national basis based on localized adverse impact on water quality. Finally, U.S. EPA is proposing to conditionally exclude from the NPDES SW program industrial facilities that have "no exposure" of industrial activities to SW, thereby reducing application of the program to many industrial activities currently covered by the program that have no industrial SW discharges.

2.4.2 States Stormwater Policy

Federal policy for SW management has also shifted the burden of implementation from the federal government to the states. Through the WQA and amendments to the Clean Water Act, a two-phased approach addressing SW discharges has developed. All states must follow guidelines that are no less stringent than the NPDES permit guidelines.

A summary of several state and regional SW management programs is provided below. This summary is not intended to address all SW programs, but rather to provide the reader with an idea of the federal policy implementation variability throughout the United States. A more detailed documentation of state SW policy can be found in Appendix E.

In response to U.S. EPA's SW policy, many states have imposed additional requirements. California is an U.S. EPA NPDES-delegated state with permitting authority that has instituted many more stringent requirements. For example, a regulated SW area is considered individually from the property's primary activity (the vehicle service area at a school would be considered a transportation area, requiring permitting). Point source guidelines are also more stringent (sheet flow from parking lots is considered a point source requiring a permit).

In contrast to California, Maine does not have NPDES permitting authority. However, the Maine Department of Environmental Protection Bureau of Land and Water Quality wrote the Natural Resources Protection Act that is used to protect the quality of the receiving waters by imposing additional regulations to those prescribed by the U.S. EPA . Proposed construction projects require permits directing adherence to SW quality and quantity standards.

Similar to the U.S. EPA guidelines, some states have imposed numerical standards. Hawaii, an NPDES- delegated state with permitting authority, requires that permitted discharges must comply with the state's basic water quality criteria. These criteria include prohibited substances. Discharges must conform to specific concentration allowances and cannot contain pollutants in 24-hour average concentrations greater than the values obtained by multiplying the minimum dilution by the acceptable standard. In addition, BMP plans must be implemented for construction SW runoff controls.

Arkansas has also established numerical guidance in addition to the U.S. EPA's guidelines. For example, coal pile runoff should not exceed 50 milligrams per liter (mg/L) maximum suspended solids and the hydrogen ion concentration (pH) must be within 6-9 standard units (SU). Iowa also has this limit. The Arkansas Department of Pollution Control and Ecology has specifications for detention ponds and erosion controls. Required detention pond volumes and sizing are determined using a "simplified volume formula" or the "modified rational hydrograph method."

Colorado, an NPDES delegated state, also issues permits requiring adherence to numerical limits. In addition to the numerical control limits, control measures also govern reclamation, acid runoff from mines, drainage control, subsidence, and grading activities.

Some states take a watershed approach to SW management instead of the point source approach. In response to contamination of its groundwater supply by continued urban development, Austin, Texas, passed a watershed protection ordinance in 1981. The 1986 amendment to the ordinance specifies standards for development within critical watersheds. These include buffer zones, building restrictions on slopes greater than 15%, and required setbacks from springs, creeks, and sinkholes.

Wisconsin also uses the watershed approach towards SW management and control. In 1983, the state initiated its priority watershed protection program, which involves retrofitting nonpoint source controls in watersheds where point source controls alone cannot meet water quality objectives.

The SW utility was pioneered by the city of Bellevue, Wash. Many cities now have SW utilities modeled after Bellevue's, which uses natural drainage systems such as swales, lakes, ponds, wetlands, and detention ponds to transport and dispose of SW. The primary mission of the Bellevue storm drainage utility is to "manage the storm and surface water system, to maintain a hydrologic balance, to prevent property damage, and to protect water quality for the health, safety, and enjoyment of citizens and for the preservation and enhancement of wildlife habitat" (Bissonette, 1985).

2.5 History of Wet Weather Pollution Management Control Strategies

Throughout history, many strategies have been implemented to control wet weather pollution for reasons such as flood control, water quality improvement, aesthetic improvement, waste removal, and others. To provide guidance for developing communities, a reference manual for wet weather flow systems in newly urbanizing areas is being developed as part of a cooperative agreement among the Urban Watershed Management Branch of the U.S. EPA , the University of Alabama at Birmingham (Pitt, et al. 1997), and ASCE (Heaney, et al. 1997). The reference manual includes a historical summary of wet weather pollution management control strategies (Pitt, et al. 1997), which is presented in Appendix F.

CHAPTER 3.0

APPROACH

3.1 Essential Wet Weather Pollution Abatement Criteria

To provide a sound program for abating wet weather pollution, a community should adopt a multi-faceted approach which includes encouraging public participation; monitoring and modeling impacts, including the impacts on receiving water; examining the usefulness of a watershed approach; and looking at the cost-effectiveness of any proposed program. These considerations, along with the experiences documented in the benchmark matrices and case histories, can be used as a starting point to develop site-specific wet weather pollution abatement programs.

3.2 Questionnaire Development

The project team used role-playing activities to identify wet weather abatement criteria. Participants included EPA regions, state regulatory agencies, municipalities, and the public. Each role player was responsible for identifying respective abatement criteria. The role-playing provided information used to facilitate the questionnaire development and interview process.

The questionnaire was categorized into six sections, namely public participation, conveyance system information, watershed approach, water quality, issues driving technical considerations, and financial considerations. A copy of the questionnaire is included in Appendix G.

The questionnaire was sent to CSO, SSO and SW communities throughout the United States and Canada. These communities were originally identified through data provided by U.S. EPA and private consultants. The communities represent a range of geographical locations, population, economic bases, and abatement strategies and schedules. In general, communities were initially reached via a personal telephone call. If the contact expressed interest in participating, then a questionnaire was sent to the attention of that person.

The number of questionnaires returned was less than anticipated. Of the approximately 150 questionnaires sent to communities throughout the United States and Canada, only 50 were returned. (Appendix H contains the list of questionnaire contact persons.) Despite this low return rate, the communities that participated do represent a wide range of geographic locations, demographics, and abatement strategies and schedules. More importantly, they provided meaningful data for the purpose of allowing other communities to benchmark their own wet weather pollution abatement progress. Though the data presented in this report is not representative of communities who have not begun wet weather abatement, those communities may find Chapter 4, Essential Wet Weather Pollution Abatement Criteria, and the benchmark data (Chapters 5-7) very useful in planning and starting their abatement programs.

3.3 Benchmark Matrices and Case Histories

Benchmarking is the process of documenting existing experiences for the purpose of culling out best practices, innovative ideas, and highly effective operating procedures that could assist in developing effective solutions.

The benchmark matrices and case histories for CSO, SSO and SW communities provide data that may be useful to stakeholders seeking to improve their wet weather pollution abatement process. Information is provided in two forms: benchmark matrices and case histories.

Data from the questionnaires were tabulated to facilitate interpretation. CSO, SSO and SW benchmark matrices can be found in Chapters 5, 6 and 7, respectively. The matrices are categorized into five sections, namely, general community statistics, public participation, systems characterization, issues driving technical considerations, and financial considerations.

Case histories for CSO, SSO and SW were developed for a select number of surveyed communities that exemplify common approaches to wet weather pollution abatement. These communities provided meaningful data for the purpose of allowing other communities to benchmark their own wet weather pollution abatement progress.

A discussion of decision criteria used to determine benefits of CSO, SSO, SW abatement follows the benchmark matrices and case histories in each chapter.

CHAPTER 4.0

ESSENTIAL WET WEATHER POLLUTION ABATEMENT CRITERIA

4.1 Criteria Development

The following guidance issues provide a fundamental approach to abating wet weather pollution. These guidance issues, along with experiences documented in the benchmark matrices and case histories, can be used as a starting point to develop a site-specific, wet weather pollution abatement program. These issues include public participation, watershed approach, receiving water impacts, monitoring and modeling of impacts and cost effectiveness analysis. The issues are structured in the form of a methodology, and are organized in a sequential manner. For example, public participation, while not always the highest priority for a municipality, should at least be considered early in the abatement process to gain the greatest returns from the program. The watershed approach, receiving water impacts and monitoring and modeling of impact issues pertain to understanding and gathering meaningful information about wet weather pollution sources and their impacts in terms of the entire watershed. Once the pollution sources and impacts are identified, a cost effectiveness analysis may be used to select alternatives and prioritize capital projects. Figure 4-1 illustrates the general methodology.

4.2 Public Participation

Public participation is the process of seeking the views and concerns of stakeholders and including them in the decision-making process. It includes open information sharing, teaming with stakeholders, gaining public input, and solving problems jointly. Stakeholders are any citizens or groups who have an interest or stake in the outcome of a decision made by the municipality. In that sense, every taxpayer in the municipality is a stakeholder. Stakeholders include federal agencies, state and local governments, environmental groups, labor organizations, citizen's groups, and community members.

The following are guides to and benefits of public participation:

- Public involvement in the process should occur early and often. Public participation takes more time and effort up front, but will result in a better decision that is less controversial and requires less outreach, education, and defense.

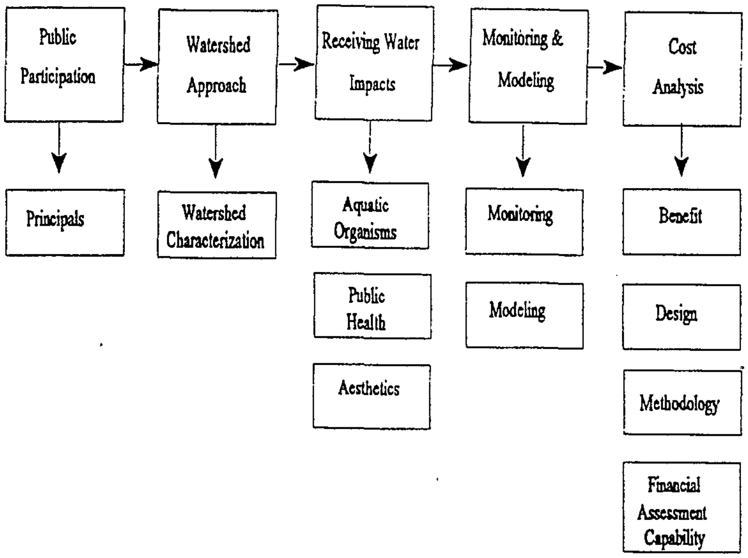

Figure 4-1. Wet Weather Issue Methodology Outline

- Public trust is earned through openness, outreach, consistency, and results. Public involvement is crucial to sound decision making. Public participation allows the municipality to enlist a much broader range of expertise than it has available in-house.
- Public dialogue increases understanding among all interests affected by decisions. Effective participation means two-way communication and the willingness of the public to take advantage of the various opportunities to participate. Public dialogue can aid both the regulated community and the public in understanding their individual expectations, resulting in more workable and widely acceptable solutions.
- Public input should be solicited from all sectors of society. Equal opportunity for comment and equal consideration of comments from the private and public sectors should be provided.
- The municipality should carefully consider all public comments, regardless of their origin, and provide a response through a comment and response document, not just an acknowledgment.

For the public to successfully participate in the decision-making process they should be informed of how and when they can get involved. The municipality should notify both the regulated community and the general public and ask for input regarding the wet weather pollution circumstances. There are many methods for obtaining public input. Each community and pollution scenario is different; therefore the most effective method, or combination of methods, should be selected on a case-by-case basis.

The following are a few methods of obtaining public input:

- *Advisory Committees.* An advisory committee is generally composed of volunteers from a wide range of occupations who are appointed by the municipality to represent the entire community. The committee generally serves as a sounding board for the public and an advisory board for the municipality. Advisory committees should be used to review technical documents and public comments and may also make recommendations to the municipality.
- *Notice and Advance Notice of Proposed and Final Milestone Decisions.* The advance notice of proposed and final decisions enables the municipality to solicit comments from the community prior to action. Information about the proposed and final decisions can be disseminated via quarterly newsletters, community newspaper articles, public service announcements, world wide web pages and local radio/television advertisements. These announcements should explain the status of the wet weather pollution abatement process and solicit input from the community. In addition, the municipality should distribute information and solicit comments through the appropriate advisory committee. In this way, the public has additional opportunities to comment on decisions, thereby developing solutions with greater community concensus.

- *Public Information Meetings.* The municipality should consider holding public information meetings on proposed decisions when it anticipates a need to inform the public on environmental impacts or explain a new wet weather pollution abatement scenario and respond to questions. Public meetings should be publicized using the forums listed above.
- *Public Hearings.* To receive comments on proposed decisions, the municipality should conduct public hearings, particularly when significant interest is generated by a proposal. These hearings should be used to officially record public comments. Public hearings should be scheduled at locations and times that allow for the greatest number of affected people to attend. Public hearings should also be publicized using the forums listed above.

4.3 Watershed Approach

4.3.1 Definition of Watershed Approach

Today's challenges require more comprehensive solutions to further restore and maintain the physical, chemical, and biological quality of our nation's waters. One such solution is the watershed approach, a coordinating framework for environmental management that focuses public and private sector efforts to address the highest priority problems within hydrologically defined geographic areas, taking into consideration both ground and surface water flow. The watershed approach has three key components:

- *Geographic Focus.* Watersheds are defined by natural boundaries. They are the areas that drain to surface water bodies. A watershed generally includes lakes, rivers, estuaries, wetlands, streams, and the surrounding landscape. Groundwater recharge areas are also considered.

- *Continuous Improvement Based on Sound Science.* Sound scientific data, tools, and techniques are critical to guide the process. Actions taken include characterizing priority watershed problems and solutions, developing action plans, and evaluating their effectiveness within the watershed.

- *Partnerships/Stakeholder Involvement.* Watersheds transcend political, social, and economic boundaries. Therefore, all affected interests should be involved in designing and implementing goals for the watershed. Watershed teams may include representatives from all levels of government, public interest groups, industry, academic institutions, private landowners, concerned citizens, and others.

4.3.2 The Urban Watershed

Within the watershed lies the urban watershed, a subset of the complete watershed bound by topography and city limits. It holds most of the population and contributes significantly to water quality problems.

At a minimum, the urban watershed includes, but is not limited to, SW runoff, sanitary- and combined-sewer discharges, and NPDES-permitted industrial and commercial discharges. Urban watersheds therefore include (1) all sources (point and nonpoint) originating within the urban center or urban fringe, and (2) water entering the urban watershed (surface and groundwaters entering from upstream sources, source waters supplying the urban population, and rain events). These contributions must be included to adapt to the situations exemplified by TMDL trading that allows upstream reductions to substitute for NPDES discharges. The urban watershed evaluation should also recognize the probability of the expanding urban geographic area as the national population is moving from the urban core to the surrounding areas.

4.3.3 Watershed Characteristics

The first step in abating wet weather pollution is to identify the sources and prioritize them before developing criteria for wet weather pollution abatement.

The most recent National Water Quality Inventory reports that runoff from urban areas is the leading source of impairments to estuaries and the third largest source of water quality impairments to surveyed lakes. Therefore, in characterizing a watershed, emphasis is placed on the subwatershed known as the urban watershed, even when the entire watershed may also include agricultural and suburban point and nonpoint pollution sources. The urban watershed can be characterized in three general categories: urban, environmental and infrastructure characteristics.

4.3.3.1 Urban Characteristics

The urban characteristics of a watershed may be illustrated by its physical properties, percent porosity and economic/social basis.

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The physical nature of the urban watershed such as size, topographic relief, and local hydrologic conditions will determine the runoff and erosion from the watershed. Characteristics such as land use and the creeks and storm drainage system in the watershed may be used to delineate sub-watersheds, so that different attributes of the watershed may be clearly differentiated and addressed.

Nonporous urban landscapes like roads, bridges, parking lots, and buildings do not permit precipitation to percolate into the ground. Water remains at the surface, accumulates, and runs off in large amounts. When leaving the system and emptying into a stream, it erodes streambanks, damages streamside vegetation, and widens stream channels, resulting in lower water depths during non-storm periods, higher than normal water levels during wet weather events, increased sediment loads, and higher water temperatures. Native fish and other aquatic life cannot survive in urban streams severely affected by urban runoff.

Urbanization also increases the variety and amount of pollutants transported to receiving waters: sediment from development and new construction; oil, grease, and toxic chemicals from vehicles; nutrients and pesticides from turf management and gardening; viruses and bacteria from sewer systems; and heavy metals from industrial activity. Sediments and solids constitute the largest volume of pollutant loads to receiving waters in urban areas. Toxins from wet weather pollution can generally be considered a primary concern in industrialized areas that are served by combined sewers.

4.3.3.2 Environmental Characteristics

The primary concern for wet weather pollution abatement is the receiving water that must support the fishable and swimmable goals set forth in the Federal Clean Water Act Amendments of 1972. The approach to plan development should address the identification of specific environmental features that are adversely affected by wet weather pollution.

The receiving water body is usually the primary focus of attention in defining the environmental characteristics. These characteristics include:

- size relative to loadings,
- type (river, sea, estuary, ocean, reservoir, etc.),
- seasonal changes (flow, temperature, and ice cover),
- physical factors (slope, velocity, mixing zones, pools and riffles, etc.), and
- beneficial uses (historical, present, and future).

Characterizing aquatic life helps identify what types of pollutants are of concern, as well as whether adverse impacts are expected to be seasonal, transient, or long term. Differentiation can initially be made between bottom organisms (subject to sediment accumulation) and water column organisms. If fish are of concern, the most sensitive type of fish should be identified to develop an approach to protect them. Important factors are:

- seasonal aspects (migration and spawning),
- transient variances in dissolved oxygen and in ammonia and other toxins,
- type and diversity of other organisms required, and
- relative importance of the physiology of the water body.

Bottom organisms are often more important to consider than fish and other aquatic life in the water column because wet weather pollution contains such a significant amount of settleable solids. These settleable solids account for a significant portion of the heavy metals and other toxins found in wet weather pollution. In addition, the deposition of inert particles can cover bottom organisms and adversely affect the environment. Wherever these solids settle, the impact can be long term, affecting both the water column and aquatic life.

There may be other constraints to realizing water quality improvements if only wet weather pollution is abated. One constraint is the effect of the bottom deposits from wet weather pollution that have accumulated previously. These bottom deposits might be classified as toxic, which complicates their removal and safe disposal; unless removed, they will continue to exert a significant oxygen demand, remain a source of toxicity in the food chain, and/or retard improvements to the fishery (spawning, bottom organisms, etc.).

Stream physiology may also be a constraint. Factors of importance include current velocity, water temperatures, bottom structure and shading for spawning, barriers to migration and movement, and diversity of aquatic organisms. Navigation uses may adversely constrain other uses perceived as beneficial. Recreational uses can be constrained by barge traffic, access limitations, stream physiology, and other pollutant loads.

4.3.3.3 *Infrastructure Characteristics*

Combined, separated and SW sewers are a significant component of a community's infrastructure. Development of a plan to abate wet weather pollution should thus include consideration of the collection system, WWTPs, and other related infrastructure components.

Some collection systems are 50 to 100 years old. Other systems were designed for a smaller population or a less impervious land than currently exists. Such issues can affect the conveyance capacity of these systems.

An assessment of the structural condition is important for two reasons. First, it may provide a rational basis for separating the sewer system, an abatement strategy used for CSO. Second, it may provide a basis for estimating the financial resources required to maintain the present level of service. Collapsed or clogged sewers will require investment to improve or maintain service.

In some urban areas, in addition to concern for the receiving water body, a significant public health and safety concern from basement and street flooding may also exist. Increasing conveyance capacity to mitigate basement and/or street flooding could have a major impact on developing a plan for wet weather pollution abatement. In some areas, the importance of protecting basements relative to street flooding could point the program toward sewer separation or use of inlet controls to avoid overloading.

Wet weather pollution abatement facilities may affect existing WWTPs and residual solids handling. Use of existing WWTPs as part of a wet weather pollution abatement plan will affect the amount of land available for future upgrading or expansion. Consideration should also be given to converting decommissioned WWTPs to wet weather pollution treatment plants rather than abandoning them.

Wet weather pollution abatement facilities will require careful consideration in siting; however, disruption during construction and interference with other utilities can be expected. Investigation of other urban improvements, such as road repairs or flood control, may lead to ways of mitigating disruption and interference by undertaking multipurpose projects. Coordination of construction activities with road or street surface improvements could be a major cost saving. In some areas it may be prudent to keep utility corridors free from obstructions or to coordinate general locations and depths of crossings.

4.4 Receiving Water Impacts

The specific receiving water impacts from wet weather pollution vary depending on the urban, environmental, and infrastructure characteristics. Depending on the particular combination of these factors, wet weather pollution impacts can be visible and intense. The size and type of the receiving water body determine its ability to dilute and assimilate intermittent wet weather pollution without toxicity. Therefore, receiving water impacts should be evaluated based on each site's particular characteristics. In each case, wet weather pollution impacts can be evaluated with respect to three basic considerations:

- water quality changes and effects on aquatic organisms,
- public health risks, and
- aesthetic deterioration.

4.4.1 Water Quality Changes and Effects on Aquatic Organisms

The wet weather pollution impacts on receiving waters depend on the rate and volume of the discharge, the degree of mixing and dilution, and the receiving water's assimilative capacity. Obviously, the larger the water body and smaller the discharge, the better likelihood of minimal impacts. For example, in some large rivers and estuaries, wet weather pollution has minimal impacts because of rapid dilution and mixing. In contrast, small streams that receive wet weather pollution with little dilution can be severely affected even for small storms. Therefore, solutions to wet weather pollution require site-specific monitoring and evaluation.

Most water quality impacts are measured by a determination of the increases (or decreases) in receiving water concentrations of toxicants as they relate to a violation of water quality criteria or standards. Such criteria are generally used to assess the potential for effects on aquatic organisms and impaired use. Although wet weather pollution is intermittent, the resultant problems may not be temporary and can persist to varying degrees. Figure 4-2 provides preliminary guidance for the time frames to be considered for different water quality problems. These different time frames can require different strategies for monitoring and calculating wet weather pollution impacts.

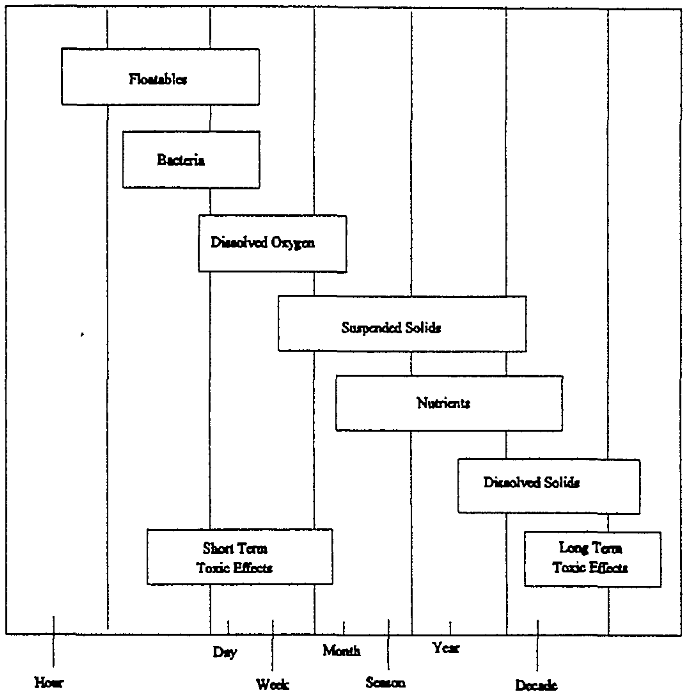

Figure 4-2. Time Scale for Wet Weather Pollution Water Quality Concerns (Moffa, 1997)

Dissolved oxygen levels, nutrient enrichment, sediment impairment, and toxicity are the major problems resulting from wet weather pollution.

Temporary depression of dissolved oxygen levels is a possible water quality problem attributable to wet weather pollution. Even though SW dilution minimizes the immediate impact, which generally lasts only hours, dissolved oxygen reductions may impair aquatic growth or reproduction and, in severe situations, cause biologic mortality. The severity, frequency, and duration of dissolved oxygen reductions caused by wet weather are dependent on the specific receiving water in question.

Nutrient enrichment from phosphorus and nitrogen is another potential problem resulting from wet weather pollution. Nutrient additions cause increased algae or aquatic weed growth. In turn, this may cause dissolved oxygen problems, reduce biological diversity, degrade aesthetics, or impair use for water supply. In fast-moving streams, nutrient contributions are typically flushed out before any impact can be realized, but in slower-moving water bodies the nutrients accumulate and assimilate into the biota. Sources of nutrients cannot easily be distinguished. However, performing relative comparisons of seasonal nutrient loadings at critical locations in the watershed can aid in the assessment of nutrient enrichment and eutrophication.

Another common problem from wet weather pollution is accumulated bottom-sediment contamination. Wet weather pollution typically has high levels of suspended materials that settle to the bottom in receiving waters. The accumulation and persistence of solids in sediments are typically long-term, not transient problems. The results can be high sediment oxygen demand due to biological oxidation and accumulation of toxic substances in the sediments. These conditions are usually present in slower-moving rivers, estuaries, or lakes, but not in fast-moving streams where sediments are routinely scoured from the bottom. Sediment criteria and standards for evaluating the severity of a problem are lacking. The U.S. EPA provides general guidelines for disposal of dredged sediments (EPA, 1997; EPA, 1977), but beyond these, the significance of sediment contamination should be evaluated on a site-specific basis.

Receiving water toxicity is the fourth general impact from wet weather pollution. In general, toxicity problems fall into two categories: (1) acute toxicity at higher concentrations, causing short-term mortality, or (2) chronic, long-term exposure to toxins, causing reduced growth and reproduction. Acute effects can often be observed as immediate fish kills or severely reduced biological diversity. Chronic effects are more subtle and harder to identify but at times can be observed by lower productivity and biomass (numbers of organisms), by bioaccumulation of chemicals, or by reduced biological diversity. Fortunately, chronic effects generally do not result from wet weather pollution because discharges are intermittent and infrequent in nature.

Toxic discharges from wet weather events can be a concern in industrialized areas served by combined sewers. Pretreatment programs are a good source of information to screen for potential toxicity from rainfall events. The more common toxicity concerns are for ammonia and dissolved trace metals, but concentrations generally are diluted enough to be of little concern. Preliminary screening for toxic effects can be performed using average dry weather discharge concentrations in combination with wet weather peak hourly flow rates for calculating a range of dilution. If such considerations are relevant to a site, then existing state and U.S. EPA water quality criteria are available for making preliminary assessments (EPA, 1986).

4.4.2 Public Health Risks

The major source of concern related to wet weather pollution, a concern in nearly all types of receiving waters, is the public health risk associated with diseases caused by pathogenic bacteria and viruses that may be carried in excrement. When people are exposed to contaminated receiving waters through wading, bathing, shellfish ingestion, and fishing, they risk becoming ill. Levels of bacteria observed in wet weather pollution varies. CSOs and SSOs have higher pathogenic bacteria counts than SW discharges; nonetheless, each type of discharge generally contains bacteria counts that are several orders of magnitude greater than applicable receiving water quality standards. For this reason, wet weather pollution can cause potential problems even in receiving waters with very high dilution. The potential risk is typically greatest at the beginning of a wet weather event, due to the "first flush" effect that delivers much of the waste that had accumulated during the preceding dry weather period. However, the risk can diminish quickly thereafter due to bacterial die-off, settling, and dilution. Significant public health risks from exposure to pathogens rarely persist more than two or three days after a storm overflow event. Wet weather pollution laden with bacteria is a special concern during warm weather when water contact recreation peaks and human exposure is greatest.

Protecting public health from exposure to microbial pathogens is complicated by the extreme difficulty in measuring concentrations of pathogenic organisms. For this reason, water quality standards are based on the presence of more easily measured indicator organisms. The most commonly used indicator of fecal materials has been fecal coliform bacteria, based upon work of the U.S. Department of Interior's National Technical Advisory Committee in 1968. Many state water quality standards are based upon this work, and consist of a standard of 200 fecal counts/100 milliliters (ml) for total body contact recreation, and 1,000 fecal counts/100 ml for partial body contact recreation. U.S. EPA revised these suggested numbers in 1986 to be based upon concentration of *Escherichia coli* and *enterococci*.

Generally, receiving water concentrations above 200-1,000 organisms/100 mL are considered to represent a greater disease risk. Concentrations of indicator bacteria in wet weather pollution usually number in the millions, and hence, dilution is rarely sufficient to eliminate all potential risk. Therefore, increased public health risks from wet weather pollution is a potentially serious issue. At times, the concern may be only transient and local (near discharge location), but in many systems the concern may extend for miles and days beyond the discharge. In all cases, wet weather pollution risks to public health should be given the highest priority.

4.4.3 Aesthetic Deterioration

Aside from physical/chemical contamination and public health risks, wet weather pollution can also impair the aesthetics of receiving waters. Wet weather pollution can contain an assortment of debris from runoff and wastes from sanitary sewage that are obvious and unsightly. Increased suspended solids, sanitary debris, plastics, floatables, and oils and grease are generally associated with wet weather pollution. Such debris is common to all receiving waters, but may persist for different periods depending on the current strength and dilution. Although aesthetic impairment may not reduce aquatic health or cause obvious human health risk, it does have socioeconomic significance. Debris and suspended solids from wet weather pollution can reduce recreational use and appreciation of receiving waters, thereby limiting recreational expenditures and near-shore development. Increased suspended solids can cause reduced water clarity, which also affects recreational use. Because aesthetics are typically an integral component of a water's designed use, aesthetic impairment can be considered a violation of water quality standards. Quantitative measures of aesthetic reduction are rare, but visual observations and resident interviews often adequately define the scope of the problem.

4.5 Monitoring/Modeling of Impacts

In every wet weather pollution abatement study, there is a recurring debate on the best means to define impacts and benefits of alternative control strategies. Should it be monitoring or modeling? Practically speaking, it is not an either/or decision, but rather how much of each. The two activities need to be balanced and designed for an integrated assessment. Monitoring is needed to identify existing problems, define baseline conditions, and support the development of reliable and verified mathematical models. Nothing provides stronger evidence of existing receiving water impacts than actual measurements and observations. However, monitoring alone has limitations; therefore, modeling should generally be used to complement monitoring and to forecast and analyze conditions other than those monitored.

4.5.1 Monitoring Impacts

Receiving water monitoring to document wet weather effects requires an integrated approach combining biological, chemical, and physical parameters, especially considering the biological community, the physical habitat, aesthetics, human health, contaminated sediments, and ambient water quality. Relying on water quality alone may be misleading. Monitoring programs should include initial wet weather pollution reconnaissance surveys involving a few stations downstream of a discharge and at least one station upstream. The reconnaissance monitoring should be conducted during seasons expected to encompass the most significant impacts and extend from a day before a storm to as much as four days afterwards. Parameters should include BOD, dissolved oxygen, temperature, bacteria, and other parameters suspected of having impacts, plus visual observations for debris and floatables. Occasionally, routine fixed-frequency monitoring data can be used to assess trends, the presence of impacts, and the periods or seasons when the receiving water is most susceptible to wet weather pollution. However, most often the timing of the fixed-frequency sampling does not coincide well with storm impacts. Therefore, surveys should be designed with this specific need in mind.

The reconnaissance surveys should be used as a basis to design more intensive surveys in terms of sampling location, duration, and frequency. Subsequent to the reconnaissance survey(s), at least two or three additional intensive surveys are recommended to better define impacts for different conditions and support model development. Often, impacts are only evident for large storms and not apparent for the smaller events. Hence, multiple surveys are recommended for defining the recurrence of problems and representing a fuller range of conditions.

In general, station locations and frequency for intensive surveys must be in sufficient numbers to clearly define spatial and temporal trends. Sufficient usually means sampling every 3 - 6 hours at stations located with time of travel between locations of approximately 6 - 12 hours. In rivers, the sampling logistics are the simplest because all impacts flow downstream. Station locations and timing are easy to define. For estuaries, choosing station locations is still relatively easy, but consideration of tidal movement and timing becomes important. Sampling at fixed times in each tidal cycle (usually a slack) are most desired to help standardize analysis and presentation of the data. For lakes, timing is less difficult, but station locations are more difficult to select due to multidimensional and sometimes erratic transport. In lakes, drogue or current studies can be used to define current transport. The circulation patterns in a lake may vary depending on wind stratification and other variable factors. Therefore, a network of lake stations should be set up to encompass the probable horizontal and vertical transport directions. Preliminary data can be used to refine the sampling network. Also, reconnaissance data may show minimal localized effects, in which case coarse whole-lake sampling may be more appropriate than a localized network. In all cases for rivers, estuaries, and lakes, the reconnaissance sampling is indispensable for defining adequate station locations and sampling frequency.

The sampling parameters should focus on the anticipated wet weather pollution related problems. However, all wet weather pollution impact surveys should routinely include measurement of bacteria, dissolved oxygen, BOD, and ammonia. Temperature and visual observations of cloud cover, sunlight, water transparency, floatables, debris, and other conditions are inexpensive and should also be routine. Daily composites are usually suitable for other parameters such as nutrients and chlorophyll. Toxic substances, such as trace metals, typically need only be measured immediately before the storm to define pre-storm conditions, immediately after the storm to define maximum impacts, and at the end of the survey to determine persistence. Diurnal dissolved oxygen variations due to photosynthetic activity can be very important and, if present, generally dictate the need for continuous monitoring and/or station measurements at 3-to-5-hour intervals. Photosynthetic activity can often confuse or mask the interpretation of wet weather pollution impacts on dissolved oxygen, especially since a reduction in both sunlight and photosynthesis usually accompanies storms. Therefore, if high productivity is present, careful evaluation of diurnal and light conditions is essential.

Some special note should be made concerning the scheduling of storm event monitoring. Obviously, it is impossible to "plan" for storms to occur conveniently for sampling, and it is also generally impractical to use automatic samplers for the receiving water. Therefore, a well-developed mobilization plan is essential to capture immediate post-storm impact, since impacts related to solids, bacteria, and toxins are best captured immediately after the storm, during the first flush of pollutants from the sewers. Weather forecasting services and routine fixed-frequency monitoring programs can also be valuable sources of pre-storm data and for identifying cumulative impacts.

4.5.2 Modeling Impacts

With data in hand, the planner/engineer can proceed to more fully analyze a wider range of conditions after developing and calibrating a mathematical model. Models are well suited for providing information not available from data alone. In particular, models can be used to simulate water quality for conditions not monitored. This could include larger, more intense storms, or more critical environmental conditions such as lower stream flow. It is generally infeasible to simply extrapolate to non-monitored conditions from data due to the large number of variable factors without the use of modeling. Modeling incorporates the mechanistic factors of a relationship, thus enabling more reliable projections under various conditions. The advantage of modeling is that virtually all such conditions can be assessed quickly. Furthermore, models can be used to examine impacts and benefits from proposed control strategies.

4.6 Cost-Effectiveness Analysis

In simple terms, a cost-effective solution is one in which the most value is received for money expended. When benefits are plotted against costs, the break, or the "knee" of the curve, is that point where additional benefits result in more rapidly rising unit costs, or the period beyond which there are diminishing returns, as illustrated by Figure 4-3. This approach becomes particularly important in light of the dwindling nature of federal and state monies and the greater reliance on local monies. Local authorities will require more information on the return on a major investment to improve water quality when making a decision regarding abatement alternatives.

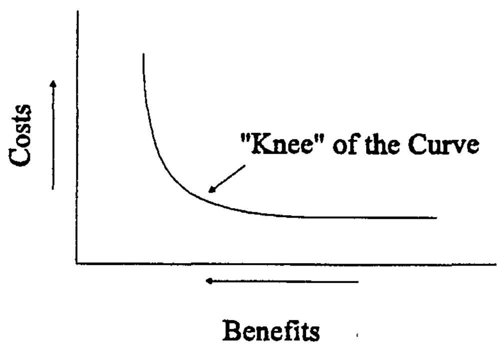

Figure 4-3. Cost-benefit Knee of the Curve

4.6.1 Benefits

There are four general methods for estimating benefits of water quality management projects (EPA-625/4-79-013):

1. The first method assumes that benefits will automatically be realized from the proposed activity and are large enough to justify the allocation of required resources. It completely avoids the benefit measurement problem. An example of this method is the federal requirement for secondary treatment at POTWs (i.e.,WWTPs).
2. In the second method, certain water quality standards are associated with the protection of water uses. Once standards to protect desired beneficial uses have been established, the comparison of projected water quality with the standards provides an estimate of benefit.
3. In the third method, estimates of increased water use potential are developed by translating improvements in water quality into numerical increases in usable length of beaches, swimming days, fishing days, or waterfront property values, to name a few possibilities. This method is, in effect, a refinement of the water quality standards approach, allowing benefits to be estimated directly.

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4. The best known method is the classical cost-benefit analysis. In this method, each anticipated water usage has a dollar value assigned as a measure of unit worth or willingness to pay. The actual project usages are multiplied by the corresponding unit values, and the sum is compared directly to total project costs.

The first approach is unacceptable for wet weather pollution control planning because the benefits are not obvious; they are highly contingent on both SW volumes and the receiving water. The second approach poses a near-impossible situation for regulatory agencies to address, particularly during storms when the overflow and receiving waters are both changing rapidly. Using the second and third approach together (i.e., relating mandated water quality requirements to lost resources and real benefits of recovery) appears to offer the most effective means of obtaining approvals and funding from all levels. The fourth approach involves a great deal of subjectivity and could result in lengthy dialogue over the unit worth of various usages on both the local and regulatory levels.

4.6.2 Design Conditions

Once data are gathered and modeling is performed to characterize wet weather pollution and identify water quality impacts, a basic decision becomes necessary: What combination of storm event and receiving water conditions should be selected for abatement? To answer this question, the joint probability of a specific storm occurring at a specified receiving water stage must be understood. For example, a 1-year storm occurring during a high river stage condition may easily exceed a once in 10-year occurrence. Thus, it becomes necessary to review rainfall records in combination with receiving water flow records before selecting design conditions.

4.6.3 Methodology

This section outlines a general methodology for determining cost-effective solutions. The general approach for analysis of wet weather pollution abatement is illustrated in Figure 4-4.

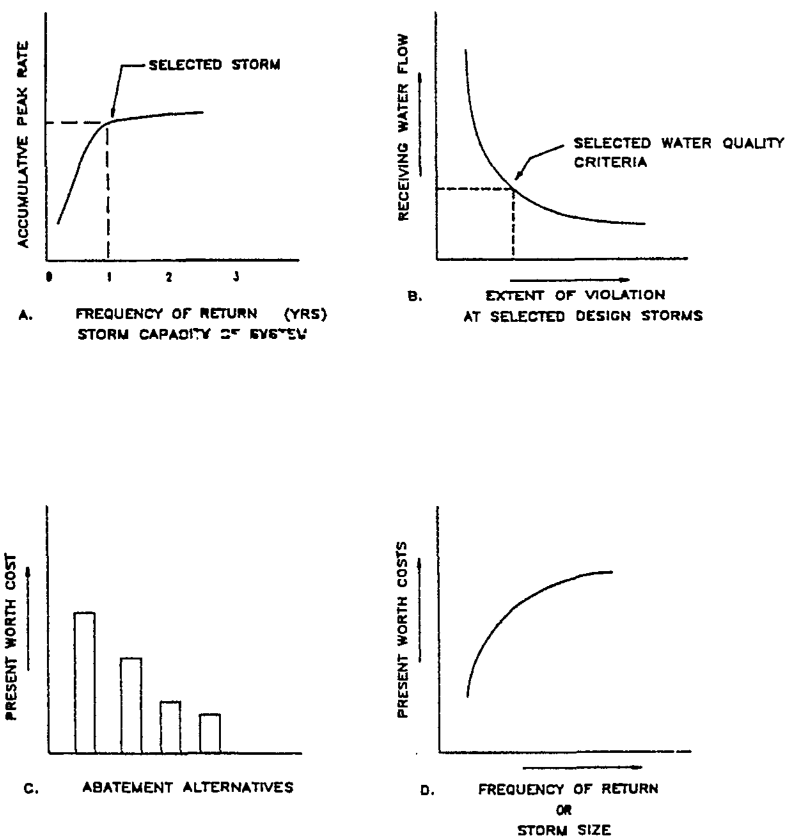

Figure 4-4. General Approach for Cost-Effective Analysis

Subfigure A illustrates the relationship between total volume discharged from a system and accumulative peak rate versus the storm size in terms of frequency of return. Generally, frequency of return is based on a constant duration such as two hours and varying rainfall intensity. The Storm Water Management Model (SWMM) can be used to develop total volume discharged, which represents total discharges irrespective of their location. This model is valid for developing a uniform set of design conditions throughout a system. In large systems with a wide range of receiving water types (e.g., small streams and large bays), it may be desirable to develop this relationship for each specific water body. Such a curve can also be developed for an accumulative peak rate, which is the summation of peak rates of all discharges at a given frequency storm, irrespective of the timing of the peak. This parameter is an indication of the peak carrying capacity of the system and complements the plot of total volume. These data can then be plotted to yield a curve as illustrated by Subfigure A, which can be used to designate the "selected storm" storm condition. At some storm frequencies, the system can no longer accept more SW flow, resulting in street ponding and either subsequent discharge to the system or evaporation or infiltration into the ground.

Subfigure B illustrates the relationship between receiving water flow and the extent of violation at the selected design storm (e.g., 1-year frequency of return). This relationship must be plotted for each of the water quality parameters of concern. This particular curve is more illustrative of the relationship for bacteria where the degree or extent of violation increases as the dilution from water flow decreases. At some point in the decision-making process, a receiving water flow must be selected which is reasonable when combined with the probability of the particular storm frequency chosen. A reasonable receiving water flow might represent the dry months of July, August, and September, when the highest intensity storms are expected. Once the evaluation for each of the water quality parameters is performed, the required removals can be determined.

Subfigure C, given the removals required, can then be developed on the basis of specific abatement technology. Various abatement alternatives that would accomplish the same reductions can be evaluated with respect to present-worth costs. Costs have been selected merely as a comparative term. In many cases, the Y-axis may represent a combination of regulatory, institutional, and local requirements, in addition to costs.

Subfigure D, given the selected abatement alternative, is a plot of the variation of different-sized facilities for that alternative, as required to treat different sized storms against the relative costs. In this way, a final evaluation of the most cost-effective sized facility can be determined.

4.6.4 Financial Capability Assessments

A community's financial capability is particularly necessary in the case of wet weather pollution abatement because there are no clear standards in most states, and the selection of a "design" storm has become a subjective decision based upon cost-benefit relationships. Additionally, other pollutants from a watershed may preclude the attainment of the fishable-swimmable goals of the Federal Clean Water Act Amendments of 1972.

A community's financial capability may be assessed by identifying the following seven factors:

1. median household income,
2. total annual wastewater and wet weather pollution abatement control costs per household as a percent of median household income,
3. overall net debt as a percent of full market property value,
4. property tax revenues as a percent of full market property value,
5. property tax collection rate,
6. bond rating, and
7. unemployment.

In 1996, the U.S. EPA released a draft guidance document on economic capability for communities with CSOs. The document, "Draft CSO Guidance on Financial Capability Assessment and Schedule Development," established boundaries for compliance schedules for CSO communities implementing U.S. EPA's national CSO policy. Although this information was written with respect to CSO, it is applicable to all wet weather pollution.

The following is a summary of the guidance developed by the CSO Partnership (The CSO Bulletin, April 1996).

The guidance proposes a two-step approach for calculating economic capability. The first step focuses on the financial impact of current and proposed wastewater and CSO controls on individual households. The second step examines the debt, socioeconomic, and financial condition of a CSO community. The results of both steps are then combined into a "Financial Capability Matrix" which is used to assess the financial burden attributable to CSO controls and to establish what U.S. EPA views as appropriate compliance schedules.

The first step calculates a residential indicator (RI), a measure of the CSO community's average cost per household for existing and proposed wastewater treatment and CSO controls, expressed as a percentage of local median household income (MHI). The guidance proposes establishing three ranges for RIs with RIs of less than 1 percent MHI characterized as imposing a "low" financial impact, RIs from 1 or 2% of MHI imposing a mid-range impact and RIs above 2% of MHI imposing a high impact.

The second step considers a community's financial capability indicators. U.S. EPA specifies six proposed indicators in the guidance for evaluating community debt, socioeconomic, and financial conditions that affect a community's financial capability to implement CSO controls. The results of the six indicators are used to classify the community's financial capability as "weak," "mid-range," or "strong."

The results these two steps are then combined in a financial capability matrix that provides the basis for the permittee and NPDES permitting authority to negotiate an appropriate compliance schedule. The financial capability matrix divides communities into three categories based upon their calculated burden under the guidance (low, medium, or high), with equal weight given to the community's RI and financial capability indicators.

Finally, the guidance proposes the following general boundaries for compliance schedules based upon a community's calculated burden:

Low burden:	0 - 5 year compliance schedule
Mid-range burden:	5 - 10 year compliance schedule
High burden:	10 - 15 year compliance schedule

According to the U.S. EPA guidance, communities in the "High burden" category may be able to negotiate compliance schedules as long as 20 years.

The lack of supporting information to explain and justify U.S. EPA's selection of the residential indicator categories and the financial capability indicator categories will make it difficult to evaluate whether the proposed categories are appropriate for CSO communities nationwide. For example, U.S. EPA does not provide any discussion of the number of CSO communities that can be expected to fall into the three categories proposed in the Financial Capability Matrix (low, mid-range, or high burden). Also, it is unclear how U.S. EPA arrived at its proposed ranges for the compliance schedules for communities falling within the three categories of financial burden.

An example of how a financial analysis can be performed is illustrated in the case history of Syracuse, N.Y. (Section 5.2.5).

CHAPTER 5.0

CSO Benchmark Data and Case Histories

5.1 Benchmark Data for CSO Communities

The following section includes benchmark matrices for general CSO community statistics (Table 5-1), CSO public participation (Table 5-2), CSO systems characterization (Table 5-3), issues driving CSO technical considerations (Table 5-4), and CSO financial considerations (Table 5-5).

5.2 Case Histories for CSO Communities

Case histories for CSO communities include Atlanta, Ga., Augusta, Me., Decatur, Ill., San Francisco, Calif., and Syracuse, N.Y. Each community represents an important and distinct element of the CSO abatement process. For example, the Atlanta case history highlights CSO policy interpretation, Augusta highlights the cost-benefit analysis, Decatur highlights one of many technical approaches, San Francisco highlights the evolving funding basis for CSO abatement, and Syracuse highlights a staged construction approach that meets the presumption and demonstration approaches of the federal CSO policy.

CSO Community Characteristics

♦ Population	700,000
♦ CSO Area	> 10,000 Ac
♦ Annual Rainfall	50"
♦ # of Discharge Points	7

Distinctive CSO Community Attributes

- Existing natural drainageways used as original sewers
- Intensive legal negotiations
- CSO policy interpretation

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Table 5.1 CSO Community Statistics

City	Astoria, OR	Atlanta, GA	Auburn, NY	Augusta, ME	Buffalo, NY	Chicago, IL	Cincinnati, OH	Cleveland, OH	Columbus, GA	Decatur, IL	Detroit, MI (Detroit R.)	Detroit, MI (Rouge R.)	Gardiner, ME	Hartford, CT	Louisville, KY	Mt. Clemans, MI	Newport, RI	New York City, NY	Portland, OR	Rochester, NY	Rockland, ME	San Francisco, CA	Seattle, WA	Syracuse, NY	Washington, D.C.	Winnipeg, Manitoba
Receiving H2O Type																										
Estuary	◆																◆						◆		◆	
Harbor																	◆	◆			◆	◆	◆			
Lake					◆	◆		◆		◆										◆						
Ocean / Bay																						◆	◆			
River	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆			◆		◆	◆
Stream		◆		◆				◆	◆				◆										◆	◆		
Population																										
<500,000	◆		◆	◆	◆				◆	◆			◆	◆	◆	◆	◆		◆	◆	◆			◆		
500,000 - 1,000,000		◆					◆	◆			◆	◆											◆		◆	◆
>1,000,000						◆												◆				◆				
CSO Area																										
<1,000 Ac			◆	◆									◆								◆					
1,000- 10,000 Ac	◆								◆	◆						◆	◆			◆				◆		
>10,000 Ac		◆			◆	◆	◆	◆			◆	◆		◆	◆			◆	◆			◆	◆		◆	◆
Annual Rainfall																										
0-20"																										◆
20-30"																						◆				
30-40"			◆			◆		◆			◆	◆				◆				◆			◆	◆	◆	
40-50"		◆		◆	◆		◆		◆	◆			◆	◆	◆		◆	◆	◆		◆					
> 50"	◆																									
# of Discharges to Public Waters																										
<10		◆	◆							◆			◆				◆			◆	◆					
10-50	◆			◆					◆		◆	◆		◆		◆						◆				
50-100					◆														◆				◆	◆	◆	◆
>100						◆	◆	◆							◆			◆								
Annual Wet-Weather Discharge Qty.																										
<10 MG													◆			◆	◆			◆						
10-100 MG			◆	◆																	◆					
100-1,000 MG	◆									◆													◆			
>1,000 MG		◆			◆	◆	◆	◆	◆		◆	◆			◆			◆	◆			◆		◆	◆	◆
Not Answered														◆												

Questionnaire Date: July 1998.

5.2.1 Atlanta, Ga.

Atlanta is a typical case where small, intermittent streams and rivers evolved into combined sewers. Before the city developed, these streams flowed from what is now the center of the city either west to the Chattahoochee River and on to the Gulf of Mexico, or east to the South River and on to the Atlantic Ocean. As the city grew, sanitary flows and SW were discharged into these waterways. Odor and health concerns led to the enclosure of the streams in pipes that became the present-day combined sewer system. As the city continued to expand, construction of combined sewer systems ceased and separated systems were initiated. The city's combined sewer system is located in the older, central business district and serves as headwaters to several small streams.

Improvements are currently being made to the WWTPs to meet effluent phosphorous limits (not to exceed 0.64 mg/l). In addition, the Georgia Environmental Protection Division is calibrating a new model that will be used to derive TMDLs. The results of this model may affect future permitting. The model considers the urban streams that are a direct result of overflows as point sources to the Chattahoochee.

Georgia first issued NPDES permits for CSO discharges in 1992. Atlanta's NPDES permits for all CSO treatment facilities are identical. The permits require that CSOs not violate water quality standards.

Atlanta's first CSO treatment facilities were built in the mid-1980s to address water quality problems in the South River Basin. The controls included two first-flush storage and treatment facilities and two small sewer separation projects. Additionally, five on-line screening and disinfection facilities were designed in 1989 to control CSOs in the Chattahoochee River Basin.

Table 5.2 CSO Public Participation

City	Astoria, OR	Atlanta, GA	Auburn, NY	Augusta, ME	Buffalo, NY	Chicago, IL	Cincinnati, OH	Cleveland, OH	Columbus, GA	Decatur, IL	Detroit, MI (Detroit R.)	Detroit, MI (Rouge R.)	Gardiner, ME	Hartford, CT	Louisville, KY	Mt. Clemans, MI	Newport, RI	New York City, NY	Portland, OR	Rochester, NY	Rockland, ME	San Francisco, CA	Seattle, WA	Syracuse, NY	Washington, D.C.	Winnipeg, Manitoba
Level of Participation																										
Proactive	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦		♦	♦			♦	♦		♦	♦	♦			♦
Reactive																				♦						
Minimum required by Law										♦			♦			♦	♦							♦	♦	
Type of Participation																										
Brochures / Pamphlets	♦	♦						♦			♦	♦		♦	♦				♦	♦		♦	♦			♦
Newsletters		♦		♦				♦			♦	♦		♦	♦				♦	♦		♦			♦	♦
Public Addresses thru Media			♦	♦							♦	♦		♦	♦			♦		♦	♦		♦			
Telephone Hotline											♦	♦											♦			
Public Hearings/Meetings	♦	♦	♦	♦		♦		♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Education & Awareness	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦		♦	♦				♦				♦			♦
Special Committee	♦	♦						♦	♦		♦	♦	♦					♦	♦	♦	♦		♦			♦
Public Concerns																										
Recreation				♦		♦		♦					♦	♦	♦	♦	♦		♦	♦	♦		♦		♦	♦
Aesthetics		♦				♦	♦	♦			♦	♦		♦	♦		♦	♦	♦	♦			♦		♦	♦
Facility Construction		♦				♦	♦	♦			♦	♦		♦	♦			♦		♦		♦				
Cost for Abatement	♦	♦	♦			♦		♦			♦	♦			♦				♦			♦			♦	
Street & Basement Flooding						♦		♦		♦				♦	♦	♦										♦
Public Health		♦	♦				♦	♦						♦					♦				♦			
Water Quality		♦		♦		♦		♦	♦	♦	♦	♦	♦	♦					♦	♦	♦		♦		♦	
Minimal																								♦		♦

Questionnaire Date: July 1998.

Before the facilities were constructed public dissension grew and the state legislature passed a bill mandating that "discharges from CSOs shall not cause a violation of water quality standards." As a result only three of the five CSO treatment facilities were constructed as originally designed and delays in construction caused the city to incur significant fines.

Citizen concerns continued and in 1996, a lawsuit was filed against the city claiming that CSOs violated water quality standards for metals and fecal coliform. In 1997, a federal district judge ruled in favor of the plaintiffs, saying that the concrete culverts into which CSOs discharge are waters of the state and therefore must meet water quality standards. The district court ruling and subsequent consent order are currently in negotiation. Various improvements to the CSO facilities include storage and treatment, relocation of outfalls, and separation. These improvements are estimated to cost between $400 to $600 million.

Motivated by the public dissension, in 1996 the Metro Atlanta Watershed Initiative was started to deal with citizen concerns and regulatory ambiguity; integrate and prioritize CSO controls to best use available money; and coordinate city agencies and stakeholders. As presented in Table 5-6, the watershed initiative faced many challenges.

The initiative started a comprehensive watershed study that was designed to determine the current conditions and uses of the urban streams, assess the type and magnitude of various impacts on these streams, and evaluate and recommend options for improving the water quality in the streams. However, the watershed study was dealt a major set back when a judge ruled that waters of the state begin at CSO discharges. Therefore, water quality standards need to be met in the small, intermittent streams that are solely produced by CSO discharges. As a result the watershed study was replaced by a mathematical model of the combined sewer system that simulates the impacts of the point-source CSOs.

Table 5.3 CSO Systems Characterization

City	Astoria, OR	Atlanta, GA	Auburn, NY	Augusta, ME	Buffalo, NY	Chicago, IL	Cincinnati, OH	Cleveland, OH	Columbus, GA	Decatur, IL	Detroit, MI (Detroit R.)	Detroit, MI (Rouge R.)	Gardiner, ME	Hartford, CT	Louisville, KY	Mt. Clemens, MI	Newport, RI	New York City, NY	Portland, OR	Rochester, NY	Rockland, ME	San Francisco, CA	Seattle, WA	Syracuse, NY	Washington, D.C.	Winnipeg, Manitoba
Mathematical Model for Flow Estimates																										
Yes	♦	♦	♦	♦		♦	♦	♦	♦	♦	♦	♦		♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
No					♦								♦													
Watershed Approach to Consider Other Wet-Weather Impacts																										
Yes		♦				♦		♦	♦			♦										♦	♦		♦	
No	♦		♦	♦	♦		♦			♦	♦		♦	♦	♦	♦	♦	♦	♦	♦	♦			♦		♦
Current Wet-Weather Abated Pollution																										
Municipal Point Source	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Industrial Point Source			♦	♦		♦	♦	♦		♦	♦	♦	♦						♦		♦	♦	♦	♦	♦	
Urban Runoff	♦	♦				♦		♦	♦		♦	♦		♦	♦				♦				♦		♦	♦
Agricultural Runoff											♦	♦			♦										♦	
Rural Non-Point															♦											
Future Wet-Weather Abated Pollution																										
Municipal Point Source	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Industrial Point Source			♦	♦		♦	♦	♦		♦	♦	♦	♦		♦				♦		♦	♦	♦	♦	♦	
Urban Runoff	♦	♦				♦		♦	♦		♦	♦		♦	♦	♦			♦			♦	♦	♦	♦	♦
Agricultural Runoff											♦	♦			♦							♦			♦	
Rural Non-Point															♦							♦				

Questionnaire Date: July 1998.

Current funding for the watershed initiative is $2.6 million. The City of Atlanta presently is the sole funding source, even though the watershed plan includes other communities and jurisdictions. The estimated cost for bringing the urban streams to good/fair standards for biotic indices, a goal created through the initiative, is approximately $1.4 billion.

References and Contacts:

U.S. Environmental Protection Agency and Water Environment Federation, *Draft Urban Wet Weather Case Studies*. Prepared for "Winning the Challenge of Urban Wet Weather Workshop," June 28, 1998, Cleveland, Ohio.

Ms. Tyler Richards, Operations Manager
City of Atlanta Wastewater Services
2440 Bolton Rd. N.W.
Atlanta, GA 30318

5.2.2 Augusta, Me.

The combined sewer area of Augusta, Me., comprises approximately 620 acres with 40 diversion structures and 29 active CSOs that discharge either directly to or into tributaries of the Kennebec River, which serves as an excellent fishery as well as a heavily used recreation area. Eleven alternatives were evaluated as part of the CSO facility plan. Evaluated storm frequencies were based upon the system capacity curves shown in Figure 5-1. Due to the large size of the Kennebec River, the primary water quality concern was bacteria.

Figure 5-2 illustrates maximum *E. Coli* concentrations in the Kennebec River at a minimal flow of 1,000 cubic feet per second (cfs) for different recurrence interval storms. As shown, the 1-year recurrence interval represents the knee of the curve. Consequently, a series of abatement alternatives were evaluated for the 1-year storm. Present-worth costs for several prime alternatives are illustrated in Figure 5-3. The least costly alternative included the construction of two satellite vortex facilities; however the second least costly alternative, which included a single vortex facility at the WWTP, was selected due to nonmonetary factors such as facility siting, the desire to avoid satellite facilities, and flexibility for future expansion or upgrades.

Table 5.4 Issues Driving CSO Technical Considerations

City	Astoria, OR	Atlanta, GA	Auburn, NY	Augusta, ME	Buffalo, NY	Chicago, IL	Cincinnati, OH	Cleveland, OH	Columbus, GA	Decatur, IL	Detroit, MI (Detroit R.)	Detroit, MI (Rouge R.)	Gardiner, ME	Hartford, CT	Louisville, KY	Mt. Clemans, MI	Newport, RI	New York City, NY	Portland, OR	Rochester, NY	Rockland, ME	San Francisco, CA	Seattle, WA	Syracuse, NY	Washington, D.C.	Winnipeg, Manitoba
Facility Plan																										
Completed			◆	◆		◆	◆	◆	◆	◆	◆	◆	◆			◆		◆	◆	◆	◆	◆	◆	◆	◆	
In Progress	◆	◆			◆			◆						◆	◆		◆						◆			◆
Reason for CSO Abatement																										
Planned Sewer Improvements				◆	◆		◆	◆		◆		◆	◆	◆	◆				◆	◆	◆		◆	◆	◆	
Regulatory Requirements	◆	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Litigation / Lawsuit		◆	◆							◆	◆	◆						◆	◆					◆		
Significant Pollution Event						◆								◆		◆	◆					◆				
Regulatory Requirements																										
Demonstrative		◆		◆			◆	◆	◆	◆	◆	◆	◆	◆				◆			◆			◆		
Presumptive	◆	◆	◆			◆	◆	◆										◆	◆	◆		◆	◆	◆	◆	
Not Answered					◆										◆	◆	◆									◆
Receiving H2O Criteria																										
BOD		◆				◆				◆		◆		◆			◆						◆		◆	
Bacteria	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆	◆
Dissolved Oxygen		◆				◆		◆				◆			◆			◆					◆		◆	◆
Fish Kills																									◆	
Floatables	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆		◆	◆	
Flow						◆																				
Metals		◆				◆			◆										◆							
Nutrients		◆				◆			◆														◆		◆	
pH																										
Solids		◆				◆			◆	◆		◆		◆	◆		◆	◆		◆			◆	◆	◆	
Abatement Tech Selection																										
Benefit-Cost Analysis	◆	◆	◆	◆			◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆	◆	◆	◆
Regulatory Requirement		◆			◆	◆	◆	◆	◆		◆	◆					◆	◆	◆				◆			
Specified Storm																										
Selected Technologies																										
BMP's	◆	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆	◆	◆	◆			◆	◆	◆	◆		◆	◆	◆	
Disinfection		◆	◆	◆	◆		◆	◆			◆	◆		◆	◆	◆			◆	◆	◆			◆	◆	
Flow Balance Method										◆														◆		
Flowslipping	◆			◆										◆												
Maximize Existing Treatment	◆			◆		◆		◆	◆				◆	◆								◆				
Netting								◆						◆	◆			◆						◆		
Rainleader Disconnection	◆		◆											◆												
Retrofitted WWTP			◆	◆				◆						◆								◆				
Screening		◆					◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆	◆					◆	
Separation	◆		◆	◆	◆				◆				◆	◆							◆		◆	◆		
Settling Tanks							◆	◆																		
System Storage (in)	◆			◆	◆	◆		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆		
System Storage (out)		◆				◆	◆	◆		◆				◆	◆		◆	◆		◆		◆	◆	◆		
Vortex	◆		◆	◆			◆		◆	◆				◆	◆			◆			◆			◆	◆	
Selection In Progress		◆						◆																		◆

The selected alternative involves retrofitting the existing WWTP to include a CSO-related bypass to treat 44% of Augusta's current annual CSO volume. Other improvements involve constructing consolidation conduits, two CSO pumping stations, and a vortex treatment facility at the site of the WWTP. This solution has been approved by U.S. EPA and the State of Maine Department of Environmental Protection.

The retrofits to the existing WWTP include new headworks that contain mechanical screens and an aerated grit chamber; new distribution structures; and new high-rate disinfection technology. Currently, when peak flow at the WWTP approaches 9 million gallons per day (MGD), excess flow is bypassed to the chlorine contact tank after physical degritting. The retrofit improvements will allow the full 29 MGD of connected interceptor capacity to receive preliminary treatment. Daily maximum flows of 12 MGD will receive secondary treatment, and 17 MGD will receive primary treatment followed by high-rate disinfection.

Later phases of the CSO abatement program will include a consolidation conduit to intercept CSO discharges throughout the system and convey the flow to the WWTP; three new vortex separators at the WWTP; and additional high-rate disinfection volume at the WWTP. After all phases are completed, the total influent peak flow capacity to the WWTP will be increased from 29 MGD to 107 MGD. Up to 78 MGD will be treated in the vortex separators. The phases of the CSO abatement program are scheduled to be completed by 2009.

Table 5-5. CSO Financial Considerations

City	Astoria, OR	Atlanta, GA	Auburn, NY	Augusta, ME	Buffalo, NY	Chicago, IL	Cincinnati, OH	Cleveland, OH	Columbus, GA	Decatur, IL	Detroit, MI (Detroit R.)	Detroit, MI (Rouge R.)	Gardiner, ME	Hartford, CT	Louisville, KY	Mt. Clemens, MI	Newport, RI	New York City, NY	Portland, OR	Rochester, NY	Rockland, ME	San Francisco, CA	Seattle, WA	Syracuse, NY	Washington, D.C.	Winnipeg, Manitoba
CSO Area																										
<1,000 Ac			◆	◆									◆								◆					
1,000-10,000 Ac	◆								◆							◆	◆			◆				◆		
>10,000 Ac		◆			◆	◆	◆	◆		◆	◆	◆		◆	◆			◆	◆			◆	◆		◆	◆
# of Wet-Weather Facilities Built																										
Zero	◆			◆	◆		◆				◆				◆								◆	◆		◆
1-10		◆	◆					◆	◆	◆		◆	◆	◆		◆	◆	◆	◆	◆	◆				◆	
10-50						◆																◆				
50-100																										
>100																										
Estimated Past Cost																										
<10 Million	◆			◆									◆						◆		◆					◆
10-50 Million			◆							◆						◆								◆	◆	
50-100 Million									◆					◆				◆								
100-500 Million		◆					◆	◆			◆	◆			◆								◆			
>500 Million						◆														◆		◆				
Not Answered					◆												◆									
Estimated Future Cost																										
Abatement Complete. O&M Only			◆							◆			◆							◆		◆				
<10 Million																					◆					
10-50 Million	◆			◆												◆									◆	
50-100 Million																							◆			
100-500 Million							◆				◆			◆										◆		◆
>500 Million		◆				◆		◆				◆						◆	◆							
Not Answered					◆				◆						◆		◆									
Funding Source																										
City Funding									◆									◆								
Federal Grant Money		◆				◆		◆	◆	◆	◆	◆								◆		◆		◆	◆	
Increase Sewer Rates	◆	◆	◆	◆				◆	◆	◆	◆	◆	◆	◆		◆			◆	◆		◆	◆	◆	◆	◆
Increase Taxes						◆	◆		◆					◆				◆			◆	◆				
Innovative Technology Grant																									◆	
Investment Income form Bonds						◆																				
Revolving Loan	◆		◆	◆		◆		◆			◆	◆	◆	◆		◆				◆	◆	◆		◆		
State Grant Money			◆			◆				◆				◆						◆			◆	◆		
Currently Seeking Funds															◆											
Not Answered					◆												◆									

Cost Estimates ENR: 5921 July 1998
Questionnaire Date: July 1998.

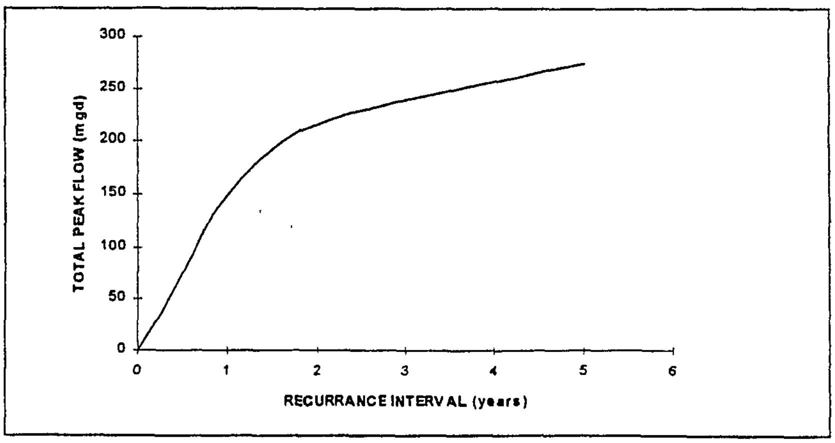
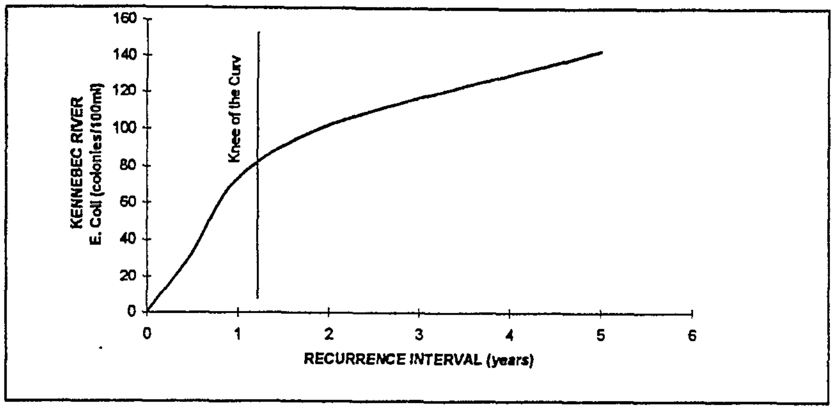


Figure 5-1. Recurrence Intervals vs. Total Peak Flow, Augusta, Maine

Water Environment Research Foundation

R0018274



1. Assumes complete mixing of untreated CSO discharges
2. Using average CSO discharge concentration of 600,000 colonies/ 100 ml
3. Kennebec River flow at 1,000 cfs

Figure 5-2. Recurrence Interval vs. E. Coli Count, Augusta, Maine

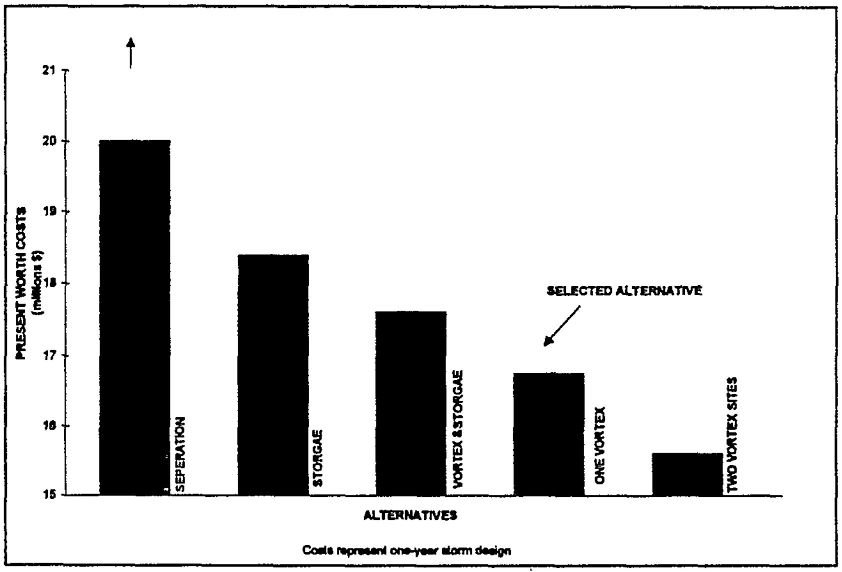


Figure 5-3. Present Worth Costs for CSO Abatement Alternatives, Augusta, Maine

Table 5-6. Watershed Initiative Diffucluties	
◆ Judicial interpretation of regulations	◆ Funding
◆ Litigation hampers open process	◆ Communication among organizations
◆ Many ancillary projects	

References and Contacts:

Moffa, Peter E. (1997) *Control and Treatment of Combined Sewer Overflows*, Van Nostrand Reinhold, New York, N.Y.

Mr. Steven D. Freedman, P.E., Vice President
Earth Tech, Inc.
500 Southborough Drive
South Portland, ME 04106-3209

5.2.3 Decatur, Ill.

CSO Community Characteristics

◆ Population	95,000
◆ CSO Area	7,000 Ac
◆ Annual Rainfall	40"
◆ # of Discharge Points	4

Distinctive CSO Community Attributes

- CSO abatement program cmpleted in 1992
- Operation of full-scale CSO treatment facilities including one EPA swirl concentrator and six Fluidsep units

Decatur, Ill. is located in the center of Illinois along the Sangamon River. A dam on the river forms Lake Decatur, which serves as a recreational resource and public water supply. The area has a population of approximately 95,000 and has a heavily industrial economic base. The combined sewer area is surrounded on three sides by newer sanitary sewers and on the fourth side by Lake Decatur.

Prior to 1992, the CSO outfalls discharged directly downstream of the Lake Decatur dam. During the summer, brief rains caused the combined sewers to overflow; however, the rains did not produce enough runoff to cause the lake to spill over the dam. Therefore, the sewer overflows resulted in stagnant pools and subsequent fish kills.

The city and sanitary district began facilities planning in 1976. At that time the WWTP was frequently overloaded, standards violations were common, and there was no CSO treatment. Between 1976 and 1980 planning concentrated on the main WWTP. Beginning in 1980 CSO control and treatment became a topic of interest when the Illinois Environmental Protection Agency (EPA) documented that the CSOs were polluting the river and control was required.

In 1982 the Sanitary District of Decatur signed a federal consent decree which ordered the upgrading of the main WWTP, implementation of an industrial pretreatment program, and compliance with Illinois rules and regulations pertaining to CSOs. The consent decree set time limits for completing work in each area. The CSO control measures were to be completed by 1986, later extended to 1992. The extension helped the cash flow of both the Illinois EPA Grants Section and local government. The schedule also allowed for a step-by-step approach to the CSO improvements

The consent decree helped both parties. The sanitary district gained assurance of grant funding for the necessary work, avoided enforcement actions until the completion date, and obtained authority to issue bonds for local funding. The Illinois EPA benefited by having a federal court order to ensure compliance by a specific date and gained the cooperation of the Sanitary District.

The overall CSO control plan included four satellite treatment facilities: the McKinley Ave., Oakland Ave., Seventh Ward, and Lincoln Park CSO Treatment Facilities. The McKinley Ave. Facility was completed in 1986 and includes a 500,000-gallon first flush storage tank and a 40 MGD U.S. EPA vortex unit. The storage tank collects the first 500,000 gallons of CSO, which is later pumped to the WWTP. CSO beyond the first 500,000 gallons is diverted to the vortex unit. The Lincoln Park CSO facility was completed in 1992 and was the final and largest treatment facility. The Lincoln Park and McKinley Ave. facilities are similar in concept; however, Lincoln Park utilizes a 1.33 million-gallon storage tank and four Fluidsep vortex units capable of treating 416 MGD (see Figure 5-4). The total CSO control plan improvements cost $34.4 million, $20.5 million coming from state and federal grants and the balance coming from the local community.

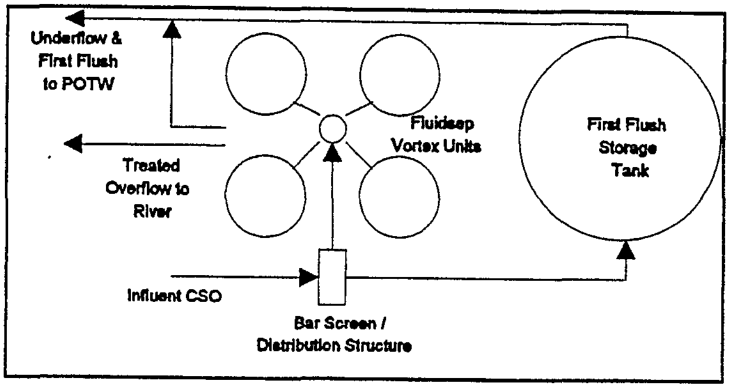


Figure 5-4. Lincoln Park CSO Treatment Facility

References and Contacts:

Bainbridge, Gee, Milanski & Associates Inc. and Crawford, Murphy & Tilly Inc. (1987) *Sanitary District of Decatur Combined Sewer Overflow Operational Study.*

Bainbridge, Gee, Milanski & Associates Inc. and Crawford, Murphy & Tilly Inc. (1995) *Lincoln Park Combined Sewer Overflow Treatment Facility Operational Study.*
Mr. Gary Hornickel, Technical Director
Sanitary District of Decatur
501 Dipper Lane
Decatur, IL 62522

5.2.4 San Francisco, Calif.

CSO Community Characteristics

♦ Population	727,000
♦ CSO Area	25,000 Ac
♦ Annual Rainfall	21"
♦ # of Discharge Points	36

Distinctive CSO Community Attributes

- CSO abatement program cmpleted in 1997
- Diverse funding source
- Conversion of WWTP into wet weather pollution treatment facility

San Francisco is a city of 727,000 people located on a peninsula surrounded by the San Francisco Bay and the Pacific Ocean. Almost 100% of the city's 25,000 acres are served by a combined sewer system. Each of the 36 CSOs discharge into the San Francisco Bay or the Pacific Ocean. The city is highly urbanized, with a large central business district. Very little space is available for the construction of treatment facilities or large storage and conveyance systems needed to handle CSO.

R0018277

March, 1997 marked the completion of the major components of the city's wastewater facility improvement program. This construction program cost more than $1.4 billion dollars over a 20-year period. The earliest projects were funded by federal (68%), state (12%) and sewer service (20%) monies. Subsequent projects used state revolving funds and sewer service charges. One project used U.S. EPA marine CSO funds.

At the time of the 1972 Federal Clean Water Act Amendments, the City of San Francisco was planning improvements to its wastewater facilities. The State of California directed the city to undertake measures to reduce impacts from WWTPs and CSOs in the early 1960s. The city's first study of water quality impacts from CSOs was completed in 1967.

Motivated by federal and state policy and the need to improve its wastewater facilities, the city committed to upgrade secondary WWTPs and eliminate SW discharges along the shoreline within reasonable costs, times, and with minimal public disruption. To meet this challenge, the city developed a "Wastewater Master Plan" (1971) and an "Environmental Impact Statement and Report" (1974). The original plan was based on cost-benefit considerations; the resulting requirements closely matched those of the federal presumption approach.

San Francisco used a combination of in-line storage, off-line storage, and wet weather treatment. Wet weather treatment included primary treatment at the city's two WWTPs and conversion of a third WWTP to a wet weather facility. In addition the CSO storage boxes were designed to capture large settleable and floatable solids (see Figure 5-5).

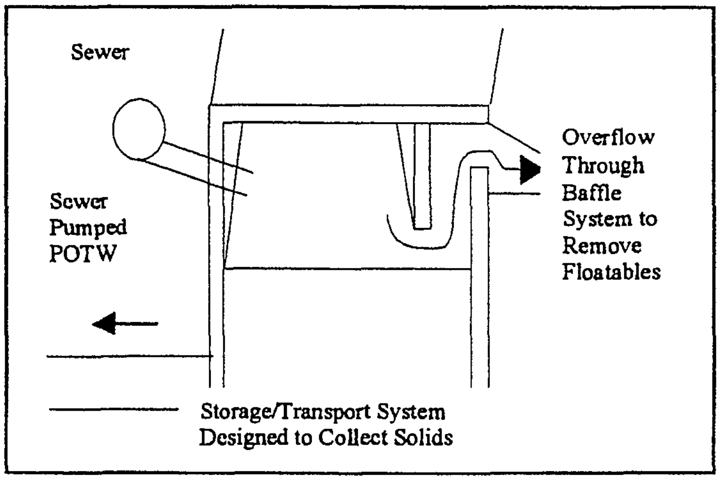


Figure 5-5. Typical Storage Boxes for San Francisco

San Francisco appears to be meeting the CSO frequency requirements (see Table 5-7). The number of days with elevated coliform levels dropped between 78% and 98%. An evaluation of a large CSO storage basin found a 33% reduction in total suspended solids and BOD through the storage and decanting of captured flows.

Table 5-7. San Francisco CSO Frequency Requirements

Waterbody	Frequency
Estuarine Shellfish Area	1/year
North Shore Area	4/year
Ocean Discharges	8/year
Maritime Area	10/year

References and Contacts:

San Francisco Public Utilities Commission (June 1997) *The Clean Water Act: 25 Years of Progress in San Francisco.*

Ms. Michelle Pla, Manager
San Francisco Public Utilities Commission
1212 Market Street, 2nd Floor
San Francisco, CA 94102

5.2.5 Syracuse, N.Y.

CSO Community Characteristics

- Population 475,000
- CSO Area 67,000 Ac
- Annual Rainfall 37"
- # of Discharge Points 66

Distinctive CSO Community Attributes

- Cost-benefit Analysis
- Staged construction that meets the presumption and demonstration approaches

The Syracuse is located in Onondaga County, N.Y. and has a population of 475,000. Approximately 40% of the city of Syracuse's 16,600 acres are served by a combined sewer system. Each of the 66 combined sewer overflows discharge into one of three receiving streams that are tributary to Onondaga Lake. Onondaga Lake has become a matter of national interest as one of the most polluted lakes in the country. This urban lake and its drainage area lie wholly within Onondaga County and serve as a good opportunity to assess CSO impacts within the context of an entire watershed.

After a period of more than 25 years of evaluating the CSO problem involving demonstrating various abatement technologies, characterizing the sewer system and receiving waters, implementing a BMP program and performing extensive cost-benefit analyses, a comprehensive CSO abatement program for the city of Syracuse, estimated at over $140 million, is underway. The final phase of this process began in 1988, when the county entered into a consent order, and was completed in 1996 upon its signing.

Between 1982 and 1984, the county instituted a successful BMP program. The results showed more than an 85% reduction in annual pollutants to the receiving waters. The major elements of the BMP program were: sewer cleaning, overflow-structure modifications, and sewer replacement to assure maximum system storage and conveyance to the Syracuse Metropolitan WWTP. Table 5-8 illustrates the improvements as a result of this $10 million BMP program.

Table 5-8. Pre & Post-BMP CSO Discharge Statistics, Syracuse, N.Y.

CSO Discharge Characterization	Pre-BMP	Post-BMP
Number of Events/Year	165	56
Annual CSO Volume (million gallons)	11,000	1,654
1-year Storm Volume (million gallons)	72	59
90 Percentile Storm Volume (million gallons)	54	40

Water quality concerns were investigated during the middle 1970s and verified in the early 1990s. These investigations utilized sewer modeling and flow monitoring combined with water quality sampling and analyses to estimate CSO loadings to receiving waters. Floatables and bacteria were the parameters of most concern. A bacteria model was also used to estimate the number of violations, defined as exceeding 200 fecal coliform per 100 ml, within the Onondaga Lake.

A limited watershed effort became necessary to put the CSO component of solids and nutrients in proper perspective. Agriculture comprises the major land actively outside of the city of Syracuse and the urban areas. Using a watershed model, solids and nutrient loadings were calculated for an average rainfall year (1991). Table 5-9 illustrates the loadings relative to the WWTP. The net result was that phosphorus, nitrogen, and solids were found to be of less significance than was thought before the watershed estimates were made.

Table 5-9. Pollutant Loading Summary to Onondaga Lake, Syracuse, N.Y.

Pollutant Source	Total Phosphorous (lbs)	Total Phosphorous % of Total	Total Nitrogen (lbs)	Total Nitrogen % of Total	Total Suspended Solids (lbs)	Total Suspended Solids % of Total
WWTP	134,320	31	5,752,620	80	1,167	7
CSO	16,800	4	25,432	2	3,739	22
Nonpoint	275,349	65	1,313,434	18	12,107	71
Total	426,469		7,201,486		17,013	

Several abatement alternatives were evaluated based on costs and benefits. The county chose regional treatment with vortex units and high-rate disinfection because it was the least costly alternative that met water quality standards. In addition, the plan includes netting devices for capturing floatables and restoration of an existing 5 MG storage facility.

High cost/benefit projects and projects designed to demonstrate effectiveness were scheduled in the initial phase. The scheduling of the projects became decisive in that the proposed regional facilities would ultimately meet both the presumption and demonstration clauses of the federal CSO policy. The next step in the process was to phase the construction of the facilities over a 15-year, build-out period to provide both a reasonable compliance schedule and an affordable cash flow. Figure 5-6 illustrates the compliance schedule.

References and Contacts:

Moffa, Peter E. (1997). *Control and Treatment of Combined Sewer Overflows.* Van Nostrand Reinhold, New York, N.Y.

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Drainage and Sanitation
650 Hiawatha Blvd., West
Syracuse, NY 13204-1194

5.3 CSO Case Histories and Benchmark Data Discussion

5.3.1 General CSO Discussion

CSOs generally were recognized as a significant source of pollution in the late 1960s and specifically identified at the federal level through the landmark 1972 Amendments to the Federal Water Pollution Control Act. Much of the CSO work was started through federal R & D programs initiated in the early 1970s.

The activity directed toward CSOs has been greater than SSOs and SW owing to the earlier awareness and recognition of this type of pollution and, perhaps more importantly, the urgency associated with the health risks stemming from the sewage component. The intensity of regulatory and municipal activities sharply increased in 1989 when U.S. EPA published the draft National CSO Control Strategy. Until then, in the absence of clear guidelines, most municipalities were unwilling to forge ahead. Upon the release of the National CSO Control Policy in

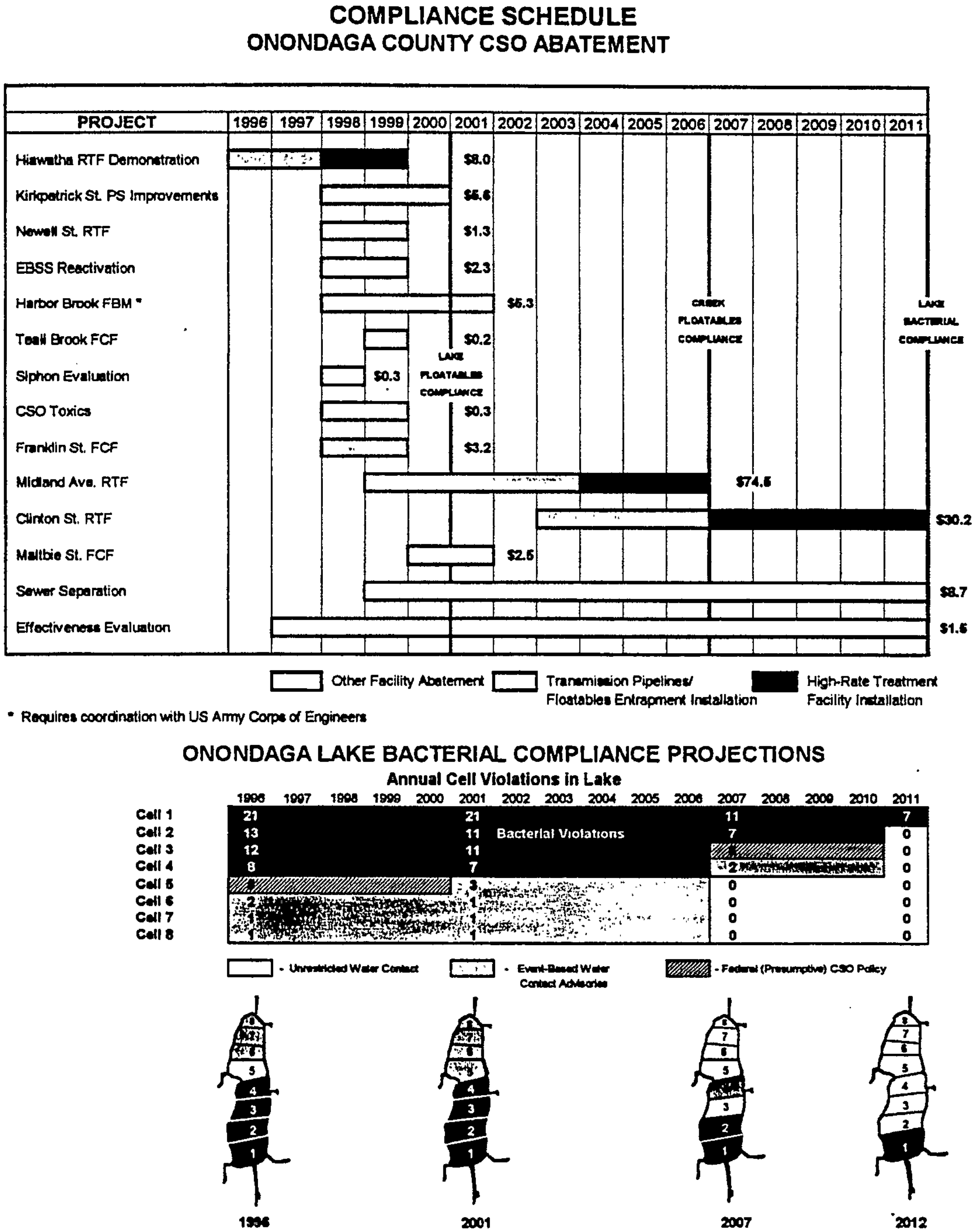

Figure 5-6. CSO Abatement Compliance Schedule, Onondaga County, N.Y.

1994, many CSO facility plans were revisited to determine compliance with either the presumption or demonstration provisions and to develop the required LTCP.

The most prevalent form of implementation has been BMPs due to the "housekeeping" nature of such steps and the low cost to benefit relationship. Reductions of annual CSO volume from BMP steps were reported as high as 90%.

Abatement beyond BMPs was implemented by only a limited number of communities prior to the national policy. In some cases, communities with high enough state priorities were able to take advantage of federally available grant funds. However, for the most part, abatement has taken place after 1989 and has not included federal grants. State revolving funds have become available in place of the previous U.S. EPA construction grants program.

As a consequence of little or no federal or state funding currently available for design and construction, financial considerations have become that much more important, resulting in a greater emphasis on cost/benefit evaluations and reviewing the affordability guidelines within the policy.

Most communities acted to abate their CSOs due to regulatory requirements which can take the form of permit renewals, administrative orders, or consent orders. Generally communities acted upon requirements more or less in that order.

There is a noticeable lack of consistency from case to case in setting permit parameters, which is understandable in consideration of their site-specific nature and related health risks. States should await site-specific information before setting permit limits.

5.3.2 CSO Questionnaire Findings

5.3.2.1 CSO Community Statistics

The communities included in these benchmark matrices represent a range of geographic locations, demographics, abatement strategies and schedules. The differences found between these communities stress the site-specific nature of CSO control and abatement.

Combined sewer systems serve roughly 950 communities with about 40 million people. Most communities with CSOs are located in the Northeast and Great Lakes regions, particularly in New England, Ohio, Illinois, Michigan, and New York. Although large cities like New York, Philadelphia, and Atlanta, have combined sewer systems, most communities with CSO problems have fewer than 10,000 people (EPA, 1998). Most sewer systems have evolved with the community, and therefore no two systems are identical. For example, some communities such as San Francisco are served entirely by combined sewer, while others, such as Atlanta, have a relatively old combined sewer system surrounded by a newer separated system. The wastewater/CSO characteristic for each community is different and is largely related to the economic base of the community. Some communities such as Detroit have an industrial economic base, while others like Auburn are residential and commercial in nature. The locations of CSO communities across the county are illustrated in Figure 5-7.

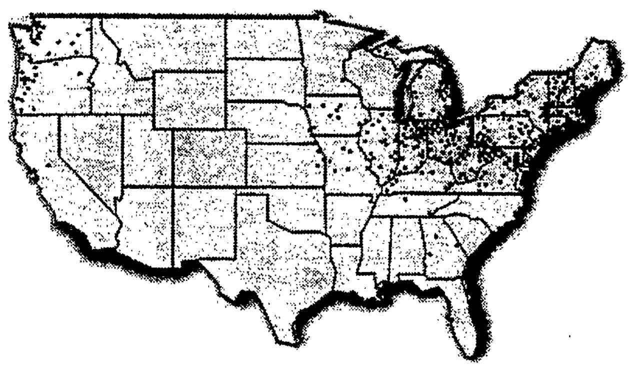

Figure 5-7. CSO Communities in the US. (EPA, 1998)

5.3.2.2 CSO Public Participation

Based on questionnaire responses, active public participation programs tend to be integrated with a watershed approach. For example, communities such as Atlanta and Detroit (Rouge River) have active public participation and watershed programs. Other communities that have public participation programs are: Astoria, Augusta, Chicago, Cincinnati, Cleveland, Hartford, Louisville, San Francisco and Winnipeg.

Public participation approaches for CSO abatement programs throughout the country appear to follow similar trends. The information provided by each municipality suggests that the public participation philosophy was established at or before the initiation of the formal CSO abatement program. At the beginning of the abatement process, a municipality either decided to actively include the public in the decision-making process or to include the public only as mandated by law. It is likely that the municipalities that identified themselves as "reactive" were including the public as required by law but increased public involvement as public demand grew. The most popular forms of public participation are newsletters, public hearings/meetings, and newspaper articles. The majority of the public was concerned about the effectiveness of the abatement strategy to meet water quality and associated aesthetics and recreational expectations. Construction impacts during implementation of abatement infrastructure were also a notable public concern.

From the viewpoint of the municipal agency, public participation programs can provide assistance but can also create obstacles. The clear advantage of engaging the public is recognizing and addressing public concerns early in the process, thus making the public a stakeholder. This process is best for the community in the long term; however, as in Atlanta, it may create ancillary work in the short term. Atlanta also noted that open public participation is difficult when litigation is brought by public stakeholders.

5.3.2.3 CSO Systems Characterization

Nearly all communities used a mathematical model to describe their sewer system. The U.S. EPA Storm Water Management Model tended to be the most preferred model. Communities have found that replicating the sewer system with a model can answer questions that would be impractical to answer through field measurements and observation.

Currently, however, most communities are focusing on abating only municipal and industrial point sources and not embodying the entire watershed and other pollution sources. Such action is driven by federal CSO policy and lack of policy for other types of pollution (e.g., agricultural runoff). The municipal and industrial point sources of pollution tend to be more easily controlled and managed at the source, whether it is at the end of a pipe in the case of a CSO, or a pretreatment program at an industrial site.

Many CSO communities are looking to the future and realizing the need to address nonpoint sources such as urban and agricultural runoff. As a result, these communities have used a watershed approach to prioritize pollutant sources and plan for the future but have not begun to use the watershed approach to abate pollution.

Some communities have initiated a watershed approach, including Atlanta, Chicago, Cleveland, Detroit and Syracuse. The watershed approach in Detroit has come to national attention. Wayne County is spearheading the watershed approach via the Rouge River National Wet weather Demonstration Project (Rouge Project) with funding from U.S. EPA and local communities. The Rouge Project oversees the 17 combined sewer overflow abatement projects (11 retention treatment basins and 6 sewer separation projects). These control technologies are currently being evaluated to help quantify their effect on the quality of the river and thereby suggest the most appropriate CSO method. The following are some findings from the Rouge Project (Rouge River National Wet Weather Demonstration Project, March 1998):

- *E. coli* concentrations discharged from the CSO treatment basins are small compared to the instream *E. coli* concentrations. Instream *E. coli* concentrations during wet weather are frequently above body contact standards due to non-CSO pollution sources.
- Dissolved oxygen sags are attributed to CSO treatment basin effluent and other non-CSO pollution sources
- Dissolved oxygen impairment during dry weather is attributed to a combination of high sediment oxygen demand and low re-aeration due to naturally flat river slope.
- CSO treatment basin effluent contributes 15% of instream BOD at points of discharge.

Because CSO control will not eliminate all pollution to the river, the Rouge Project is assessing and implementing nonpoint source controls as well and pollution prevention programs for watershed residents and businesses. Findings from this study will be shared with other urban watersheds.

Syracuse exemplifies a community that assessed pollution sources from throughout the watershed before developing abatement alternatives for CSOs. This evaluation included the use of a watershed model, sewer system model, and geographic information system to calculate solids and nutrient loadings. The major finding suggested that phosphorous loading from CSOs was less significant than loadings from the WWTP and agricultural runoff. Identifying that significant phosphorous loadings came from sources other than CSOs allowed the municipality to proceed with physical treatment and disinfection rather than storage for CSOs, representing a huge savings to the city.

5.3.2.4 *Issues Driving CSO Technical Considerations*

Most CSO communities have completed or are in the process of completing a long term control plan. However, some variability exists in the initiation of the plan. As documented in the 1994 federal CSO policy, the LCTP is to be submitted within two years of an enforcement action, which can take the form of a state permit (generally the most preferred) or a specific administrative or consent order. Many large communities, such as Boston and New York City, were targeted as high priorities by regulatory agencies. As such, enforcement actions were served even before the federal CSO policy was finalized. On the other hand, medium-sized communities, such as Gardiner, Me., were a lower priority to regulatory agencies and therefore were not served an enforcement action as early. In this same manner, small CSO communities may not have to complete a LCTP in the near future because of their low priority status. The CSO policy states, at the discretion of the NPDES authority, that communities with populations less then 75,000 may need to comply with only the nine minimum controls. Yet, still other communities, such as Rochester, N.Y., moved ahead with a LCTP before the CSO policy was developed. The motivation for such a progressive stance was the availability of federal and state grant money.

Most communities acted to abate their CSOs due to regulatory requirements. These regulations may be enforced by either the state government (delegated state) or by the U.S. EPA. Communities who have not completed a LTCP are generally required to complete the plan. Communities who have an approved LTCP are required to follow either the presumption or demonstration approach. If a community follows the demonstration approach, the critical permit requirements generally relate to an effluent standard. If a community follows the presumption approach, the critical permit requirements tend to specify some level of capture/treatment. Regardless of the approach bacteria and floatables tend to be the pollutants of most concern.

Some communities were motivated to abate their CSOs because of litigation. In the case Decatur, the litigation and resulting consent decree helped both parties. The Sanitary District gained assurance of grant funding for the necessary work, avoided enforcement actions until the completion date, and obtained authority to issue bonds for local funding. The Illinois EPA benefited by having a federal court order to ensure compliance by a specific date and gained the cooperation of the Sanitary District.

Almost the same number of communities followed the presumption approach as followed the demonstration approach; however, the majority of smaller communities followed the Presumption approach. The major advantage of the presumption approach is that it allows smaller communities that cannot afford extensive water quality monitoring and impact studies to proceed with abatement planning. Some larger communities proceed with presumption approach because it provides an opportunity to avoid any stalemate until a consensus is reached over water quality impacts. And yet some communities, with diverse combined sewer systems, used both approaches where appropriate.

The major receiving water criteria were floatables and bacteria. Solids and BOD follow, with nutrients and dissolved oxygen being the parameters of least concern. These criteria originate from public interest; however, they are enforced through the CSO policy and ultimately the Clean Water Act. It is clear that the public desires aesthetically pleasing waters (i.e., no floatables) that are safe for recreation (i.e., no harmful bacteria). These criteria are addressed in the CSO policy as part of the presumption and demonstration approaches. The presumption approach requires a community to meet any one of three predefined conditions, thereby presuming that water quality requirements are being met. The demonstration approach requires that water quality standards and designated uses be met on a case-by-case basis consistent with a LTCP, unless uses cannot be met as a result of other pollution sources (e.g., natural background conditions). Regardless of the approach, the obligation is to meet the requirements of the Clean Water Act, the protection of designated uses.

Generally the technology chosen by a community should and did reflect the site-specific nature/characteristics of CSOs within that community. The majority of the communities are planning to implement many different abatement technologies to most effectively meet water quality criteria. BMPs as prescribed by the nine minimal controls are currently the most popular form of CSO control. Implementation of BMPs has made a positive impact on water quality. For example, in Syracuse, BMP improvements such as sewer cleaning and raising weirs were implemented in the early 1980s to optimize flows to the WWTP. Comparisons of pre-BMP to post-BMP rainfall versus CSO overflow volume relationships showed a reduction in annual overflow pollutants of 85% to 90%. Many communities are in the process of planning for the implementation of structurally intensive solutions. In-system and offline storage, screening, disinfection, and vortex solid separators are the most popular control approaches among the communities responding.

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5.3.2.5 CSO Financial Considerations

In the last 25 years, the federal government has spent more than $60 billion through grants and low-interest loans for the construction of WWTPs and sewer lines. States and municipalities have spent additional billions in matching funds for these improvements. A large percentage of the federally available funds was spent throughout the '70s and early '80s making improvements to WWTPs.

Some CSO communities took advantage of the federally available funds to abate CSOs while making improvements to WWTPs. In some respects this approach was uncertain because the federal CSO policy was in its infancy and no clear CSO related standards were available as guidance. A good example of this type of community is Rochester, N.Y., which moved to abate CSOs by separating the sewer system during WWTP improvements. The federal government funded almost the entire CSO abatement project. A small portion of Rochester's CSO abatement was completed without federal funds. The remaining CSO abatement included in-line and off-line storage, a more cost-effective approach reflecting the local funding source.

San Francisco started its CSO abatement program while federal funds were available and before the federal CSO policy was promulgated. However, San Francisco, being much larger than Rochester, could not implement a CSO abatement program as quickly. San Francisco started its program in 1978 and completed the major parts by 1997. As a result, San Francisco accepted funding from the entire range of available sources. The earliest projects were funded from approximately 68% federal, 12% state and 20% local sources. Subsequent projects used state revolving funds and local funds. One project used a special U.S. EPA marine CSO fund.

Many smaller communities such as Astoria and Augusta did not start their CSO abatement programs until the '90s. Their size and low priority, as discussed in the Issues Driving CSO Technical Considerations section, can explain this timing. Nonetheless, communities that began their CSO abatement programs in the '90s with the dawn of the federal CSO policy were too late to take advantage of federal grant money. These communities tended to rely on state revolving loans and local funding. As a result the local authorities required more information on the returns of these major investments to improve water quality before being willing to proceed. Also, these local authorities were more apt to challenge the legality of water quality standards. Owing to the greater sensitivity to costs, communities became more interested in satellite treatment as opposed to centralized treatment.

Selected abatement controls tend to reflect the source of funding. This may be illustrated by comparing the cost of sewer separation to satellite treatment such as vortex facilities. Sewer separation costs, including the cost for new SW treatment, for 6,813 acres in the City of Syracuse were estimated to be $612 million. Satellite treatment costs, including vortex units, netting devices and disinfection for the same area were estimated to be $144 million (Moffa & Associates, 1996). Obviously the cash flow for these approaches is very different. Sewer separation projects tend to be large up-front capital expenditures with smaller future operation and maintenance (O&M) costs, while satellite treatment tends to have smaller up-front capital expenditures with larger future O&M costs. Separate sewers also produce SW issues that need to be addressed.

CHAPTER 6.0

SSO BENCHMARK DATA AND CASE HISTORIES

6.1 Benchmark Data for SSO Communities

The following section includes a benchmark matrix for general SSO community statistics (Table 6-1), SSO public participation (Table 6-2), SSO systems characterization (Table 6-3), issues driving SSO technical considerations (Table 6-4), and SSO financial considerations (Table 6-5).

Table 6-1. SSO Community Charcteristics

City	Bloomington, IN	Flagstaff, AZ	Greenwood, SC	Hillsboro, OR	Houston, TX	Johnson County, KS	Kennebunk, ME	Laughlin, NV	Martinez, CA	New Orleans, LA	Oakland, CA	Oklahoma City, OK	Orange County, CA	San Diego, CA	Tulsa, OK	Wayne County, MI
Receiving H2O Type																
Estuary					◆		◆		◆		◆					
Harbor																
Lake			◆					◆		◆						
Ocean / Bay					◆		◆		◆				◆	◆		
River		◆	◆	◆		◆	◆	◆		◆		◆	◆		◆	◆
Stream	◆		◆	◆	◆	◆						◆				
Population																
<500,000	◆	◆	◆	◆		◆	◆	◆	◆			◆			◆	◆
500,000 - 1,000,000										◆	◆					
>1,000,000					◆								◆	◆		
SSO Area																
<10,000 Ac		◆						◆								
10,000- 100,000 Ac	◆		◆	◆		◆	◆			◆	◆					
100,000 -500,000 Ac					◆				◆			◆	◆	◆	◆	◆
Annual Rainfall																
0-20"		◆						◆	◆				◆	◆		
20-30"											◆					
30-40"				◆		◆						◆				◆
40-50"					◆		◆								◆	
>50"	◆		◆							◆						
# of Discharges to Public Waters																
Zero		◆		◆									◆			
<10			◆				◆	◆			◆				◆	
10-50	◆				◆	◆			◆	◆		◆		◆		◆
50-100																
>100																
Annual Wet-Weather Discharge Qty.																
<10 MG								◆					◆			
10-100 MG							◆								◆	
100-1,000 MG						◆			◆		◆					◆
[illegible]000 MG					◆									◆		
Unknown	◆	◆	◆	◆						◆		◆	◆			

Questionnaire Date: July 1996.

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Table 6-2. SSO Public Participation

City	Bloomington, IN	Flagstaff, AZ	Greenwood, SC	Hillsboro, OR	Houston, TX	Johnson County, KS	Kennebunk, ME	Laughlin, NV	Martinez, CA	New Orleans, LA	Oakland, CA	Oklahoma City, OK	Orange County, CA	San Diego, CA	Tulsa, OK	Wayne County, MI
Mathematical Model for Flow Estimates																
Yes	◆	◆	◆	◆	◆	◆			◆	◆	◆		◆	◆	◆	
No							◆	◆				◆				◆
Watershed Approach to Consider Other Wet-Weather Impacts																
Yes	◆		◆	◆	◆	◆			◆		◆		◆		◆	◆
No		◆					◆	◆		◆		◆		◆		
Current Abated Wet-Weather Pollution																
Municipal Point Source		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Industrial Point Source		◆	◆	◆					◆				◆			
Urban Runoff				◆				◆	◆	◆	◆		◆		◆	
Agricultural Runoff				◆									◆		◆	
None	◆															
Future Abated Wet-Weather Pollution																
Municipal Point Source	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Indusinal Point Source		◆	◆	◆					◆				◆			
Urban Runoff	◆		◆	◆				◆	◆	◆	◆		◆		◆	
Agricultural Runoff			◆	◆									◆		◆	

Questionnaire Date: July 1998

Table 6-3. SSO Systems Characterization

City	Bloomington, IN	Flagstaff, AZ	Greenwood, SC	Hillsboro, OR	Houston, TX	Johnson County, KS	Kennebunk, ME	Laughlin, NV	Martinez, CA	New Orleans, LA	Oakland, CA	Oklahoma City, OK	Orange County, CA	San Diego, CA	Tulsa, OK	Wayne County, MI
Level of Participation																
Proactive	◆			◆	◆			◆		◆	◆	◆			◆	
Reactive																
Minimum required by Law		◆	◆			◆	◆		◆				◆	◆		◆
Type of Participation																
Brochures / Pamphlets												◆				
Newsletters						◆										
Public Addresses thru Media						◆									◆	
Public Hearings/Meetings	◆			◆						◆	◆					
Educational & Awareness	◆			◆				◆				◆				
Special Committee	◆				◆						◆					◆
Not Answered		◆	◆				◆		◆				◆	◆		
Public Concerns																
Recreation										◆	◆		◆	◆		
Aesthetics													◆	◆		
Facility Construction																◆
Cost for Abatement								◆								
Flooding / Sewer Backups	◆	◆	◆	◆	◆							◆			◆	◆
Public Health																
Water Quality	◆	◆		◆	◆	◆		◆		◆	◆		◆	◆		◆
Minimal			◆				◆	◆	◆							
Uninterrupted Service		◆			◆							◆				

Questionnaire Date: July 1998.

Table 6-4. Issues Driving SSO Technical Considerations

City	Bloomington, IN	Flagstaff, AZ	Greenwood, SC	Hillsboro, OR	Houston, TX	Johnson County, KS	Kennebunk, ME	Laughlin, NV	Martinez, CA	New Orleans, LA	Oakland, CA	Oklahoma City, OK	Orange County, CA	San Diego, CA	Tulsa, OK	Wayne County, MI
Facility Plan																
Completed				◆	◆	◆	◆	◆			◆				◆	◆
In Progress	◆		◆						◆	◆			◆	◆		
Not Started / None		◆										◆				
Reason for SSO Abatement																
Planned Sewer Improvements	◆	◆	◆	◆		◆	◆		◆		◆	◆	◆	◆	◆	◆
Regulatory Requirements			◆	◆		◆	◆		◆		◆		◆	◆	◆	◆
Litigation / Lawsuit				◆	◆					◆						◆
Significant Pollution Event								◆								
Receiving H2O Criteria																
Bacteria	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆	◆
BOD	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆			◆			◆
Dissolved Oxygen		◆	◆	◆		◆	◆	◆	◆	◆	◆		◆			
Fish Kills													◆			
Floatables		◆	◆						◆				◆			
Nutrients		◆	◆	◆												◆
pH											◆					
Solids		◆	◆	◆				◆	◆				◆			
Toxins			◆										◆			
None												◆				
Abatement Tech Selection																
Benefit-Cost Analysis	◆		◆	◆	◆	◆		◆	◆		◆	◆	◆	◆		◆
Regulatory Requirement		◆		◆		◆	◆	◆			◆		◆		◆	◆
Specified Storm													◆			
Tech Not Selected										◆						
Selected Technologies																
I / I Reduction	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆
Increased Capacity at WWTP					◆	◆										◆
Preventive Maintenance			◆					◆	◆			◆				
System Storage (In)					◆								◆			
System Storage (Out)											◆				◆	
Wet-Weather Treatment Plant					◆	◆										◆
Tech Not Selected										◆						

Questionnaire Date July 1998

Table 6-5. SSO Financial Considerations

City	Bloomington, IN	Flagstaff, AZ	Greenwood, SC	Hillsboro, OR	Houston, TX	Johnson County, KS	Kennebunk, ME	Laughlin, NV	Martinez, CA	New Orleans, LA	Oakland, CA	Oklahoma City, OK	Orange County, CA	San Diego, CA	Tulsa, OK	Wayne County, MI
SSO Area																
<10,000 Ac		◆						◆								
10,000- 100,000 Ac	◆		◆	◆		◆	◆			◆	◆					
100,000 -500,000 Ac					◆				◆			◆	◆	◆	◆	◆
Estimated Past Cost																
<10 Million	◆		◆	◆			◆	◆	◆	◆		◆				◆
10-50 Million																
50-100 Million						◆										
100-500 Million											◆					
>500 Million					◆										◆	
Not Answered		◆											◆	◆		
Estimated Future Cost																
Abatement Complete. O&M Only					◆		◆	◆			◆	◆				
<10 Million			◆	◆												
10-50 Million	◆															
50-100 Million																
100-500 Million									◆	◆					◆	◆
>500 Million																
Not Answered		◆				◆							◆	◆		
Funding Source																
Municipal Funding									◆					◆		
Federal Grant Money										◆	◆					
Increase Sewer / Users Rates	◆	◆	◆	◆	◆		◆		◆	◆		◆			◆	
Increase Taxes															◆	
Innovative Technology Grant																
Investment Income form Bonds		◆	◆													
Revolving Loan	◆		◆			◆					◆				◆	◆
State Grant Money						◆										
Not Applicable Not Answered								◆					◆			

Cost Estimates ENR: 5921 July 1998
Questionnaire Date: July 1998.

R0018289

6.2 Case Histories for SSO Communities

6.2.1 Bloomington, Ind.

SSO Community Characteristics

♦ Population	110,000
♦ Sewer Area	77,000 Ac
♦ Annual Rainfall	60"
♦ # of SSO Discharge Points	15

Distinctive SSO Community Attributes

- Formation of utulity specifically for wet weather flows
- Retrofitting decommissioned WWTP as for off-line storage of wet weather flows

Bloomington's 250 miles of sanitary sewer are separate from the storm sewer system. However, during wet weather, the "separate" sewer system overflows at a number of points in the collection system, backs up into basements, and violates the NPDES permit for WWTPs. Bloomington's wet weather problem has been ongoing since the formation of the utility in the early 1970s. A sanitary sewer evaluation survey performed in conjunction with U.S. EPA's construction grants program identified a number of pipe replacement projects. The most recent project increased the capacity of two large pump stations in the collection system where SSOs frequently occurred. Unfortunately, these pipe replacement projects have done little to reduce the impact of wet weather discharges. These impacts have, for the most part, merely been transferred downstream.

In 1996, Bloomington experienced significantly higher than normal rainfall and the resulting wet weather impacts for that year were excessive. Also, the South WWTP consistently exceeded its design flow, and preliminary planning efforts began to either expand or replace the existing plant. At this point, Bloomington recognized the need to better manage wet weather flows and establish a wet weather management program. The focus of the $26 million dollar program was to reduce infiltration/inflow (I/I). Sewer system rehabilitation and replacement, off-line storage, and WWTP expansion are some of the strategies being investigated to reduce wet weather impacts.

A wet weather focus group consisting of a cross section of interested citizens was formed in 1997 and assisted in the selection of an engineering consultant to manage the wet weather program. The focus group meets on a regular basis and advises the wet weather management team in pursuing wet weather reduction strategies.

Currently, Bloomington is evaluating a number of cost-effective strategies. The South WWTP will add capacity through a combination of physical and process improvements. The lagoons at the decommissioned WWTP near the center of the collection system will be converted for off-line storage of peak flows during wet weather. Rehabilitation and replacement of the sewer pipe and manholes will be more aggressive, particularly in three problem areas of the city where SSOs and basement flooding have been concentrated. A number of direct SW connections to the sanitary sewer system have already been identified and eliminated. Bloomington has also formed a local SW utility in an effort to comprehensively manage wet weather impacts. Formerly operated and maintained at a minimum level under the city's public works department, the new utility dedicates funds especially for the operation and maintenance of the SW system in addition to capital repair of the long neglected infrastructure.

References and Contacts:
Mr. Douglas T. Jones
City of Bloomington Utilities
1969 S. Henderson Street
Bloomington, IN 47404

6.2.2 Houston, Texas

SSO Community Characteristics

♦ Population	1,800,00
♦ Sewer Area	385,000 Ac
♦ Annual Rainfall	46"
♦ # of SSO Discharge Points	20

Distinctive SSO Community Attributes

- Selection of SSO controls based on flow and water quality monitoring
- Use of wet weather treatment facilities for SSO
- Stakeholder involvement created wide support

Located 40 miles inland of the Gulf of Mexico, Houston is the fourth largest metropolitan area in the United States. Houston experienced a period of rapid growth early in the 20th century after a shipping channel connected the city to Galveston Bay and the gulf, making it a deepwater port. Other than the channel, most of the surface waters in and around Houston are classified as bayous. However, as Houston's bayous approach Galveston Bay they become wider and more closely approximate shallow tidal wetlands. During periods of wet weather, the bayous fill rapidly and carry SW away from the city to Galveston Bay.

The city's wastewater system is one of the country's largest. Currently, the average daily wastewater treatment demand is 250 MGD. With a service area of 600 square miles, it incorporates 46 WWTPs, 377 lift stations, 5,700 miles of separate sanitary sewers, and 100,000 manholes. The city provides water and wastewater service to approximately 378,000 customers and a total population of nearly 1.8 million. Much of Houston's growth in the last 25 years occurred as the city annexed previously unincorporated county areas. This rapid growth exceeded WWTP capacity. By the late 1980s, moratoriums on new construction existed in 90% of the metropolitan area.

Houston received administrative orders from the Texas Natural Resources Conservation Commission (TNRCC) and EPA Region 6 in 1987 requiring the city to control SSOs and upgrade the collection system by December, 1997. The administrative orders resulted in an investment of $1.2 billion by the city of Houston in SSO control.

Houston invested $65 million between 1988 and 1991 to evaluate its collection system and conduct extensive flow monitoring. The physical analysis identified infiltration due to leaking joints, cracks, and breaks in the city's sewers and laterals on private property as the primary sources of the increased wet weather flows. In 1992, the Greater Houston Wastewater Program (GHWP) was formed as an integrated organization of city employees and consultant staff, developed specifically for complying with the mandates of state and federal regulatory agencies. In the absence of a national SSO policy, the GHWP, TNRCC, and EPA Region 6 had to consider two principal issues regarding control of wet weather SSOs. These were: (1) the level of design storm protection that the collection system would provide for customers; and (2) the level of treatment required for overflows in excess of the design storm flow, based on impact to receiving water quality.

In 1994, Houston completed a water quality study of local receiving waters (bayous) for the purpose of quantifying the surface water quality benefits associated with SSO control alternatives. Monitoring confirmed that the quality of wet weather discharges from the constructed overflows was roughly equivalent to wet weather bayou water quality, so the city concluded that selection of a design storm for development of the capital improvements program was an issue of customer service, not water quality.

The capital improvements program, completed in December 1997, consisted of approximately 400 projects made up of relief sewers, sewer rehabilitation, new or upgraded pump stations, WWTP expansions, and wet weather facilities at a cost of nearly $1.2 billion. All engineering was performed by more than 70 local design firms, and most construction contracts were awarded to local firms, using local labor, equipment, and materials. The capital improvements program provided a significant boost to the local economy.

The GHWP was one of the most ambitious collection system improvement efforts ever undertaken in the country. Now complete, this comprehensive response to regulatory mandates and customer needs encompassed more than 400 projects. Both EPA Region 6 and TNRCC officials have given the city high marks for its progress and meeting the December 1997 deadline.

In November, 1997 TNRCC lifted the final set of administrative orders against Houston. This marked the first time in 24 years that the city was not under any administrative orders. The GHWP not only improved the reliability of the collection system, but also fostered local economic growth. New development boomed following completion of the SSO abatement program. In 1997 Houston issued building permits for $2 billion of new construction. This would not have been possible without the city's capital investment in its wastewater infrastructure.

References and Contacts:

Limno-Tech Inc. (as sub-contractor to Parsons Engineering Science) (1999) *Developing Case Studies on Sanitary Sewer Overflow Abatement Programs.* U.S. Environmental Protection Agency, Office of Water.

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6.2.3 Johnson County, Kan.

SSO Community Characteristics

◆ Population	400,000
◆ Sewer Area	120,000 Ac
◆ Annual Rainfall	37"
◆ # of SSO Discharge Points	20

Distinctive SSO Community Attributes

- Successful private property I/I reduction program
- Use of wet weather treatment facilities for SSO

Johnson County is located in eastern Kansas, on the southwest edge of the Kansas City, Mo., metropolitan area. The county includes 22 separate city governments. Johnson County Wastewater (JCW) operates three WWTPs throughout the county, treating a combined average dry weather flow of slightly more than 38 MGD. JCW also operates six wet weather treatment facilities that provide primary treatment to excess wet weather flows. These facilities were developed in the 1960s. JCW cleans and maintains more than 1,500 miles of sewer line and 32,000 manholes.

In the early 1980s, the sanitary sewer system was experiencing both excessive groundwater infiltration and SW inflow. In the districts, the considerable amount of I/I caused the wet weather facilities to activate frequently. Moderate amounts of rainfall often resulted in surcharging manholes, bypassing of raw wastewater to receiving streams, and backups of sewage into basements. The bypasses and backups of raw wastewater were a potential health hazard and resulted in considerable financial loss each year. During heavy rainfall events, JCW would receive hundreds of telephone calls from residents concerning basement flooding and sewage backups. In 1983, the Board of County Commissioners of Johnson County recognized the need for an aggressive public and private property I/I reduction program.

JCW's effort to control SSOs has two primary components: (1) an aggressive I/I reduction program; and (2) the operation of satellite wet weather treatment facilities. Numerous complaints by residents of sewers backing up into homes motivated JCW in 1985 to begin the extensive I/I reduction program. The program included a comprehensive sanitary sewer evaluation study to inspect all structures, including more than 55,000 private connections to residential and commercial properties.

The initial efforts of the I/I reduction program included inspection of numerous commercial and residential properties and public sector projects (manhole inspections, sewer line smoke testing, and television inspections) to ascertain the structural condition of the collection system. The goal was to determine the total number of I/I sources in the districts. Public notices were placed in local newsletters and area newspapers, explaining that inspectors would visit each property to obtain information from residents and owners concerning past problems with the collection system. While on site, the inspectors also located rainwater downspouts, area drains, and sump pump connections. As the information was collected, it was entered into a database, which allowed JCW to identify direct and suspect connections that were contributing inflow to the collection system. The inspection program covered more than 55,000 homes and businesses, eventually identifying approximately 15,600 sources on private property. The five most common private-property sources of I/I were foundation drains, basement entry drains, sump pumps, cleanouts and downspouts, and driveway and other area drains. Additionally, the program inspected more than 17,000 manholes and found that nearly all had some defect that allowed for inflow.

Following source identification and hydraulic modeling, the I/I reduction program focused on the elimination of as many of the known sources as possible in a prompt, orderly, and cost-effective manner. It was determined that a phased implementation would result in the lowest possible construction and administrative costs. The phased approach was based on a combination of watershed location, unit inflow rate, and the local history of sewer backups. The phasing tended to concentrate survey and construction activities in the same geographic area, thereby producing measurable improvements early in the program.

The I/I reduction program work was completed in 1994. The public and private property I/I reduction programs together resulted in a net reduction of nearly 280 MGD during the 10-year, 1-hour storm. The removal of 15,632 private property sources is estimated to have eliminated more than 110 MGD of the 280 MGD. Out of the 55,000 buildings in the districts, only nine remain to either be inspected (refused entry) or to have a source disconnected, and these are being addressed through the appropriate legal channels.

The total cost for the overall I/I reduction program was approximately $60 million. The private property work cost nearly $10.3 million, the public sector work (I/I reduction and relief sewers) almost $30 million and the remainder consisted of engineering and administrative expenses. JCW received almost $12 million in grant funds and nearly $18 million in state revolving fund low interest loans. However, the private property I/I reduction program expenditures were not grant or loan eligible and were funded with obligation bonds.

JCW's SSO control plan also includes the use of six satellite wet weather treatment facilities to provide primary treatment and disinfection to excess flows during wet weather. Although these facilities are somewhat controversial in that they are discharging partially treated sewage, JCW believes that they are a viable component of its effort to reduce direct human exposure to raw sewage. JCW has performed water quality monitoring during wet weather events and determined that the facilities have a minimal impact on the small urban creeks into which they discharge. JCW has also looked at the cost of eliminating the wet weather facilities while maintaining the same level of storm protection, and found costs prohibitive.

JCW believes that the I/I reduction program has significantly reduced I/I. The I/I work has met or exceeded the expected reductions in wet weather flows throughout the system. The focus on private property I/I was a proactive approach to reducing peak flows. EPA Region 7 and Kansas state officials agree that the allocation of local public funds to address private property I/I sources is an effective approach to solving I/I problems.

Through what is believed to be the largest private property I/I reduction program in the country, JCW has eliminated all capacity-related uncontrolled SSOs during events up to the 10-year, 1-hour (2.5 inches) storm.

References and Contacts:

Limno-Tech, Inc. (as sub-contractor to Parsons Engineering Science) (1999) *Developing Case Studies on Sanitary Sewer Overflow Abatement Programs.* U.S. Environmental Protection Agency, Office of Water.

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6.2.4 **Oklahoma City, Okla.**

SSO Community Characteristics	
♦ Population	470,000
♦ Sewer Area	400,000 Ac
♦ Annual Rainfall	40"
♦ # of SSO Discharge Points	20

Distinctive SSO Community Attributes

- ♦ Successful sewer rehabilitation and replacement program
- ♦ "Business" approach has markedly improved funding base and customer service

Oklahoma City is located in central Oklahoma, approximately 200 miles north of Dallas, Texas, spanning more than 620 square miles. Oklahoma City's central business district contains large numbers of commercial and single family residential properties, while the outskirts are primarily agricultural. Oklahoma City Water and Wastewater Department (OCW) provides water and wastewater services to more than 470,000 people spread across 320 square miles — nearly 96% of the city's total population. OCW maintains more than 2,400 miles of sewer line, including 63 lift stations and 4 WWTPs with a combined capacity of 101 MGD. The average dry weather flow to these plants is 75 MGD.

In the mid-1980s, SSOs in Oklahoma City sewers were a daily occurrence. The OCW, now part of the Oklahoma City Utility Trust, had a substantial backlog of complaints of sewer stoppages and overflows. Basement flooding occurred regularly in parts of the city. In 1986, OCW adopted an "enterprise system" under which all revenues derived from the water and wastewater utilities were put back into the system, instead of the city's general fund. With the inception of the enterprise system, OCW became committed to implementing efficient business practices and delivering quality water and sewer services. This effort, which continues today, included a dedication to sewer rehabilitation and repair which has virtually eliminated capacity constraints within the system and vastly improved customer service.

OCW does not have a specific SSO control plan. The progress it has made in controlling SSOs was not driven by water quality concerns. Rather, OCW established a goal of eliminating sewer back-ups in homes and has dedicated much of the work of the capital improvements program (CIP) to this end. At an annual cost of $6 million, or slightly less than $13 per capita, OCW replaces approximately 1%, or 120,000 linear feet of sewer line each year. The focus on sewer line replacement has been a continuous and sustained element of the CIP since 1986. The CIP has also included a number of improvements in the city's WWTP capabilities.

OCW tracks sewer system complaints and uses this information to gauge the success of the CIP investment in line replacement. Each complaint is entered into a database that helps identify persistent problem areas. By systematically replacing the weakest portions of the sewer system, OCW has dramatically improved wastewater service in Oklahoma City.

Fully 95% of OCW's maintenance activities are preventative, rather than reactive. Increased levels of routine maintenance have proved valuable in eliminating line blockages and in identifying the need for repairs before problems are elevated to emergencies.

The OCW management believes that there are three primary components to a well functioning utility: adequate financing, control over planning, and dedicated personnel. In Oklahoma City, the enterprise system has given OCW control over financing and planning for the water and wastewater utilities. The city's conversion to the enterprise system has resulted in excellent water and wastewater improvements. The revenues generated by the utility are controlled by the utility and put back into projects to improve utility services.

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The CIP focus on line replacement and I/I control has allowed Oklahoma City to decrease total flows to the WWTPs, while the population has grown, and virtually eliminate capacity related overflows within the system. Sewer rehabilitation programs have had numerous benefits, including: reduced frequency of emergency maintenance; lower incidence of damage to public and private property; extended infrastructure life; and decreased overflows and stoppages. All these contribute to the ultimate goal of improved customer service. Both the Oklahoma Department of Environmental Quality and EPA Region 6 officials believe that OCW has found an effective, proactive means of controlling SSOs and would like to see their efforts emulated by other jurisdictions.

References and Contacts:

Limno-Tech, Inc. (as sub-contractor to Parsons Engineering Science) (1999) *Developing Case Studies on Sanitary Sewer Overflow Abatement Programs.* U.S. Environmental Protection Agency, Office of Water.

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6.2.5 Wayne County (Downriver Communities), Mich.

SSO Community Characteristics	
♦ Population	320,000
♦ Sewer Area	100,000 Ac
♦ Annual Rainfall	34"
♦ # of SSO Discharge Points	20

Distinctive SSO Community Attributes

- Michigan state rigorous SSO abatement criteria
- Construction of a regional storage-transport system as SSO control

The Downriver Collection System (DCS) in Wayne County, Mich., serves more than 320,000 people in 13 communities. These communities are located southwest of Detroit and are known as the Downriver Communities.

Administered by the Michigan Department of Environmental Quality (MDEQ), Michigan has one of the most rigorous state-mandated abatement criteria for controlling SSOs. In deriving the criteria for controlling SSOs, MDEQ started by assuming wet sanitary sewers closely approximate storm sewers. Therefore, the design criteria is based loosely on standard storm sewer requirements. Storm sewers are normally designed to transport the 10-year, 1-hour storm in residential areas, and the 25-year, 1-hour storm in commercial areas. To be conservative, MDEQ initially considered using the 25-year, 1-hour storm event as a uniform standard for all areas. However, a storm of such short duration did not provide enough information about the volume required to contain a longer, equally intense storm. Hence, MDEQ adopted the 25-year, 24-hour design storm. With such rigorous design criteria, MDEQ expects very few overflow events. Most will be attributable to extreme conditions such as large back-to-back events; storms having intensities greater than the design storm; or theoretical system capacities reduced by high groundwater, snowmelt, or late winter rains on frozen ground. Therefore, each overflow event is reviewed on a case-by-case basis, with MDEQ giving careful consideration to extenuating circumstances before levying fines.

When MDEQ initiated legal action against the DCS in 1987, the collection system was experiencing 25 to 35 SSO events annually with an estimated total volume of 366 MG per year. Basement flooding due to sewer backups was also widespread within the DCS service area.

During the fall of 1990, as part of the Downriver Improvements Program, system-wide flow, rainfall, and groundwater information was collected. The flow monitoring revealed a number of system deficiencies and evidence that many of the tributary communities routinely exceeded their contractual peak flow, which in turn caused the hydraulic capacity of the system to be exceeded. Excess flows were determined to be attributable to high I/I in many communities, excessive pumping from the city of River Rouge, and a non-operational regulator in the city of Ecorse. It was also determined that the WWTP did not have sufficient capacity to handle the resultant flow if all communities were to simultaneously discharge at their contractual peaks.

Flow monitors in the thirteen communities were used to evaluate the relative contribution of each to the wet weather flow problem. The measured flows were also used in negotiations between the communities when determining an equitable distribution of the Downriver Improvement Program costs. In order to direct local rehabilitation efforts, most of the communities also undertook a concurrent flow-monitoring program to identify areas subject to the greatest wet weather inflows. In general, the older communities had higher levels of I/I, often two to three times those of newer areas. These high rates were mainly attributable to SW connections, footing drains, the relatively large older sewers, deteriorating pipes, and leaks in manholes.

The Downriver Communities entered into a consent agreement with MDEQ in 1994 after numerous violations of both the Federal Clean Water Act, the Mich. Water Resource Commission Act, and the terms and conditions of the county's NPDES permit. The objectives of the improvements program, mandated by the consent decree were:

- reducing discharges of untreated sanitary sewage,
- reducing basement flooding related to the DCS capacity or WWTP constraints, and
- reducing wet weather inflows into the collection system.

In order to meet these objectives, the collection system and the WWTP must have the capacity to transport and treat all flows (blend of primary and secondary treatment) up to the 25-year, 24-hour storm (roughly equivalent to 3 inches). The collection system must also have the capacity to transport all flows up to the 100-year, 24-hour storm (roughly equivalent to 4-5 inches) to the WWTP. The WWTP must provide secondary treatment for flow up to 125 MGD and a blend of primary and secondary for an additional 25 MGD. Flow that exceeds 150 MGD up to 225 MGD must receive preliminary treatment (screening, grit removal, and disinfection). Flows greater than those generated by the 100-year, 24-hour storm can be routed to "inactive" emergency bypass structures spread throughout the system.

The consent agreement put the DCS on a compliance schedule to reduce the occurrence and volume of SSOs. A number of alternatives, representing both "local" and "regional" approaches, were considered for meeting the requirements of the consent decree. These included: WWTP relief capacity for peak flows; off-line storage basins; on-line storage basins; and a regional storage-transport system including relief sewers and a large diameter tunnel. The regional storage-transport system was selected because it was the most cost effective on an annualized basis. This alternative was also particularly attractive because all flows would receive some treatment; all emergency discharges would, for the most part, go to the Detroit River (rather than smaller tributary streams); a minimum amount of site acquisition was required; and because of the lower O&M requirements associated with the operation of a regional facility compared to a series of satellite storage basins. In addition to the regional storage-transport system, the mandated SSO abatement plan includes the expansion of the WWTP, implementation of localized sewer rehabilitation programs, and construction of an off-line basin facility and an emergency discharge outfall.

Implementation of various aspects of the mandated improvements began in 1994. The rehabilitation of county interceptors and community sewers was completed in the fall of 1995, with significant state revolving fund loan assistance. Subsequently, system flows have been monitored to track the effectiveness of improvements and to provide data for sizing the regional storage-transport system. Work on the WWTP upgrades began in 1994, including the construction of dechlorination facilities, the installation of a new solids handling facility, and construction of a new maintenance facility. The WWTP is currently being expanded to provide reliable primary/secondary treatment for flows up to 150 MGD and preliminary treatment for emergency flows up to 225 MGD. The WWTP improvements also include expansion of the disinfection and outfall facilities, which will bring the capacity of these facilities in line with the increased capacity of the rest of the plant. The final component of the mandated improvements is the construction of community relief sewers and a large diameter tunnel. Construction of the upper portion of the tunnel and a county relief sewer began late in 1996. Local relief sewer projects commenced in 1997. Construction of the main portion of the tunnel began in 1998 and should be completed in 2001.

In general, water quality is a primary concern for local governments, and Wayne County officials do not believe that the SSOs within the DCS service area represented a $270 million water quality problem. Wayne County's Director of Public Works, James Murray, stated that: "SSO water quality objectives need to be integrated with CSO and SW quality objectives. Substantial costs are being incurred by the DCS to eliminate SSO discharges, while at the same time current SW and CSO programs provide for discharges into the same watercourse with effluent quality far less stringent."

Wayne County officials advocate a watershed-based approach, which would integrate the control of all sources of wet weather pollutants and yield a more cost effective solution with maximum water quality benefits. They also indicated that:

- it is not practical to assume that SSO events will never occur;
- it would be more appropriate to clearly define emergency conditions, identifying specific circumstances when a system bypass would be acceptable; and
- emergency conditions should not necessarily be based on a design storm, but rather on the frequency of occurrence of overflow events.

References and Contacts:

Limno-Tech, Inc. (as a sub-contractor to Parsons Engineering Science) (1999) *Developing Case Studies on Sanitary Sewer Overflow Abatement Programs.* U.S. Environmental Protection Agency, Office of Water.

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6.3 SSO Case Histories and Benchmark Data Discussion

6.3.1 General SSO Discussion

Although surveys and studies have collected information on sanitary sewer collection systems and SSOs, information on the status of the collection systems and extent of SSO problems remain limited. However, these surveys and studies have identified SSOs as a common characteristic of most sanitary sewer collection systems.

Because many municipalities have not quantified their SSOs, very few have moved to correct or abate this pollution source. The lack of a national SSO policy, and the rarely enforced NPDES requirements also make SSO abatement a low priority for most municipalities.

SSOs during dry weather conditions are less common today then they were in the past due to efforts to increase WWTP and collection system capacities. However, SSOs during wet weather conditions continue to be a common occurrence around the nation. Although many communities have not moved forward in abating wet weather SSO related concerns, some generalizations can be made about the condition of sanitary sewer collection systems and SSOs, and permitting inconsistencies around the nation.

There are many potential strategies that municipalities may adopt to abate SSOs. Most involve some combination of upgrading the WWTP, removing sources of I/I, and increasing the storage capacity of the collection systems. Some strategies involve technology used for CSO control, such as off-line storage and satellite treatment facilities. However, currently this approach is atypical. Reasons for abating SSOs come from customer complaints regarding sewer backups as much as from water quality concerns.

6.3.1.1 Sanitary Sewer Failures and Resulting Overflows

The Urban Institute (1984) estimated that as an annual average there are 825 sewer backups and 140 sewer breaks every year for every 1,000 miles of sewer. A system of 1,000 miles of sewer serves about 250,000 people. The Urban Institute also proposed that sewer backup rates were highest in the northeast and economically distressed cities and were generally higher in communities with the oldest sewer systems. High sewer break rates in the south and west are particularly associated with large, growing cities. The Urban Institute survey attributed backups to a variety of factors: the location of pipe in trouble-prone areas, the pipe material, the size of pipes, the material, construction methods, local soils, and maintenance practices.

In 1994, the Civil Engineering Research Foundation found that three quarters of the sanitary sewer systems function at 50% of capacity or less. Root penetration, corrosion, soil movement, and inadequate construction are the cause of most structural failures.

As a result of reduced sewer capacity and failures, SSOs during wet and dry weather are a reality. The Association of State and Interstate Water pollution Control Administrators (ASIWPCA) found that 31% of municipal systems have at least an occasional dry weather SSO. The estimated annual number of dry weather SSOs was 1,962 for the 25 states providing information. The ASIWPA study also found that 29% of the municipal sanitary sewer systems experience wet weather SSOs and 25% of the WWTPs experience some problems during wet weather.

In a Water Pollution Control Federation study (1989), 1,003 WWTPs identified facility performance problems. I/I was the most frequently cited problem.

6.3.1.2 NPDES Inconsistencies

Different NPDES authorities have historically provided different emphasis on oversight of sanitary sewer collection systems. In addition, some of the NPDES regulatory provisions addressing sanitary sewer collection systems are unclear, and different NPDES authorities have provided different interpretations regarding SSOs. For example, the ASIWPCA study (1996) found that only two states issue permits to municipalities that discharge from their sanitary sewer system to another municipal sewer collection system, five states issue permits for some of these types of system, and 26 states do not issue permits for these systems. The ASIWPCA study also found that 13 states authorize wet weather control facilities that provide some level of treatment or flow control. EPA Region 6 and states in at least four other EPA regions (2, 3, 5 and 9) have issued permits for controlled discharges from wet weather facilities. Other states and EPA regions have not currently decided whether or not to allow wet weather facilities.

6.3.2 SSO Questionnaire Findings

6.3.2.1 SSO Community Statistics

The SSO benchmark questionnaires returned cover a wide range of conditions and receiving waters. Most SSOs discharge into rivers, but lakes, the ocean, estuaries, and streams are also represented, and most communities discharge into several different types of receiving waters. The surveyed SSO communities also represent a wide range of populations and service areas. Annual rainfall for these communities varies significantly. Many communities had not determined the quantity of annual SSO discharge, in part because many SSOs occur as basement and street flooding which is difficult to quantify.

In contrast to CSO and SW, most communities have not defined their SSO annual discharge quantity; Wayne County, Mich. was one of the few exceptions. Flow monitoring in 13 Wayne County communities was used to evaluate the relative contribution of each to the wet weather pollution.

6.3.2.2 SSO Public Participation

Public participation for SSO tends to be different as compared to CSO and SW. SSO public participation efforts tend to originate from sewer backup-related occurrences rather than environmental issues or water quality. Therefore SSO public participation tends to be more of a pragmatic approach rather than environmental education approach. For example, Houston, Texas needed to move ahead simultaneously with initial planning, design, and construction activities in order to meet a consent agreement deadline. The local engineers and construction community, along with the municipality staff, organized together during the initial phase of planning and program development. This relationship helped the stakeholders to become fully committed to the process well ahead of actual design and construction contracts.

General water quality, along with basement flooding and other sewer backup related occurrences, were the most commonly listed public concerns. The major water quality parameters of concern were bacteria, BOD, and dissolved oxygen.

6.3.2.3 SSO Systems Characteristics

The majority of the communities responding had used a mathematical model to estimate flow in their sanitary sewer collection systems. Houston invested $65 million between 1988 and 1991 to evaluate its collection system and conduct extensive flow monitoring. The physical analysis identified infiltration due to leaking joints, cracks, and breaks in city sewers and private property laterals as the primary source of increased wet weather flows. The collection system modeling helped Houston better define the size of the satellite treatment facilities.

Although many communities say they use a watershed approach, some interpret this approach as encompassing all the sewers and laterals in the sewershed when planning for rehabilitation or abatement. Houston and the Downriver Communities, however, pursued a more ideal watershed approach. The city completed a water quality study of local receiving waters for the purposes of evaluating surface water quality benefits associated with SSO control. Monitoring and modeling confirmed that the water quality of wet weather pollution from constructed overflows was roughly equivalent to wet weather receiving water quality. As a result, the goals of the SSO control program were more concerned about customer service (i.e., sewer backups) than receiving water quality. The Downriver Communities in Wayne County also pursued a watershed approach, but the results were not as successful as Houston. The Downriver Communities identified other pollution sources in the watershed such as CSOs and SW. However, the regulatory agency viewed each pollution source separately and held the Downriver Communities to rigid SSO effluent standards regardless of water quality impacts of other pollution sources.

Current pollutant abatement included municipal and industrial point sources, plus urban runoff, from practically all cities. Control efforts for the same targeted pollutant sources were generally expected to remain in the future.

6.3.2.4 *Issues Driving SSO Technical Considerations*

Two cities, Flagstaff and Oklahoma City, indicated that an SSO facility plan has not been initiated. The remaining communities were equally split between developing a plan and completion of a facility plan. Of the many potential strategies municipalities may adopt to abate SSOs, most involve some combination of upgrading the WWTP, removing sources of I/I, and increasing the storage capacity of the collection systems. Some abatement strategies involve technology used for CSO control, such as off-line storage and satellite treatment facilities. However, currently this approach is atypical. Bacteria, BOD, and dissolved oxygen were the most prevalent water quality criteria for local receiving waters. Floatables, sediments, and nutrients were also notable water quality concerns.

Planned sewer improvements and regulatory requirements were listed as the most common reason for SSO abatement. A few communities, such as Downriver Communities, Hillsboro, Houston, and New Orleans, responded to litigation.

SSO abatement is almost exclusively accomplished by I/I reduction. However, upgrading the WWTP and increasing the storage capacity of the collection systems are also common. In a few select cases, such as Johnson County and Houston, satellite treatment of SSOs have been approved. Satellite treatment technology included screening, settling tanks or ponds, and disinfection. Such an approach provided a cost-effective means of complying with water quality requirements.

6.3.2.5 *SSO Financial Considerations*

Most communities spent less than $10 million for past SSO costs, indicating that the communities have not started major infrastructure-type abatement. Most communities have acquired or plan to acquire funding for SSO abatement through increased sewer rates. Another common funding source was revolving loans.

CHAPTER 7.0

SW Benchmark Data and Case Histories

7.1 Benchmark Data for SW Communities

The following section includes a benchmark matrix for general SW community statistics (Table 7-1), SW public participation (Table 7-2), SW systems characterization (Table 7-3), issues driving SW technical considerations (Table 7-4), and SW financial considerations (Table 7-5).

7.2 Case Histories for SW Communities

Stormwater case histories are useful in documenting the successes and disappointments of SW management in areas having up to several decades of experience. Most U.S. cities are just beginning to consider local SW controls as a result of federal regulations. However, the literature (especially technical conference publications) shows that many cities throughout the country have been involved to a certain extent in some SW control. The following case histories present five municipalities that have been involved in local SW management longer than many in the nation: Bellevue, Wash., Denver, Colo., Austin, Texas, Milwaukee, Wis., and Orlando, Fla. These mature SW management programs have all progressed through many phases of operation and are renowned for developing or making major advances in certain specific aspects of SW management, such as utility district financing, integrating drainage and water quality issues, addressing groundwater problems, and dealing with watershed-scale problems.

7.2.1 Austin, Texas

Austin has been long known as an innovator for SW controls, especially the sand filter. It was also one of the earliest cities to enact comprehensive SW management regulations specifically to protect both surface and groundwater receiving water quality.

Austin was incorporated in 1839 and is a rapidly growing city, with a population of about 460,000 (1990 census). It is the capital of Texas, home to the University of Texas, and an important high-technology center. The city covers an area of 116 square miles and the land elevation ranges from about 400 to over 1,000 ft. The area receives about 32 inches of rain a year, but can have prolonged dry periods with large amounts of evapotranspiration, resulting in arid characteristics. The separate storm drainage system discharges into several heavily urbanized streams which drain to the Colorado River. The river is dammed in Austin into a chain of three large lakes (Lake Travis, Lake Austin, and Town Lake) that comprise the local water supply. The Edwards Aquifer recharge zone underlies parts of Austin, making groundwater protection an additional important component of local SW management efforts.

Table 7-1. SW Community Statistics

City	Austin, TX	Bellevue, WA	Birmingham, AL	Boston, MA	Burbank, CA	Denver, CO	Detroit, MI	Frederick, MD	Fridley, MN	Hillsboro, OR	Orem, UT	Orlando, FL	River Falls, WI	Struthers, OH
Receiving H2O Type														
Estuary				◆										
Lake	◆	◆	◆			◆	◆		◆		◆	◆		
Ocean				◆										
River	◆			◆		◆	◆		◆	◆	◆		◆	◆
Stream	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆			◆	
Groundwater											◆			
Population														
<500,000	◆	◆	◆		◆			◆	◆	◆	◆	◆	◆	◆
500,000 - 1,000,000														
>1,000,000				◆		◆	◆							
SW Area														
<10,000 Ac				◆	◆			◆	◆		◆		◆	
10,000- 100,000 Ac	◆	◆	◆							◆				◆
100,000 -500,000 Ac	◆					◆	◆					◆		
Annual Rainfall														
0-20"					◆	◆					◆			
20-30"									◆					
30-40"	◆	◆					◆			◆			◆	◆
40-50"				◆				◆				◆		
>50"			◆											
# of Discharges to Public Waters														
<10											◆			
10-50														
50-100									◆				◆	
>100	◆	◆		◆		◆	◆					◆		
Not Answered			◆		◆			◆		◆				◆
Annual Wet-Weather Discharge Qty.														
<10 MG														
10-100 MG														
100-1,000 MG														
>1,000 MG	◆						◆							
Not Answered		◆	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆	◆

Questionnaire Date: July 1998.

Austin's peak discharge control regulations were implemented in the mid-1970s in response to the city's rapid growth and associated increased flooding and erosion. SW quality regulations were first implemented in the early 1980s to protect the city's water supply. A drainage fee was established in 1982 and the Drainage Utility was established in 1991.

SW Community Characteristics

◆ Population	460,000
◆ Sewer Area	100,000 Ac
◆ Annual Rainfall	32"
◆ # of SSO Discharge Points	200

Distinctive SW Community Attributes

- Innovative SW controls, incluiding the sand filter
- One of the first communities to develop comprehensive SW management regulations

Table 7-2. SW Public Participation

City	Austin, TX	Bellevue, WA	Birmingham, AL	Boston, MA	Burbank, CA	Denver, CO	Detroit, MI	Frederick, MD	Fridley, MN	Hillsboro, OR	Orem, UT	Orlando, FL	River Falls, WI	Struthers, OH
Level of Participation														
Proactive	◆	◆		◆	◆	◆	◆			◆		◆	◆	
Reactive														
Minimum required by Law			◆					◆	◆		◆			◆
Type of Participation														
Brochures / Pamphlets				◆		◆								
Newsletters														
Public Addresses thru Media						◆								
Public Hearings/Meetings	◆			◆										
Educational & Awareness	◆	◆		◆	◆	◆						◆	◆	
Special Committee		◆											◆	
None			◆					◆	◆		◆			◆
Not Answered							◆			◆				
Public Concerns														
Recreation		◆		◆	◆									
Aesthetics			◆											
Facility Construction														
Cost for Abatement														
Flooding	◆		◆		◆	◆		◆	◆	◆	◆	◆	◆	◆
Public Health		◆					◆							
Water Quality	◆	◆		◆	◆	◆	◆				◆	◆	◆	◆
Minimal														
Uninterrupted Service		◆			◆									

Questionnaire Date: July 1998.

Table 7-3. SW Systems Characterization

City	Austin, TX	Bellevue, WA	Birmingham, AL	Boston, MA	Burbank, CA	Denver, CO	Detroit, MI	Frederick, MD	Fridley, MN	Hillsboro, OR	Orem, UT	Orlando, FL	River Falls, WI	Struthers, OH
Mathematical Model for Flow Estimates														
Yes					◆	◆	◆							
No	◆		◆	◆					◆	◆		◆		
Not Answered		◆						◆			◆		◆	◆
Watershed Approach to Consider Other Wet-Weather Impacts														
Yes	◆	◆		◆	◆	◆	◆	◆	◆	◆		◆	◆	◆
No			◆								◆			
Current Abated Wet-Weather Pollution														
Municipal Point Source		◆	◆		◆	◆		◆	◆	◆		◆	◆	◆
Industrial Point Source		◆	◆		◆	◆		◆	◆	◆		◆	◆	◆
Urban Runoff	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆
Agricultural Runoff					◆		◆			◆			◆	
Other		◆		◆			◆	◆		◆				
Not Answered											◆			
Future Abated Wet-Weather Pollution														
Municipal Point Source			◆			◆		◆	◆		◆		◆	◆
Industrial Point Source	◆		◆			◆		◆	◆		◆		◆	◆
Urban Runoff	◆		◆		◆	◆	◆	◆	◆		◆	◆	◆	
Agricultural Runoff							◆			◆			◆	
Other				◆			◆							
Not Answered		◆												

Questionnaire Date: July 1998.

Table 7-4. Issues Driving SW Technical Considerations

City	Austin, TX	Bellevue, WA	Birmingham, AL	Boston, MA	Burbank, CA	Denver, CO	Detroit, MI	Frederick, MD	Fridley, MN	Hillsboro, OR	Orem, UT	Orlando, FL	River Falls, WI	Struthers, OH
Facility Plan														
Completed	◆	◆					◆							
In Progress						◆			◆	◆	◆		◆	◆
Not Started / None			◆	◆				◆						
Not Answered					◆							◆		
Reason for SSO Abatement														
Planned Sewer Improvements		◆	◆	◆	◆					◆	◆		◆	
Regulatory Requirements	◆	◆		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Litigation / Lawsuit			◆				◆			◆				
Significant Pollution Event	◆													
Receiving H2O Criteria														
Bacteria	◆				◆		◆		◆	◆	◆	◆	◆	◆
BOD	◆								◆	◆	◆		◆	◆
Dissolved Oxygen	◆				◆		◆		◆	◆	◆	◆	◆	◆
Floatables	◆		◆		◆		◆				◆		◆	
Heavy Metals					◆									
Nutrients	◆		◆		◆					◆	◆	◆	◆	
Sedimentation	◆		◆						◆	◆	◆		◆	
Solids	◆		◆								◆		◆	◆
Temperature													◆	
Toxins	◆		◆								◆	◆	◆	◆
Other					◆	◆					◆			
Not Answered		◆		◆				◆						
Abatement Tech Selection														
Benefit-Cost Analysis					◆				◆	◆	◆		◆	
Regulatory Requirement	◆	◆	◆		◆	◆		◆	◆	◆			◆	◆
Not Answered				◆			◆					◆		
Selected Technologies														
Construction Site Erosion Controls	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆	◆	◆	
Public Works Practices	◆	◆	◆	◆		◆		◆	◆	◆	◆	◆	◆	
Infiltration	◆			◆		◆	◆	◆	◆	◆	◆		◆	
Sedimentation	◆	◆	◆			◆	◆	◆	◆	◆	◆	◆	◆	
Other	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	
Not Answered														◆

Questionnaire Date: July 1998.

Austin has enacted three major watershed ordinances to protect both surface water and groundwater resources:

- the Comprehensive Watersheds Ordinance (1986),
- the Urban Watersheds Ordinance (1991), and
- the Barton Springs Ordinance (1992).

The objectives of the local SW management program are to:

- protect citizens from flooding,
- preserve the natural and traditional character of the city's waterways,
- protect the water quality of the Edwards Aquifer and the city's drinking water supply, and
- protect the city's recreational and aesthetic resources (such as Town Lake and Barton Springs).

Some of the ordinance requirements are very specific, such as those for source controls as part of the Barton Springs ordinance. Because of some of these requirements, especially for areas outside the city limits, successful court challenges by developers have weakened some of the laws.

Current funding for the city's erosion and sediment control program is about $750,000 (evenly derived from general city appropriations, permit fees, and from the SW utility fee). The SW management program is funded at about $8 million (mostly from the SW utility fee).

Table 7-5. SW Financial Considerations

City	Austin, TX	Bellevue, WA	Birmingham, AL	Boston, MA	Burbank, CA	Denver, CO	Detroit, MI	Frederick, MD	Fridley, MN	Hillsboro, OR	Orem, UT	Orlando, FL	River Falls, WI	Struthers, OH
SW Area														
<10,000 Ac				◆	◆			◆	◆		◆		◆	
10,000- 100,000 Ac	◆	◆	◆							◆				◆
100,000 -500,000 Ac	◆					◆	◆					◆		
Estimated Past Cost														
<10 Million	◆			◆		◆					◆			◆
10-50 Million														
100-500 Million														
>500 Million							◆							
Not Answered		◆	◆		◆			◆	◆	◆		◆	◆	
Estimated Future Cost														
<10 Million	◆													◆
10-50 Million						◆					◆			
100-500 Million														
>500 Million							◆							
Not Answered		◆	◆	◆	◆			◆	◆	◆		◆	◆	
Funding Source														
Revolving Loan				◆			◆							
Increase Sewer Rates	◆						◆							◆
State Grant Money				◆									◆	◆
User Fees from Utility District						◆			◆		◆		◆	◆
Federal Grant Money					◆		◆						◆	
Increased Taxes						◆	◆						◆	
Other					◆	◆	◆		◆			◆		
Not Answered		◆	◆					◆		◆				

Cost Estimates ENR: 5921 July 1998
Questionnaire Date: July 1998.

The city has long conducted local monitoring activities. The city worked with the U.S. Geological Survey on a cooperative effort starting in 1975 to evaluate SW from eight large mixed land use watersheds. Starting in 1981, the city also participated in NURP, monitoring runoff from two residential areas and one undeveloped area. The city expanded its efforts in 1984 to include a total of 11 single land use areas representing new development. Five additional single land use sites (older, existing areas) were monitored as part of the NPDES SW permit. Selected event mean concentration data from these monitoring activities are shown in Table 7-6.

Table 7-6. Land Use versus Event Mean Concentrations, Austin, Texas

mg/L	Suspended Solids	COD	Total P	TKN	NO2 NO3	Lead	Copper	Zinc
Open/Vacant/Parkland	80	26	0.10	0.52	0.15	0.004	0.01	0.008
Medium density, single-family	170	83	0.47	2.35	0.96	0.02	0.05	0.10
Townhouse/apartment	111	113	0.38	1.82	0.58	0.02	0.02	0.10
Commercial/office/ light industrial/utilities	111 160	113 93	0.38 0.39	1.82 1.65	0.58 0.39	0.02 0.05	0.02 0.04	0.10 0.20
Institutional	160	93	0.47	2.35	0.96	0.05	0.04	0.20
Major roads/highways	143	103	0.44	1.78	0.83	0.53	0.05	0.37

In 1989, the city started a study to identify and quantify the critical pollutants and sources adversely affecting the Town Lake water supply, listed below, along with their removal goals, in order of decreasing importance:

- nutrients (25 - 30%),
- toxic metals (50%),
- suspended solids (50%),
- trash and debris (50 - 90%), and
- oil and grease (25%)

Concentration reduction efficiencies for various SW control devices have been extensively evaluated in Austin to support the city's SW management planning activities. Table 7-7 summarizes some of the expected concentration reductions for the flows being treated. Because some devices bypass significant amounts of untreated SW due to clogging (especially in sand filters due to inadequate maintenance) or because they are undersized (such as for oil/water separators), the actual annual pollutant removals may be substantially less. In addition, Table 7-7 only reflects concentration reductions and not the greater pollutant mass reductions associated with devices having significant infiltration benefits (such as for grassed waterways).

Table 7-7. Concentration Reduction Efficiencies for SW Controls, Austin, Texas

% Reduction	Wet Pond	Sand Filter (no pretreat)	Dry Pond (earth/grass lined)	Oil/Water Separator	Grassed Waterway
Suspended Solids	93	87	16	17	68
COD	50	67	8	42	33
Total P	87	61	3	66	43
TKN	57	62	12	40	32
Lead	39	80	16	na	na

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7.2.2 Bellevue, Wash.

SW Community Characteristics

♦ Population	100,000
♦ Sewer Area	19,000 Ac
♦ Annual Rainfall	35" - 40"
♦ # of SSO Discharge Points	>100

Distinctive SW Community Attributes

- One of the first communities to establish SW utility
- Rate structure based on runoff volume generated

Bellevue has a long history of SW management. It was one of the first communities in the U.S. to establish a SW utility district and to develop a method for local financing of both flood control and water quality enhancements. Bellevue is a rapidly growing community near Seattle, with a population of about 87,000 (1990 census) and covering more than 30 square miles. The area receives 35 to 40 inches of rainfall a year with a separate drainage system. The SW is discharged to many small heavily urbanized streams which lead to Lake Washington.

Washington state law was changed in 1965 to allow the establishment of utilities as a funding mechanism for SW control. The city established its storm and surface water (SSW) utility in 1974, after several years of discussion and planning based on citizen concerns about declining water quality in Bellevue streams. The SSW utility's founding mission was "to maintain the hydrological balance, to prevent property damage, and to protect water quality; for the health, safety, and enjoyment of citizens and the preservation and enhancement of wildlife habitat." During the initial five years, the utility focused mostly on runoff volume and velocity, and erosion control. After these fundamental problems began to be addressed, the utility was able to shift its focus to also include water quality objectives.

A critical part of the development of the SSW utility was the establishment of a rate structure based on volumetric runoff coefficient (Rv) generated:

- undeveloped (Rv <0.25),
- light (0.25 <Rv<0.4),
- moderate (0.4<Rv<0.5),
- heavy (0.5<Rv<0.75), and
- very heavy (0.75<Rv<1.0).

Onsite runoff controls result in rate reductions. A major public education program was conducted to emphasize the benefits of the utility and the costs. In 1991, the average single-family household paid about $90 per year to the SSW utility. The 1986 budget was about $4.3 million, and the 1980 to 1986 capital improvement budget was

$13 million. In 1997, the SW program was funded at about $450,000 per year from permit fees, and the erosion and sediment control program is funded at about $500,000 per year from the SW utility fee and permit fees. Both programs have a combined staff of two administrators, three full-time development reviewers (plus four part-time reviewers), four inspectors (plus two part-time inspectors), and three others, including support staff.

Some opposition continued to the utility fee within the city, but it has subsided greatly as the citizens understand the benefits of the utility. The main benefit is in preventing problems instead of responding to existing problems, which tends to diminish the utility's perceived value. Adding a stronger component to more adequately address water quality issues is a future challenge being currently addressed by Bellevue.

Preferred SW practices include wet detention ponds, grass roadside drainage swales, catchbasins, oil-water separators, and filters. Ground infiltration practices are not allowed due to slowly percolating soils and problems with these practices in the past. During 1992 and 1993, 13 biofiltration facilities, 8 extended dry detention ponds, and 1 filtration facility were installed.

The SSW major programs include:

- capital improvement (by 1991, 11 ponds with real-time control had been established for flood control);
- operations and maintenance (operating flood control facilities to minimize fishery impacts, consulting with private property owners to solve private drainage problems, cleaning inlets and storm drainage, repairing structural facilities, emergency response, etc.);
- water quality (routine monitoring of all receiving waters, stream enhancement and lake restoration projects, inspection of private SW systems, etc.);
- development regulations (using the city's land use authority to regulate construction, enforce clearing, grading, and development of sensitive areas, inspect construction sites, etc.);
- public education (award-winning "stream teams" and "business partners for clean water" programs, etc.); and
- administration (policy development, financial management, rate administration, drainage planning, etc.).

Bellevue participated in NURP, resulting in much data on local characterization and control effectiveness. With this local data, the city applied for a general NPDES permit for SW in 1985, more than ten years before the SW NPDES permit program was established for the country.

The SSW utility operates a spill response team on 24-hour call to respond to accidents or citizen calls for inappropriate or illegal discharges to the drainage system or streams. It also operated one of the first oil recycling programs in the nation.

The Bellevue SSW utility efforts have succeeded because:

- the utility is a unified agency (although city reorganization in 1993 resulted in the erosion and sediment control program being assigned to a different city unit);
- the utility has the backing of strong regulations;
- the utility has strong citizen support;
- all enforcement and maintenance activities are staffed within the utility; and
- the utility coordinates extensively with other agencies and governments in the region.

The SSW utility programs do have some current conflicts with other city programs, such as biofiltration conflicting with the city's land use code landscaping requirements, and the preferred use of swales conflicting with the city's transportation code.

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7.2.3 Denver, Colo.

SW Community Characteristics

♦ Population	>1,000,000
♦ Sewer Area	>100,000 Ac
♦ Annual Rainfall	15"
♦ # of SSO Discharge Points	2,000

Distinctive SW Community Attributes

- Successful SW utilities
- Flood control receives more emphasis than water quality

Denver is known for its efforts in flood control in an arid, high elevation area that receives large amounts of runoff from upstream areas. The city's efforts to develop and evaluate site-specific SW quality control practices and its experiences with utility district are also noteworthy.

Denver was incorporated in 1858 and had a population of about 470,000 in 1990. The city covers an area of about 155 square miles and is at an elevation of more than 5,000 ft. The area receives only about 15 inches of rain a year and experiences cold and long winters. The separate stormwater system has more than 1,000 outfalls in the metropolitan area that discharge into small streams that, in turn, eventually discharge into the Platte River. Rain occurs on about 60 days a year, but only about 30 storms per year are of sufficient size to produce runoff.

The Urban Drainage and Flood Control District (UDFCD) serves an area of about 400 square miles, having a total population of more than 2 million. Flood control has received the most emphasis from the district, and receiving water quality problems are not generally thought to be associated with wet weather flows because of other influencing factors. However, a watershed approach has been taken locally where urban runoff, municipal point sources, and industrial point sources are being addressed. Federal and state regulatory requirements are the major driving forces behind local wet weather flow water quality control efforts.

Denver was a participant in NURP in the early 1980s, monitoring several catchments and control practices over several years.

About $4 million has been spent in the past on wet weather pollution control efforts, and about $10 million is projected to be spent in the future, coming from increased taxes, user fees from the utility district, and by reallocation of funds from other municipal activities. The UDFCD is coordinating NPDES SW permit activities for the cities of Denver, Aurora, and Lakewood. As more communities in the Denver area are required to participate in the

NPDES permit program, the UDFCD will be available to assist these other areas also. A joint task force was created in 1990 to define the goals, objectives, and responsibilities necessary to meet the needs of the permit process. The initial goals were to:

- coordinate application efforts of the three cities,
- jointly negotiate application requirements with the state of Colorado,
- jointly conduct activities whenever possible,
- share knowledge and experience,
- facilitate use of resources of other organizations,
- evaluate candidate SW control practices,
- develop dry weather screening work plan, and
- develop a joint SW monitoring program.

In addition to helping to coordinate these activities, the UDFCD, in conjunction with local colleges, also conducts erosion control training courses for local contractors.

The NPDES SW permits were issued by the state to the three cities in May 1996. All permit requirements must be implemented within three years. Some of the permit requirements, such as street and inlet cleaning and trash removal from channels, has been an on-going activity, but other activities will need to be implemented, including:

- annual reporting and cost estimates,
- industrial facilities program,
- municipal facility runoff controls,
- wet weather monitoring program,
- dry weather sampling protocols, and
- other major programs (including public education, new development planning procedures, and construction site sediment control).

Local construction site erosion control efforts typically include mulching, diversions, filter fencing, and sedimentation practices. Stormwater control is accomplished through many activities, including public works practices (street and inlet cleaning, litter control, oil/water separators, inappropriate discharge elimination, grass swales, and grit chambers), infiltration (porous pavement and grass filters), sedimentation (wet detention ponds and wetlands), and other activities (including dry detention ponds, filtration, and public education). The performance of many of these devices has been determined through local monitoring. The district identified severe problems with typically constructed sand filters, such as clogging caused excessive bypassing of untreated water. Design guidelines need to be modified to account for expected high suspended solids loadings and to enable more efficient maintenance. Monitoring a wet pond followed by a series of wetland cells showed moderate to high levels of control of many pollutants over a wide range of runoff conditions.

Stream restoration along the Platte River has also been successful. Denver is well known for Confluence Park, a $7.5 million project that incorporates flood control, boating access, recreation, 5 acres of wetlands, wildlife and aquatic habitat, plus a cooling water diversion structure for a power plant. Denver also had constructed more than 12 miles of recreational trails along the South Platte River within the city, which connects with six other trails having an additional 50 miles.

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7.2.4 Milwaukee, Wis.

SW Community Characteristics

◆ Population	630,000
◆ Sewer Area	61,500 Ac
◆ Annual Rainfall	30"
◆ # of SSO Discharge Points	Unknown

Distinctive SW Community Attributes

- Extensive SW quality information
- Watershed approach and nonpoint source pollution control

Milwaukee has a great deal of SW quality information and a state regulatory program that has put these data to good use in a watershed context.

Milwaukee was incorporated in 1846 and has been known as a heavily industrialized city, although it is more diversified now. It had a population of abut 630,000 in 1990 and a land area of about 96 mi^2. Its elevation is about 600 ft. The central part of Milwaukee has a combined sewer system, but the vast majority of the city and most of the surrounding communities have separate storm drainage. The storm drains flow to Lake Michigan, with most stormwater flowing from the Milwaukee, Kinnickinnic, and Menomonee Rivers (which form the inner harbor) from urbanized tributaries (such as Lincoln Creek). The annual rainfall in Milwaukee is about 30 inches, and snow cover is common for several months each winter. Winter temperatures can be severe and snowmelt is an important contributor to urban runoff pollution, in addition to rainfall induced runoff.

Stormwater quality management in the Milwaukee area was initiated as part of the Wisconsin Priority Watershed Program. This program (one of the oldest in the nation funding nonpoint pollution abatement) was developed in 1978 to help combat both urban and rural nonpoint sources of pollution. An important element of the program is retrofitting control practices in both rural and urban areas. Initially the program was heavily involved in rural areas, with technical assistance from the National Resources Conservation Service (NRCS). A unique aspect of the program is that it is implemented on a watershed and not on a political jurisdiction basis. Of the state's 330 watersheds, 130 (mostly located in the southern part of Wisconsin) will likely require comprehensive management activities to control nonpoint pollutants. A 25-year plan was developed in 1982 that requires the startup of about eight or nine new watershed abatement efforts per year. The watershed plans are prepared by the state with cooperation and reviews by local government agencies. They contain detailed analyses of the water resources objectives (existing and desired beneficial uses including the problems and threats to these uses), the critical sources of problem pollutants, and the control practices that can be applied within each watershed. The plans also include implementation schedules and budgets to meet the pollution reduction objectives.

Each plan requires one year to prepare, including the necessary fieldwork. Various field inventory activities are needed to prepare the plans, including aquatic biology and habitat surveys to identify existing and potential fishery uses, streambank surveys to identify the nature and magnitude of streambank erosion problems and to help design needed controls, field and barnyard surveys to supply information needed to estimate and rank their pollution potentials and to design farm control practices, and urban surveys needed to evaluate urban runoff pollution potential and its control.

Urban planning was initiated in 1983 in the Milwaukee and Madison areas, with other urban areas of the state following. The urban practices eligible for cost sharing identified in these plans have included streambank protection, detention basins, and infiltration devices for existing urbanized areas. Construction site erosion controls are also usually required as a condition for a grant agreement in an urban area, but they are not eligible for state cost sharing. About $3 to $5 million per year will be used by the nonpoint source program over a 20-year period in controlling urban runoff.

The Wisconsin nonpoint source plan addresses watersheds, not just political areas. The Milwaukee River basin contains 500 streams, 100 lakes, and 60,000 acres of wetlands in its 900-square-mile watershed. The city of Milwaukee is at the terminus of the river, where it discharges into Lake Mich. The water quality in the watershed varies dramatically, from excellent in many headwater trout streams to poor in the heavily urbanized southern portions of the basin. The Milwaukee Basin Priority Watershed Program started in 1985 as a voluntary program to address both urban and rural sources of nonpoint pollution. More than 500 rural landowners and 26 local governments have participated in the program, with total local and state investments of about $40 million.

An outcome of the Milwaukee River South Watershed plan included goals for reducing urban SW discharges. These goals were 50% reduction for suspended solids and heavy metals, and 50% to 70% reduction for phosphorus. The city cleanup program has four elements:

- local controls on construction erosion,
- improved SW management,
- better urban housekeeping, and
- streambank erosion controls.

The city identified construction site erosion as the leading cause of sediment into the Milwaukee River South watershed. Of the annual 26,000 tons of sediment, about 62% comes from construction sites, while only 16% comes from cropland, with the remainder from urban SW and streambank erosion.

A Wisconsin Pollutant Discharge Elimination System permit (under EPA NPDES authority) was issued to Milwaukee in October 1994. It covers SW discharges from more than 200 major outfalls to area streams and Lake Mich. The permit addresses discharges from Milwaukee and another 26 local communities. These communities each pay the Wisconsin Department of Natural Resources $5,000 per year as a permit fee, totaling more than $1 million for the 5-year permit period.

An important part of the Milwaukee wet weather flow program is monitoring urban streams to identify and quantify actual receiving water problems. Milwaukee participated in the early International Joint Commission studies with Canada to characterize discharges into the Great Lakes. Milwaukee was also a participant of NURP in the early 1980s. During NURP, eight single land use catchments were extensively monitored for three years in cooperation with the U.S. Geological Survey. The benefits of street cleaning as a pollutant discharge reduction practice were included in this effort. Snowmelt characterization monitoring and effects of de-icing compounds have also been extensively studied in Milwaukee. Recently, detailed studies on toxicant sources, effects, and controls have also been conducted in Milwaukee, including a study conducted in heavily urbanized Lincoln Creek (a 19mi.^{2} watershed, 9 miles long). A seven-tiered indicator program, incorporating many physical, chemical, and biological tests, was simultaneously conducted which identified long-term toxicity problems likely associated with re-suspended contaminated sediments having high levels of organic compounds. It was found that discharges of these fine sediments could be significantly reduced through the use of well-designed and maintained wet detention basins. The instream toxicity monitoring methods developed and used during the Lincoln Creek study can be used by other municipalities to answer the following basic questions:

- Are toxic conditions present?
- What is causing the toxicity?
- How much is too much urbanization? and
- Can SW controls reduce these problems?

The benefits of SW controls have also been evaluated in Milwaukee, especially grass swales, wet detention ponds, and underground devices for critical source areas. The Southeastern Wisconsin Regional Planning Commission also prepared a comprehensive report documenting costs associated with construction site erosion and SW control.

In addition, the Wisconsin Nonpoint Source Program includes an important public education component. Milwaukee conducted a survey to identify the most likely successful public education program. The more than 3,000 responses indicated that TV news stories, newspaper articles, targeted newsletters, and pamphlets would be most effective. Site visits, workshops, and videos were unlikely to be successful. The survey also found that more than 90% of Milwaukee respondents were willing or are already doing activities to protect water quality (recycling used oil, separating household hazardous wastes, limiting landscaping chemicals, controlling dog wastes, etc.). Virtually all of the respondents rated the local waters as poor to fair and less than 10% used the local waters for any recreational activities. However, more than half were willing to pay more than $50 per household per year for programs to protect and restore local waters.

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7.2.5 Orlando, Fla.

SW Community Characteristics	
◆ Population	165,000
◆ Sewer Area	100,000 Ac
◆ Annual Rainfall	50"
◆ # of SSO Discharge Points	1,000

Distinctive SW Community Attributes

- Recipient of EPA's SW award in 1990

Orlando is known for its long history of SW management, including receiving the U.S. EPA's SW award in 1990. The city has extensive local data, especially concerning the performance of SW controls in its unique area, which has heavy rains, flat topography, high groundwater, and highly percolating sandy soils.

Orlando is located in central Florida and had a 1990 population of about 165,000. The area receives about 50 inches of rainfall each year, mostly occurring in the summer. Most of the area is underlain with sandy soils. Therefore, urban development produces dramatic increases in runoff volumes and rates as the highly percolating soils are covered with impervious surfaces. The infiltrating water recharges the Floridan Aquifer, the major drinking water supply for most of central Florida. The area is relatively flat, at about 100 feet elevation. The city of Orlando contains 82 named lakes and several hundred drainage wells that receive SW runoff from the separate storm drainage system.

Florida began to investigate SW pollutant sources in the 1970s as part of the Section 208 requirements of the Clean Water Act. The Florida Department of Environmental Regulation and 12 regional agencies received many large Section 208 grants to assess the extent of the state's nonpoint pollution problem and to develop technical and administrative methods for treatment and control. The state had authority to draft regulations pertaining to SW control as part of its existing environmental laws. The first official state regulation addressing SW was adopted in 1979 based on the results of the Section 208 studies that found urban SW was responsible for:

- 80 to 95% of the heavy metal loadings to Florida surface waters,
- almost all of the sediment deposited in state waters,
- 450 times the suspended solids and 9 times the BOD loads compared to typical municipal wastewater treatment facilities, and
- nutrient loads about the same as those being discharged from typical municipal wastewater treatment facilities.

The state regulations were revised several times for clarification and to ensure long-term operation through adequate maintenance and better design.

The Florida Department of Environmental Regulation requires SW controls for new development. The requirements specify that the first 0.5 inch of runoff, or the runoff from 1 inch of rain, whichever is greatest, be treated. This regulation is thought to result in about 80% to 85% of the annual pollutant loads being treated. Orlando published one of the earliest SW management guides (Orlando Urban Storm Water Management Manual) in 1984 to assist developers in meeting these requirements. Stormwater wet detention ponds, excavated into the groundwater, were the first controls commonly used. Research has investigated the performance of these and other devices, including their potential impacts on groundwaters. Outfall screening devices and street cleaning (especially in March when the leaves from oak trees fall) were also thought to be an effective control for lakes. Sand filters, grass swales, wetlands, and alum injection have also been used and tested in the Orlando area.

The Orlando urban stormwater management program was established in the early 1980s to address increasing SW runoff quality and quantity problems resulting from new development. Orlando sponsored a lake assessment study in 1983 to evaluate the city's lakes in response to residents complaints of deteriorating water quality. The assessment study resulted in a priority listing of lakes needing remediation assistance. Large regional facilities (such as the Lake Greenwood Urban Wetland project) have been retrofitted in existing urban areas, and alum injection facilities have also been added to several existing urban lakes.

The preferred SW control practices in Orlando are off-line retention, filtration, and both dry and wet detention ponds. Source controls, as described in the local manual, are encouraged. The performance standards are to reduce the annual average suspended solids loadings by 80%.

The city received its NPDES SW permit and funds local oversight through the Orlando SW utility. The current utility fee is $36 per residential household equivalent per year. The total annual budget is $1.25 million, of which about 90% is from the utility fee. The utility has four administrators, four engineers, 18 inspectors, two scientists, and five clerical support staff. Educational programs are a voluntary component of the program, with the utility presenting more than 40 programs each year to educate the general public about SW management. Local volunteers also participate in the Florida Lake Watch program. The city has a limited program to monitor the water quality in the city's lakes to measure success of the SW management program. As noted previously, numerous research projects have also been conducted in Orlando to evaluate the performance of SW management practices.

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7.3 SW Case Histories and Benchmark Data Discussion

7.3.1 General SW Discussion

Community accomplishments in addressing SW concerns are highly varied throughout the U.S. In most cities, very little has been done beyond basic SW drainage. In a few communities (such as those selected for discussion in the case studies), early concerns by the public about declining water quality resulted in attempts to manage SW quality. After drainage problems were brought under control, usually through master planning and the construction of large-scale facilities, construction erosion control was usually implemented. With these important considerations addressed, some of the communities were able to address SW quality. Some stressed controls for new developments, while a very few examined retrofit opportunities (Wisconsin's Priority Watershed Program, for example).

Historically in almost all communities in the U.S., SW management only addressed drainage issues, because scarce local resources were needed for more pressing issues. Such communities are only able and willing to participate in SW management at the most basic and minimal level. Without specific guidance and requirements contained in local and state ordinances, very little SW quality management was conducted in most communities. In fact, some communities backed off from prior rigorous attempts at SW quality management to more minimal efforts that barely meet existing regulations.

With the Clean Water Act SW NPDES permit program in place, SW quality management is no longer a luxury program only being conducted in rapidly growing sunbelt communities that have the resources and motivation. Because of the large number of communities involved in the first and second phases of the NPDES SW permit program, the federal and state approach has been to define relatively basic requirements for the permits, with generally few specified control goals. Obviously, submitting all the municipal permits (along with the new industrial SW permits required at the same time) has produced a financial, logistic, and management problem for state agencies and EPA regions. It is apparent that the main goal was to get the permits issued in a timely manner, while accomplishing such basic and necessary goals as drainage area characterization information; screening for inappropriate discharges at storm drain outfalls; starting erosion control programs; establishing local authority over the drainage system; and developing a financial basis for management of the program. Even with the relatively simplified permit process and requirements, however, large municipalities (in phase one of the program) often spent more than $1 million each to gather the necessary information and to prepare and submit the permit applications.

The requirements included in the issued permits rarely specified any control goals or management needs beyond conducting an outfall monitoring program of about three storms a year at about five land use sites. The permits are generally issued for 5 years, with the expectation that specific control requirements would be added during subsequent periods as local problems become better defined. Nearing the tenth year of the SW NPDES program, medium cities (between 100,000 and 500,000 population) have also submitted permit applications and most have received their initial permits, and small communities (greater than 10,000 in population) are to be included in the program within a year. Therefore, the SW permit program burden on the regulatory agencies has increased, with little opportunity for increased site-specific control objectives to be included in the permits. The role of TMDL allocations was to be a tool to determine allowable discharges of SW and point source permits to a watershed's receiving waters. However, there is still much concern, and therefore delay, in allocations.

Most of the specific accomplishments of SW quality have occurred in communities with flooding/drainage problems, scarce water resources, and the financial ability (usually through local funding mechanisms). Specific requirements by local communities, and some state agencies, are the driving force behind these major accomplishments. Federal legislation now requires SW quality management at most levels of government. However, the direct application of approaches from the few communities currently having successful SW quality management programs may not be workable. All these communities have found that advances have been slow and greater public awareness and understanding (especially when local funding is involved) is needed. Specific guidance and requirements, along with strenuous enforcement, are also necessary components of successful programs; voluntary efforts by themselves are rarely adequate.

7.3.1.1 *Stormwater Quality Problems as the Driving Force*

The main purpose of treating SW is to reduce its adverse impacts on receiving water beneficial uses. Therefore, any urban SW runoff study must assess the detrimental effects that runoff is actually having on receiving water. Urban receiving waters may have many beneficial use goals, including:

- stormwater conveyance (flood prevention);
- biological uses (warm water fishery, aquatic life use, biological integrity, etc.);
- non-contact recreation (linear parks, aesthetics, boating, etc.);
- contact recreation (swimming and wading); and
- water supply.

With full development in an urban watershed and no SW controls, it is unlikely that any of these uses can be attained. With less development and the application of SW controls, some uses may be possible. But unreasonable expectations should not be placed on urban waters, as the cost to obtain these uses may be prohibitive. With full-scale development and lack of adequate SW controls, severely degraded streams will be common. However, SW conveyance and aesthetics should be the basic beneficial-use goals for all urban waters. Aquatic life use should also be a goal, but with the realization that the natural stream ecosystem will be severely modified with urbanization.

Certain basic SW controls, installed at the time of development, plus protecting stream habitat, may enable partial realization of some of these basic goals in urbanized watersheds, but careful planning and optimal utilization of SW controls are necessary to obtain these basic goals in most watersheds. Water contact recreation, consumptive fisheries, habitat for sensitive aquatic organisms, and water supplies are not appropriate goals for most urbanized watersheds. However, these higher uses may be possible in urban areas where the receiving waters are large and drain mostly undeveloped areas.

The latest National Water Quality Inventory released by the U.S. EPA showed only slight improvement in attaining beneficial uses in the nation's waters. Urban runoff was cited as the leading source of problems in estuaries, primarily from nutrients and bacteria. Problems in rivers and lakes were mostly caused by agricultural runoff, with urban runoff the third-ranked source for lakes and fourth ranked for rivers. Bacteria, siltation, and nutrients were the most significant problems in rivers and lakes.

In general, urban SW runoff monitoring has indicated that the biological beneficial uses of urban receiving waters are most likely affected by habitat destruction and long-term pollutant exposures (especially for macroinvertebrates via contaminated sediment), while documented effects from acute exposures to toxicants in the water column are rare. Receiving water pollutant concentrations resulting from runoff events and typical laboratory bioassay test results have indicated few significant short-term receiving water problems. Therefore relating actual receiving water problems to conventional numeric standards is difficult. Interest in developing special wet weather standards, especially considering contaminated sediments, intermittent exposures to high flows, and habitat destruction exists. Using local reference stations for comparison is usually necessary to identify local problems and the needed extent of SW discharge reductions.

7.3.1.2 Changes in Stormwater Management and Attitudes with Time

In 1967, researchers at the University of Wisconsin distributed a survey to engineers in the state, the main objective of which was to determine the level of service considered adequate. This questionnaire explored design procedures and policies. In 1997 a survey by the University of Alabama at Birmingham was mailed to over 350 recipients in engineering firms and municipal water authorities across the nation. This recent survey was designed to examine changes in design methods, objectives, and understanding of SW quality problems over this 30-year period. The university received about 85 responses (mostly from Minnesota, Ohio, New York, Florida and California), about half of whom were consulting engineers in private practice and the other half engineers with municipalities. Tables 7-7 and 7-8 present the findings from the 1997 survey and compare them to the 1967 survey.

7.3.2 SW Questionnaire Findings

7.3.2.1 SW Community Statistics

The returned SW benchmark questionnaires cover communities with a wide range of conditions and receiving waters. Most discharge SW into rivers, streams, or lakes, but the ocean, groundwater, and estuaries are also represented by one city each. Almost all communities discharge into several different types of receiving waters.

Three communities (Boston, Denver, and Detroit) have populations greater than 1 million, while the other 12 cities have populations less than 500,000. All manage total drainage areas of more than 1,000 acres (most greater than 10,000 acres) and had more than 50 outfalls (except for Orem, Utah, which reported less than 10 discharge points). Annual rainfall was less than 20 inches for three cities (Burbank, Denver, and Orem), between 20 and 30 inches in one city (Fridley), between 30 to 40 inches in six cities (Austin, Bellevue, Detroit, Hillsboro, River Falls, and Struthers), and more than 40 inches in four cities (Birmingham, Boston, Frederick, and Orlando).

Table 7-8. 1997 Stormwater Management Design Survey Responses

Practice	Response (Percentage of Respondents if Reported)				
Design Storm Used	5 year (10%)	10 year (42%)	25 year (7%)	100 year (9%)	
Method of Design	Rational (41%)	NRCS (SCS) (14%)	Combination (31%)	Regional (13%)	
Tools Used	Computerized tools (86%)	SWMM (25%)	HEC-1 (17%)		
Conditions of Failure	Manhole covers popping off	Water rising above curbs	Water in Basements		
Water Quality Concern	Sediment (60%)	Nutrients (35%)	Metals (34%)	Oil & Grease, Bacteria, Toxicants, Floatables, and Salts.	Staying within regulated discharge limits

Table 7-9. Stormwater Management Design Survey Comparison 1967 versus 1997 Results

	1967 Survey Responses	1997 Survey Responses
Design Storm	5 to 10 year (70%)	Approximately the same range, most using the 10 year.
Method of Design	Rational (Most cities misapplied the runoff coefficient or rainfall intensity)	Rational (Understood the use of Time of Concentration)
Indicator of Failure	Water ponding at inlets Water ponding in back yards.	Water ponding at inlets, but not a prevalent concern. Not a high priority for today's design engineers.
Water Quality Concerns	Sediments, Nutrients, Metals, Oil & Grease, Bacteria, Toxicants, Floatables, Salts, and Staying within regulated discharge limits.	

Few cities reported annual SW discharge quantity; however, the quantity may be estimated using a few assumptions. As an example, for the smallest reported service areas of 1,000 acres and 10 inches of annual rainfall with a reasonable arid area volumetric runoff coefficient of 0.2, the annual runoff volume would be about 50 million gallons. In a small city of only 10,000 acres (15 square miles), with an annual rainfall of 30 inches and a Rv of 0.3, the annual SW runoff discharges would be increased to more than 2,500 million gallons.

7.3.2.2 SW Public Participation

Only five communities (Birmingham, Frederick, Fridley, Orem, and Struthers) reported no public participation. However, at least Birmingham and Frederick do have public participation programs, but the responders possibly thought that their programs did not include any of the program elements listed. It is hard to imagine that public hearings would not be used for all major public works projects associated with SW projects.

Signs and general public education were most commonly indicated methods for informing the public, while the more successful TV addresses and newsletters were parts of only two community efforts. The least successful *tools, neighborhood meetings and videos available for loan from the local libraries,* were not listed by any of the respondents. Bellevue sponsored community educational projects, and receiving water monitoring by citizen volunteers was reported by Austin and Orlando. As part of its NPDES permit requirements, Birmingham is starting a new monitoring effort using local volunteers to investigate inappropriate discharges into storm drainage.

Basement flooding, along with general water quality, were the most commonly listed public concerns (11 and 9 cities, respectively). Aquatic life, street flooding, general recreation, water contact recreation, and public health were all noted by 3 cities each.

7.3.2.3 *SW Systems Characteristics*

Seven responding cities did not have a mathematical model of their SW systems, while three did. However, all (except Birmingham and Orem) indicated that a watershed approach has been taken.

Almost all cities included municipal and industrial point sources plus urban runoff among their current pollutant abatement efforts. Four communities indicated that agricultural runoff was also being controlled in their watersheds. Control efforts for the same targeted pollutant sources were generally expected to remain in the future. However, little documented performance information for urban runoff abatement efforts is available from the cities. Most cities listed estimated abatement levels only, with no monitoring programs either in the receiving waters or at outfalls to quantify any discharge reductions.

7.3.2.4 *Issues Driving SW Technical Considerations*

Only three cities (Birmingham, Boston, and Frederick) indicated that a SW facility plan was not started yet, three (Austin, Bellevue, and Detroit) indicated that the facility plans were completed, while six others indicated that plans were in progress.

All respondents indicated that regulatory requirements were the main driving force in their SW quality management efforts, with the exception of Boston. Litigation and lawsuits were also primary motivation sources for SW abatement in three cities. Five of the cities had no permitted facilities, while three cities listed up to 10 permitted facilities, and one city (Frederick) listed more than 100 permitted facilities.

Water quality criteria for local receiving waters included the following parameters (in order of most frequent mention): bacteria, dissolved oxygen, nutrients/floatables (tie), BOD/toxicants/sediment (tie), and finally temperature and heavy metals (only one city each).

Cost/benefit analyses were used by six cities, but regulatory requirements directed the selection of the abatement technology in 11 of the cities. Almost all technologies (construction site erosion controls, public works practices, and sedimentation) were being used by almost all communities. Infiltration practices were the least popular option.

7.3.2.5 *SW Financial Considerations*

Only Detroit listed significant past expenditures for past SW abatement efforts (at more than $500 million), while five others (Austin, Boston, Denver, Orem, and Struthers) all listed less than $10 million. Detroit also listed a similar level for future expenditures, while the others remained the same, except for Denver and Orem which expected an increase of $10 million to $50 million. Birmingham is starting a stream corridor protection program at a cost of about $30 million, as part of the settlement of a local lawsuit concerning wet weather flow pollution abatement.

The funding sources were varied, with fees from utility districts being most common (five cities), followed by "other" (four cities), then increased sewer rates, state grant money, federal grant money, and increased taxes (tied with three cities each), and finally revolving loans (two cities).

CHAPTER 8.0

COST-BENEFIT ANALYSIS

8.1 Syracuse, N.Y., Case Study

The Syracuse, N.Y., case study serves as a good example of a cost-benefit approach to abating wet weather pollution in that the decision-making process involved all the critical components of the community, from the technical engineers to the municipal government budget and financial management departments.

Syracuse began its CSO abatement program in the early 1970s with the country's first full-scale demonstration of an U.S. EPA vortex and disinfection facility. A very successful BMP program followed in the middle 1980s. The CSO abatement program was expedited in 1989 as a result of a legal consent order. During the early stages of the consent order process, several planning meetings were held under Section 208 of the 1972 Clean Water Act Amendments. These meetings culminated in a work plan for the CSO abatement program, which required the consensus of stakeholders on the storm frequency that would serve as a reasonable target for abatement.

All parties, including local health and state regulatory agencies, agreed that a 1-year storm frequency would be used to size the wet weather pollution abatement facilities. Figure 8-1 illustrates an inflection (knee of the curve) in the system conveyance capacity at the 1-year storm recurrence interval. It was agreed that such a storm would likely be a convective storm occurring in the summer months when base flow in receiving water streams would be low. It was also agreed that such a combination of wet weather pollution and low stream flow represented reasonably stringent conditions.

Once the 1-year storm recurrence interval was agreed upon, five abatement strategies were evaluated using a cost-benefit analysis on the basis of bacteria, solids, and BOD improvements in the receiving water. Figures 8-2 and 8-3 show these relationships. Figure 8-3 illustrates the point of inflection for the cost curve occurring at the "Regional" abatement alternative. The regional abatement alternative included satellite treatment facilities designed to control bacteria, solids and floatables, in-system storage, and some sewer separation. This alternative was adopted as the accepted CSO abatement plan. The location of these satellite treatment facilities, known as regional treatment facilities, is illustrated in Figure 8-4.

Further application of the cost-benefit analysis was used to justify the need for all satellite treatment facilities to control bacteria, solids, and floatables. Detailed system and receiving water bacterial modeling demonstrated that the facilities needed to control bacteria and solids loadings to the receiving waters were not as great as originally estimated. All parties agreed to reduce some of the regional treatment facilities to floatables control facilities. This reduced the CSO abatement costs from $267 million to $144 million.

The construction planning for the regional treatment facilities and floatables control facilities ultimately culminated in a 15-year build out period that would progressively achieve full compliance during that time. This compliance was in terms of both the presumption and demonstration clauses of the federal CSO policy as illustrated by Figures 8-5 and 8-6.

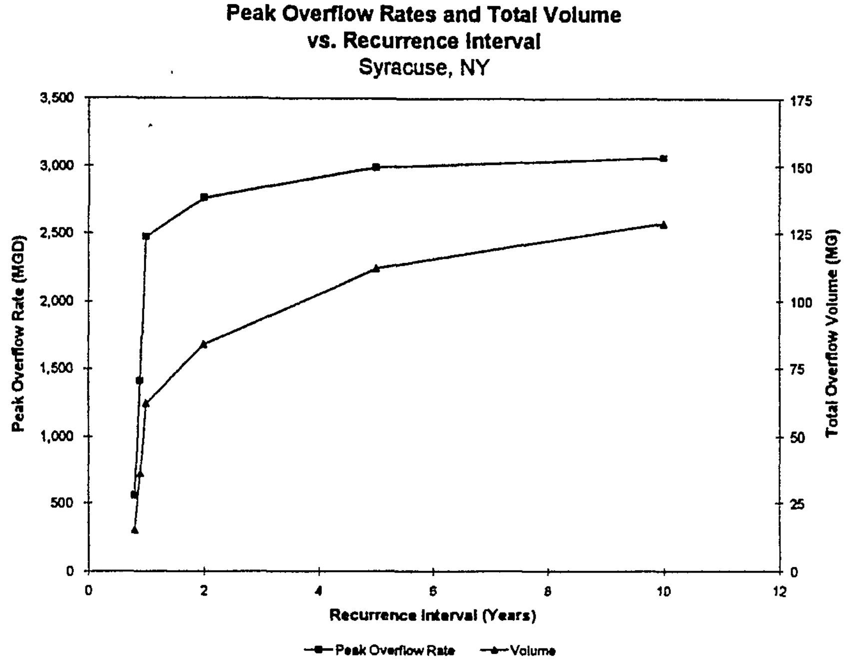

Figure 8-1. Peak Overflow Rates and Total Volume versus Recurrence Interval, Syracuse, N.Y.

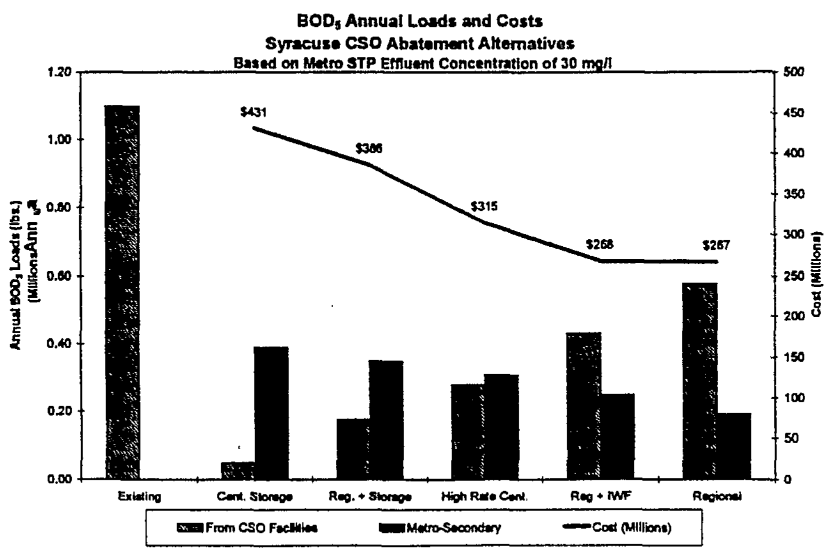

Figure 8-2. BOD Loads and Costs, Syracuse N.Y., CSO Abatement Alternatives

Water Environment Research Foundation

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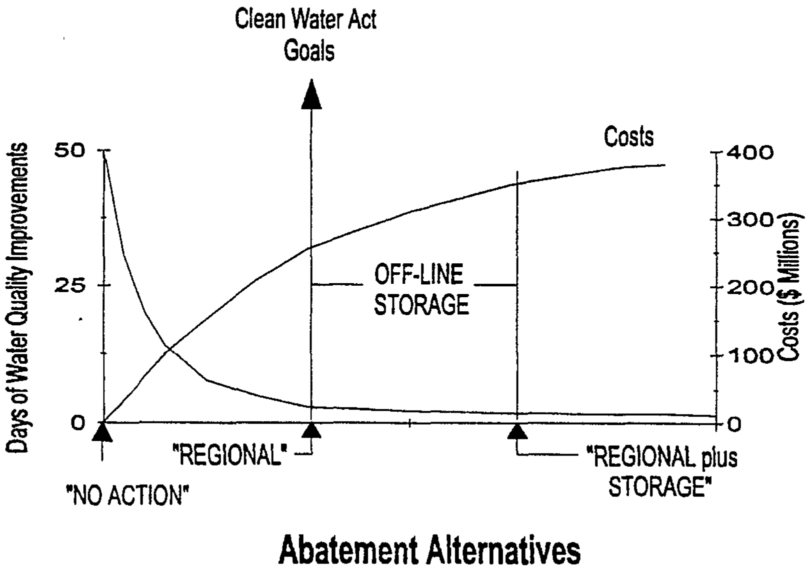


Figure 8-3. Abatement Alternatives versus Days of Water Quality Improvements, Syracuse, N.Y.

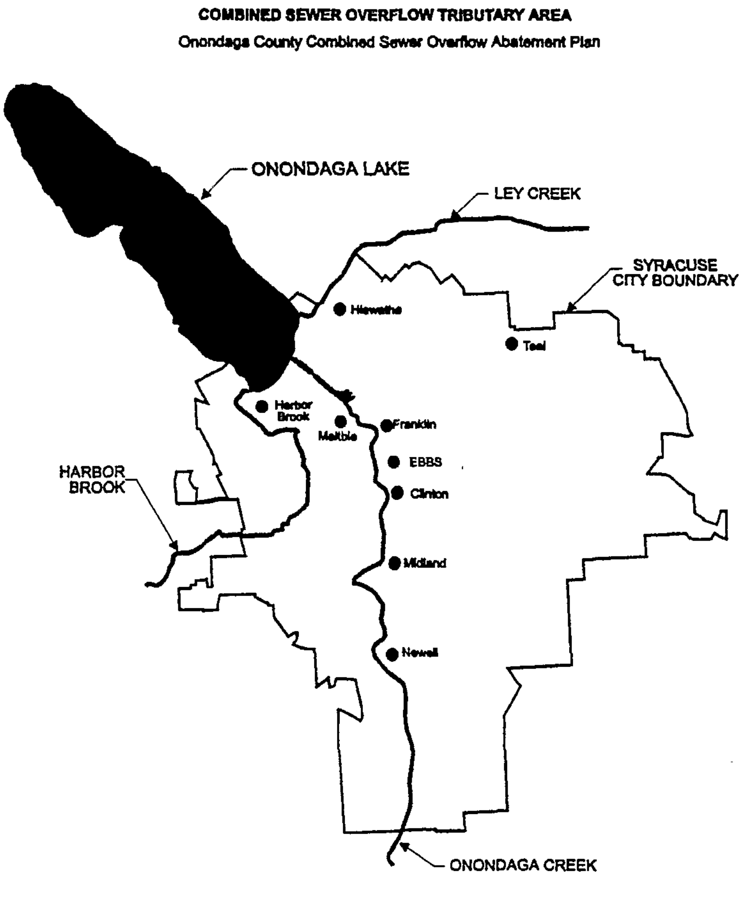


Figure 8-4. Onondaga County CSO Tributary Areas and CSO Regional Treatment Facilities

R0018323

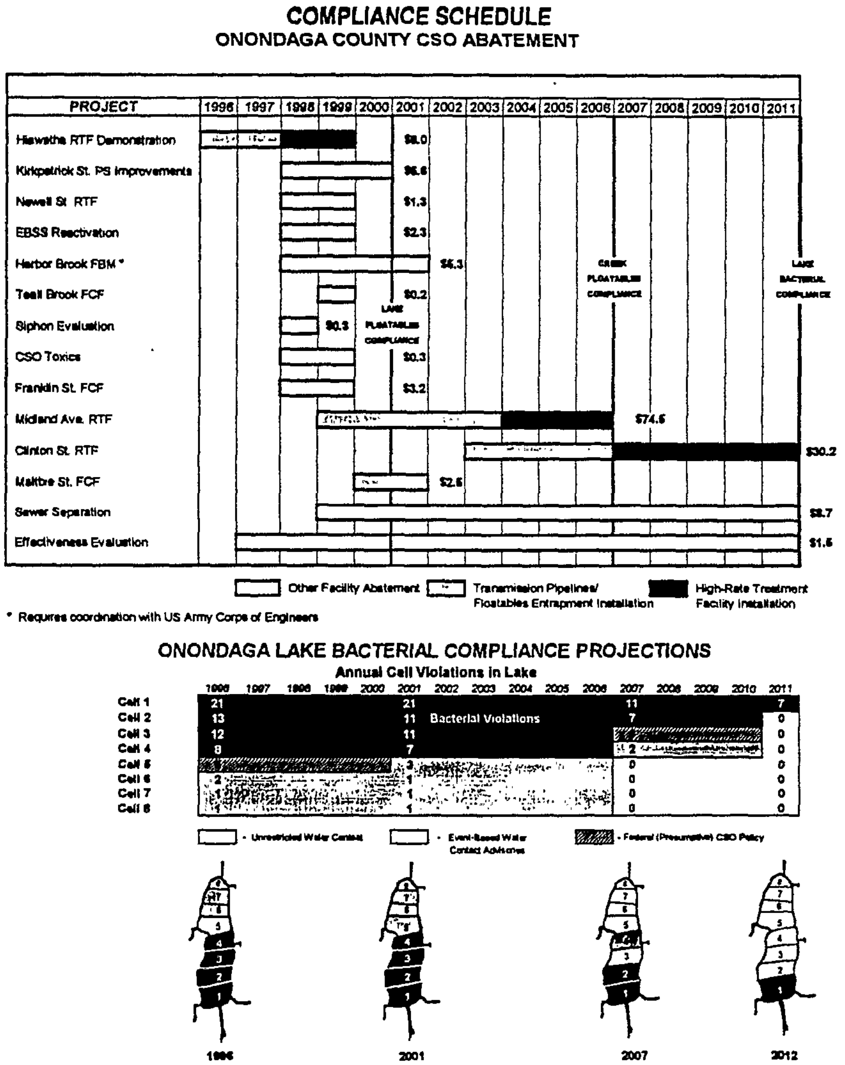


Figure 8-5. CSO Abatement Compliance Schedule, Onondaga County, N.Y.

WET-WEATHER COMBINED SEWER SYSTEM FLOWS

Regional Facility	Total Wet-Weather Flow in CSS (MG)	Average Annual Interceptor Flow (MG)	Regional Facility CSO Discharge (MG)	RTF Captured Flow (MG)	Percent Capture
INTERIM PROJECTS					
Harbor Brook FBM	458.39	331.98	37.92	88.49	92%
Hiawatha RTF	57.90	33.50	0.62	23.78	99%
Teall FCF	84.19	76.79	7.40	0.00	91%
EBSS	284.32	0.00	55.96	228.36	80%
Newell RTF	7.22	3.62	1.70	1.90	76%
INTERMEDIATE PROJECTS					
Midland RTF	574.59	275.39	112.40	186.80	80%
Clinton RTF	543.58	401.68	86.48	55.42	84%
Franklin FCF	527.11	443.81	77.29	6.01	85%
Maltbie FCF	67.79	40.89	21.54	5.36	68%
TOTAL	2605.09	1607.66	401.31	596.12	85%

Figure 8-6. Wet Weather Combined Sewer Flows, Syracuse, N.Y.

An integral part of the decision making process during construction planning was resolving the issue of affordability. The affordability analysis was used to evaluate the financial impacts of the CSO abatement program. Once the technical solution was agreed on and planning level cost estimates were developed, the municipal budget and financial management department began to evaluate the cost impacts of various construction schedules; 15 distinct projects were evaluated in time frames varying from 15 to 25 years. An example is shown in Figure 8-7. Corresponding plots of unit charge and debit service as a percent of median household income were developed as illustrated by Figures 8-8 and 8-9, respectively. These dollars represent the combined costs of the CSO abatement program and the WWTP improvements program.

WET-WEATHER COMBINED SEWER SYSTEM FLOWS

Regional Facility	Total Wet-Weather Flow in CSS (MG)	Average Annual Interceptor Flow (MG)	Regional Facility CSO Discharge (MG)	RTF Captured Flow (MG)	Percent Capture
INTERIM PROJECTS					
Harbor Brook FBM	458.39	331.98	37.92	88.49	92%
Hiawatha RTF	57.90	33.50	0.62	23.78	99%
Teall FCF	84.19	76.79	7.40	0.00	91%
EBSS	284.32	0.00	55.96	228.36	80%
Newell RTF	7.22	3.62	1.70	1.90	76%
INTERMEDIATE PROJECTS					
Midland RTF	574.59	275.39	112.40	186.80	80%
Clinton RTF	543.58	401.68	86.48	55.42	84%
Franklin FCF	527.11	443.81	77.29	6.01	85%
Maltbie FCF	67.79	40.89	21.54	5.36	68%
TOTAL	2605.09	1607.86	401.31	596.12	85%

Figure 8-7. Annual Cost per Regional CSO Treatment Facilities

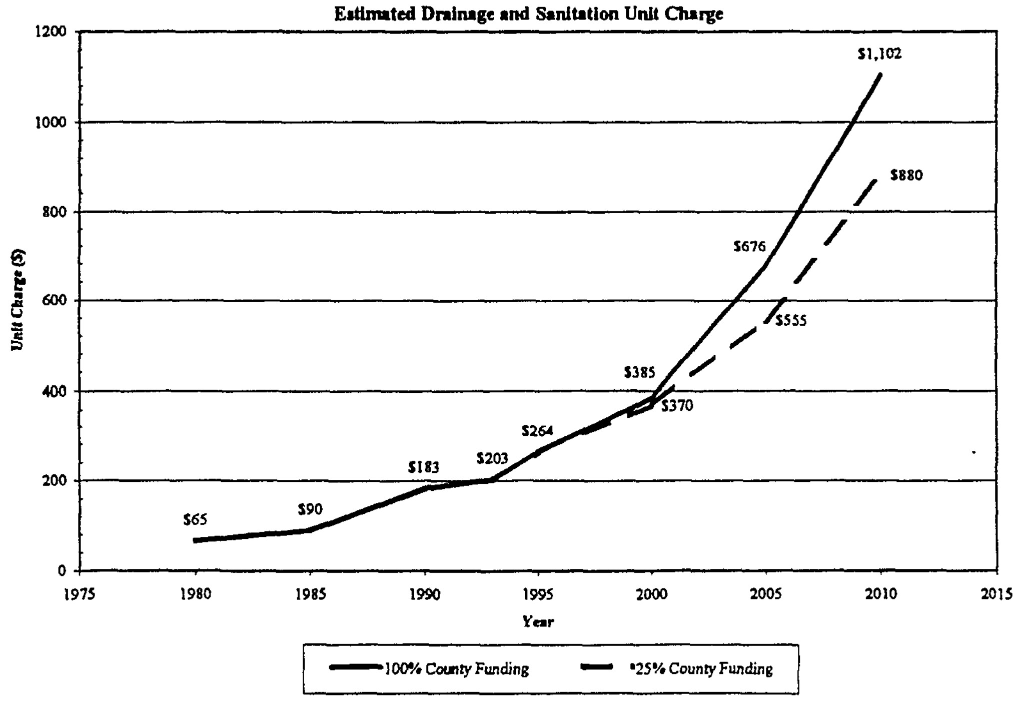


Figure 8-8. Estimated Drainage and Sanitation Unit Charges, Syracuse, N.Y.

R0018325

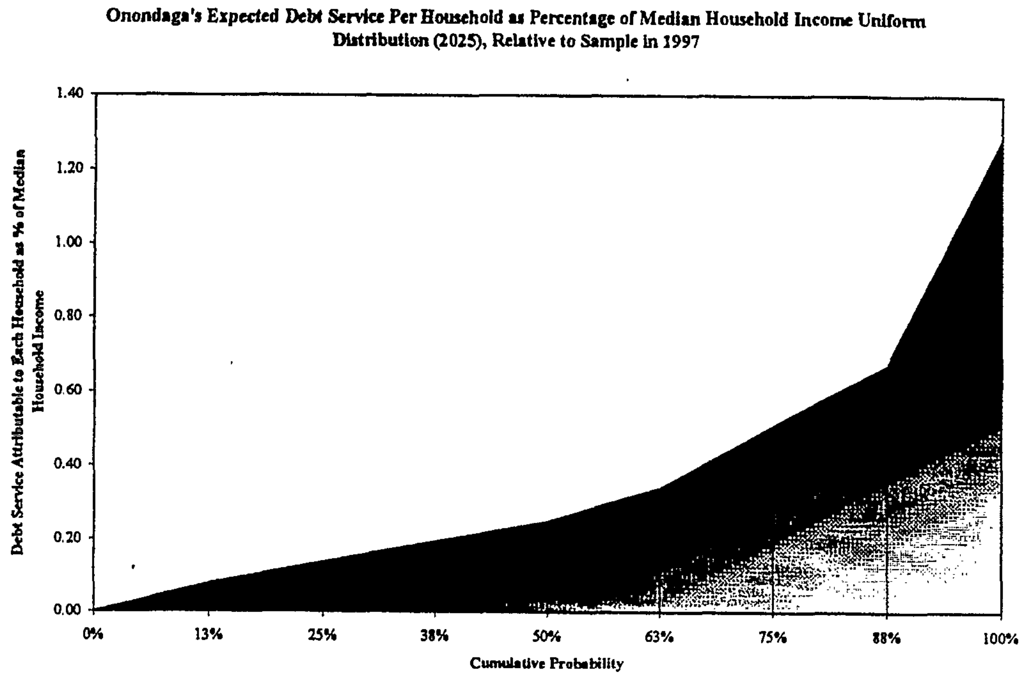


Figure 8-9. Expected Debt per Household as Percentage of Median Income, Onondaga County, N.Y.

Despite the fairly flat growth of population and service expected in the Syracuse area, the debt service fell within the allowable 2% guide stated in the federal CSO control policy. Consequently, the state and U.S. EPA required that a 15-year schedule be implemented. Milestone dates for specific completion projects of construction were incorporated into the Consent Order which was signed in October 1997.

APPENDIX A

NATIONAL CSO CONTROL POLICY

The National CSO Control Policy contains four key principles intended to ensure that CSO controls are cost effective and meet the requirements of the Clean Water Act (CWA) of 1972 and its amendments:

- provide clear levels of control that would be presumed to meet appropriate health and environmental objectives;
- provide sufficient flexibility to CSO communities, especially those that are financially disadvantaged, to consider the site-specific nature of CSOs and to determine the most cost-effective means of reducing pollutants and meeting CWA objectives and requirements;
- allow a phased approach for implementation of CSO controls considering a community's financial capability; and
- review and revise, as appropriate, water quality standards and their implementation procedures when developing LTCPs to reflect the site-specific wet weather impacts of CSOs.

Nine Minimum Controls

1. Proper operation and regular maintenance programs for the sewer system and the CSOs. This control should consist of a program that clearly establishes operation, maintenance, and inspection procedures to ensure that a combined sewer system (CSS) and treatment facility will function in a way to maximize treatment of combined sewage and still comply with NPDES permit limitations.

2. Maximum use of the collection system for storage. This control consists of making relatively simple modifications to the CSS to enable the system to store wet weather flows until downstream sewers and treatment facilities can handle them.

3. Review and modification of pretreatment requirements to ensure that CSO impacts are minimized. The objective of this control is to minimize the impacts of discharges into CSSs from nondomestic sources during wet weather events and to minimize CSO occurrences by modifying inspection, reporting, and oversight procedures within an approved pretreatment program.

4. Maximizing flow to the POTW for treatment. This control entails simple modifications to the CSS and treatment plant to enable as much wet weather flow as possible to reach the treatment plant.

5. Eliminating CSOs during dry weather. This control includes any measures taken to ensure that the CSS does not overflow during dry weather conditions.

6. Controlling solid and floatable materials in CSOs. This control is intended to reduce, if not eliminate visible floatables and solids using relatively simple measures including baffles, screens, racks, booms, and skimmer vessels.

7. Pollution prevention programs to reduce contaminants in CSOs. This control is intended to keep contaminants from entering the CSS and prevent subsequent discharge to receiving waters through street cleaning, public education, solid waste collection, and recycling.

8. Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts. This control is intended to let the public know where outfalls are located, when CSOs occur, what possible health and environmental effects are, and what recreational or commercial activities may be curtailed as a result of CSOs.

9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls. This control involves visual inspections and other simple methods to determine the occurrence and apparent impacts of CSOs.

Long Term Control Plan

The LTCP is a comprehensive plan that recognizes the site-specific nature of CSOs and their impacts on receiving waters. The long term planning approach consists of four major elements: system characterization; development and evaluation of alternatives; selection and implementation of controls; and compliance monitoring. A primary objective of the LTCP is to develop and evaluate a reasonable range of CSO control alternatives sufficient to meet water quality standards, including attainment and protection of designated uses on CSO-affected receiving waters. The CSO policy is flexible in allowing a CSO community to select controls that are cost effective and tailored to meet local conditions.

Two general approaches to attaining water quality standards are recognized in the CSO policy. These are the "demonstration" approach and the "presumption" approach. Both approaches provide CSO communities with targets for controls that achieve compliance with the CWA, particularly the protection of designated uses. Under the "demonstration" approach, water quality modeling or other tools are used to demonstrate that predicted CSO discharges resulting from the LTCP would be sufficient to attain water quality standards. The "presumption" approach is based on the premise that a LTCP that meets certain minimum defined performance criteria in terms of expected frequency of overflow or percent capture of the CSO pollutant load would be presumed to provide an adequate level of control to meet the water quality-based requirements of the CWA.

CSO communities are encouraged to meet and coordinate frequently with state water quality standards authorities and NPDES permitting authorities and to engage the general public in the planning process through public participation activities. In particular, developing goals, evaluating alternatives, and considering the local financial impacts of the LTCP should be a collaborative effort among all the participating interests. The developing performance measures or other measures of success to quantify environmental improvements and benefits related to CSO control is also a major element of the LTCP. Because of the site-specific nature of CSSs and CSO impacts, a strong linkage between performance measures and locally defined objectives is essential.

Presumption Approach

This approach allows a community to achieve an adequate level of control to meet the water quality- based requirements of the CWA if one of the following conditions are met.

1. No more than an average of four (4) overflow events per year. The permitting authority may allow up to two additional overflow events per year. An overflow event is one or more overflows from a CSS as a result of a precipitation event that does not receive the minimum treatment specified as:

    - primary clarification (removal of floatation and settleable solids equivalent to primary clarification) and
    - disinfection of effluent to meet water quality standards, including removal of harmful disinfection chemical residuals if feasible.

    Or, if the above is not met:

2. The elimination or capture for treatment of no less than 85 percent by volume of the combined sewage collected on a system-wide annual average basis; or

3. The elimination or removal of no less than the mass of the pollutants identified as causing water quality impairment through the sewer system characterization, monitoring, and modeling effort, for the volumes that would be eliminated or captured for treatment under paragraph 2 above.

Demonstration Approach

The community that undertakes this approach should demonstrate each of the following:

1. The long-term plan is adequate to meet water quality standards (WQS) and protect designated uses, unless uses cannot be met as a result of other pollution sources, e.g., natural background conditions.

2. The CSO discharges remaining after plan implementation will not preclude the attainment of WQS designated uses of the receiving waters or contribute to their impairment. Where these conditions are not met in part because of natural background conditions or other pollutant sources, then wasteload allocations should be used to apportion loads. The total maximum daily load should serve as the basis for such allocations.

3. The long-term plan will provide the maximum pollution reduction benefits reasonably attainable.

4. The plan is designed to allow cost-effective expansion if additional controls are necessary.

Financial Capability Assessments

For CSO abatement, a community's financial capability is particularly important, since there are no clear wet weather standards for most states; the selection of a "design" storm has become a subjective decision based upon cost-benefit relationships. Additionally, other pollutants from the watershed in question may preclude the attainment of the "fishable-swimmable" goals of the CWA.

The policy identifies seven factors to be included in consideration of a community's financial capability, namely:

1. median household income;

2. total annual wastewater and CSO control costs per household as a percent of median household income;

3. overall net debt as a percent of full market property value;

4. property tax revenues as a percent of full market property value;

5. property tax collection rate;

6. bond rating; and

7. unemployment.

The following is an excerpt of the U.S. EPA document, "Draft CSO Guidance on Financial Capability Assessment and Schedule Development," developed by the CSO Partnership (*The CSO Bulletin*, April 1996).

"The CSO Policy provides that implementation schedules for CSO controls may be phased, based in part on a community's financial capability. The Guidance seeks to provide criteria for assessing financial capability and to relate that capability to appropriate compliance schedules. The goal of the guidance is to 'provide general boundaries to aid all parties in negotiating reasonable and effective schedules' for implementing CSO controls.

"The Guidance proposes a two-step approach for calculating economic capability. The first step focuses on the financial impact of current and proposed wastewater and CSO controls on individual households. The second step examines the debt, socioeconomic, and financial condition of a CSO community. The results of both steps are then combined into a 'Financial Capability Matrix' which is used to assess the financial burden attributable to CSO controls and to establish what EPA views as appropriate compliance schedules.

"Step One. This step calculates a Residential Indicator (RI), which is a measure of the CSO community's average cost per household for existing and proposed wastewater treatment and CSO controls, expressed as a percentage of local median household income (MHI). The Guidance proposes to establish three ranges for RIs with RIs of less than one percent MHI characterized as imposing a 'low' financial impact, RIs from one or two percent of MHI imposing a mid-range impact and RIs above two percent of MHI imposing a high impact.

"Step Two. The second step is to consider a community's financial Capability Indicators. EPA specifies six proposed indicators in the Guidance for evaluating community debt, socioeconomic, and financial conditions which affect a community's financial capability to implement CSO controls. The results of the six indicators are used to classify the community's financial capability as 'weak,' 'mid-range,' or 'strong.'

"The results of step one (Residential Indicator) and step two (Financial Capability Indicators) are then combined in a financial Capability Matrix which provides the basis for the permittee and NPDES permitting authority to negotiate an appropriate compliance schedule. The Financial Capability Matrix divides communities into three categories based upon their calculated burden under the Guidance (low, medium, o high), with equal weight given to the Community's RI and Financial Capability Indicators.

"Finally, the Guidance proposes the following general boundaries for compliance schedules based upon a community's calculated burden:

Low burden:	0-5 year compliance schedule
Mid-Range burden:	5-10 year compliance schedule
High burden:	10-15 year compliance schedule

"According to the Guidance, communities in the 'High burden' category may be able to negotiate compliance schedules as long as 20 years.

"The lack of supporting information to explain and justify EPA's selection of the Residential Indicator categories and the Financial Capability Indicator categories will make it difficult to evaluate whether the proposed categories are appropriate for CSO communities nationwide. For example, EPA does not provide any discussion of the number of CSO communities that can be expected to fall into the three categories proposed in the Financial Capability Matrix (low, mid-range, or high burden). Also, it is unclear how EPA arrived at its proposed ranges for the compliance schedules for communities falling with the three categories of financial burden."

MEMORANDUM: IMPLEMENTATION OF THE CSO CONTROL POLICY (REPRINT FROM U.S. EPA — OFFICE OF WATER)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAY 19 1998

MEMORANDUM

SUBJECT: Implementation of the CSO Control Policy

FROM: Robert Perciasepe
Assistant Administrator
Office of Water

Bob Perciasepe

Steven A. Herman
Assistant Administrator
Office of Enforcement and Compliance Assurance

TO: Water Management Division Directors, Regions 1-10
Regional Counsels, Regions 1-10
State Directors

The purpose of this memorandum is to discuss implementation of the Combined Sewer Overflow Control Policy (CSO Policy) and identify areas where heightened efforts are necessary.

The Environmental Protection Agency (EPA) published the CSO Policy on April 19, 1994 (59 FR 18688), following a negotiated policy dialogue among representatives from States, environmental groups, municipal organizations, and EPA. The CSO Policy provides for a phased process to bring communities with combined sewer systems into compliance with the technology-based and water quality-based requirements of the Clean Water Act. To date, EPA has released six guidance documents and continues to work with stakeholders to foster implementation of the Policy.

The CSO Policy is now four years old and continues to be recognized as an example of innovation and good government. In principle, EPA and its stakeholders continue to affirm the Policy's key themes, such as permitting flexibility, stakeholder coordination and public participation, financial capability as a factor affecting implementation schedules, and examination of water quality standards as appropriate. In practice, however, many challenges remain, and implementation of the Policy has not met some initial expectations.

Nine Minimum Controls. The CSO Policy's first key milestone was implementation of the nine minimum controls by January 1, 1997. The nine minimum controls are measures that can reduce CSOs and their effects on receiving water quality without requiring significant engineering studies, construction activity, or financial investment. In a November 18, 1996, memorandum to the Regional and State Directors, we communicated the importance of meeting this deadline.

Under the CSO Policy, implementation of the nine minimum controls should become an enforceable obligation through inclusion in an appropriate enforceable mechanism. The Policy describes how the nine minimum controls and other CSO requirements are to be included in National Pollutant Discharge Elimination System (NPDES) permits (renewed permits or reopened and reissued permits) or administrative orders. The November 18, 1996, memorandum reminded NPDES authorities that the approach identified in the CSO Policy — not to seek civil penalties for past CSO violations — would not apply unless the permittee has no discharges during dry weather and meets the objectives and schedules of the CSO Policy, including the January 1, 1997, deadline for implementing the nine minimum controls. By now, every CSO community should be implementing the nine minimum controls, and most NPDES permits should contain measurable, enforceable, and specific conditions requiring implementation of the nine minimum controls, including submittal of appropriate documentation.

Although the January 1, 1997, implementation deadline has passed, our best information from EPA Regions and States indicates that only about 52 percent of CSO communities are currently implementing the nine minimum controls. Approximately another 25 percent have not yet implemented the nine minimum controls but are under an enforceable requirement to do so in the future.

There are several reasons for this. Many communities' permits have not yet been reissued to include the nine minimum controls, and permittees are reluctant to implement the nine minimum controls in the absence of an enforceable requirement. Some States have focused their efforts on requiring long-term control plans or have resisted using enforcement mechanisms as implementation tools. We believe, however, that the nine minimum controls are an essential element of any community's CSO program and that full implementation of the nine minimum controls is crucial to the success of the CSO Policy. The goal of 100 percent implementation remains a high Agency priority. We will continue to track implementation of the nine minimum controls and coordinate with EPA and State enforcement authorities as necessary to foster compliance.

We also stress the need for communities to provide appropriate documentation that they have implemented the nine minimum controls and for NPDES authorities to review this information thoughtfully. To date, although 52 percent of CSO communities have implemented the nine minimum controls, approximately 42 percent have submitted documentation. The Agency does not believe documentation is simply a "paperwork" exercise. Rather, documentation describes the community's comprehensive effort to use the nine minimum controls to reduce the frequency, volume, and impacts of CSOs. Without strong documentation, a CSO community and its permitting authority cannot meaningfully assess the effectiveness of the nine minimum controls and the extent to which additional controls, if any, may be needed.

Long-Term Control Plans. The CSO Policy calls for initial ("Phase I") NPDES permits to require development of a long-term CSO control plan as soon as practicable, but generally within two years after issuance of the permit, Section 308 information request, or enforcement action requiring a plan. The long-term control plan should include measures that provide for compliance with the technology-based and water quality-based requirements of the Clean Water Act, including attainment of water quality standards under either the "presumption approach" or the "demonstration approach." The subsequent ("Phase II") permit should require immediate implementation of the control measures in the long-term control plan. The long-term control plan should include a fixed-date implementation schedule. Requirements for expeditious implementation of the long-term control plan should be placed in an appropriate enforceable mechanism.

Regions and States indicate that approximately 33 percent of CSO communities are moving ahead to implement long-term CSO controls. Approximately another 28 percent are subject to an enforceable requirement to develop a long-term CSO control plan. We do not have adequate information to determine how much of the current CSO planning and control activity is being undertaken consistent with the CSO Policy.

Long-term planning consistent with the CSO Policy is key to the success of local CSO control efforts. We urge Regional and State authorities to work actively with permittees to ensure that long-term control plans address important elements of the CSO Policy such as characterization, monitoring, and modeling of the combined sewer system and receiving water; public participation; evaluation of the cost and performance of alternatives; and coordination with State water quality standards authorities and NPDES authorities. EPA Headquarters will continue to track progress in the development of long-term control plans consistent with the CSO Policy.

Water Quality Standards (WQS). Long-term CSO control plans must ensure that both the technology-based and water quality-based requirements of the CWA are met. With respect to water quality-based requirements, the CSO Policy provides that "[d]evelopment of the long-term plan should be coordinated with the review and appropriate revision of WQS and implementation procedures on CSO-impacted receiving waters to ensure that the long-term controls will be sufficient to meet water quality standards" (59 FR 18694). The CSO Policy places a high priority on eliminating or redirecting CSOs that discharge to sensitive areas such as beach areas and shellfish beds. Remaining overflows must neither cause nor contribute to a violation of WQS.

In locations where uses have been designated without consideration for the wet weather conditions of urban streams, it is appropriate to evaluate the attainability of WQS. The CSO Policy recognizes the States' flexibility to review their WQS and encourages them to define recreational and aquatic life uses more explicitly where appropriate. Such refinements could define, for example, seasonal conditions or a particular size storm event when primary contact recreation would not occur. In making such adjustments to uses, however, States must ensure that downstream uses are protected and that the use is fully protected during other seasons or after the storm event has passed. Furthermore, a use attainability analysis would be required in such cases, since use attainability analyses are required prior to the removal of a designated use or the modification of a use to one requiring less stringent criteria. Such a structured scientific analysis is an appropriate mechanism for determining the attainability of a use. In any case, if a State has a reasonable basis to determine that the current designated use could be attained after implementation of the technology-based controls of the CWA, then the use could not be removed.

We strongly encourage Regions and States to work with permittees to ensure that long-term plans are developed consistent with WQS. We also encourage greater coordination among EPA, States, and permittees in refining designated uses as appropriate in CSO-impacted receiving waters. In many cases the permittee's development of a long-term control plan, and the State's review and revision of WQS, will occur concurrently and interdependently. Site-specific data collected as part of the development of the long-term control plan and data from watershed analyses should assist States in evaluating the adequacy of the long-term control plan to contribute to the attainment of WQS. Such data will also provide important information necessary for determining whether a use is attainable and, where the designated use is not attainable, the appropriateness of a variance or other revision to the applicable WQS. Variances may be appropriate, in limited circumstances on CSO-impacted waters, where the State is uncertain as to whether the WQS can be attained and time is needed for the State to conduct additional analyses on the attainability of the WQS.

Measuring Program Performance. The CSO Policy continues to have a high level of support within EPA and among stakeholder groups. With visibility, of course, comes scrutiny. Understandably, the Policy continues to provoke questions about how well a flexible approach can address a costly and complex environmental issue. In addition, implementation of the CSO Policy is occurring amid public demands that investments in pollution control yield tangible environmental benefits.

Under the Government Performance and Results Act (GPRA), EPA developed a pilot performance plan to track the implementation status of the CSO Policy. Program indicators developed under the performance plan include progress in implementation of the nine minimum controls, development of long-term plans, and reduction in the frequency, volume, and adverse water quality impacts of CSOs. The data base developed to implement the performance plan will continue to provide useful insights into the status of CSO Policy implementation and will be a useful program management tool.

Accountability for the CSO Program is also embodied in the Agency's Strategic Plan under GPRA for the water program. Objectives to be attained by 2005 currently include a 30 percent reduction from 1992 levels in annual point source loadings from CSOs, publicly owned treatment works, and industrial sources. EPA's FY 1998 goal is for 80 percent of CSO communities' permits to be issued consistent with the CSO Policy; for FY 1999, the goal is 100 percent consistency.

We also encourage you to support efforts by CSO communities to develop other, locally defined, indicators of progress in controlling CSOs. Locally defined measures of success can provide meaningful incentives to select and implement CSO controls that not only meet CWA requirements but are cost-effective, tailored to local water quality objectives, and likely to yield results that the public, and specifically rate-payers, will support.

In closing, we urge you to help make the CSO Policy a success. We remind you that implementation of the CSO Policy continues to be a high priority for the Water Program and is among the top program priorities for the Office of Regulatory Enforcement in FY 1998. It is essential that all CSO communities be moving aggressively toward two important goals: full implementation of the nine minimum controls and coordination with NPDES and WQS authorities in the development and implementation of long-term control plans. We welcome continued dialogue among EPA Headquarters, Regional, and State permitting and enforcement authorities on removing any identified impediments to achieving these goals.

If you have questions concerning this memorandum, please contact either Ross Brennan of the Office of Wastewater Management at (202) 260-6928, or John Lyon of the Office of Regulatory Enforcement at (202) 564-4051.

ENFORCEMENT MANAGEMENT SYSTEM — CHAPTER X (REPRINT FROM U.S. EPA — OFFICE OF WATER)

Setting Priorities for Addressing Discharges from Separate Sanitary Sewers

Discharges of raw or diluted sewage from separate sanitary sewers before treatment can cause significant public health and environmental problems. The exposure of the public to these discharges and the potential health and environmental impacts are the primary reasons EPA is developing this additional guidance on these discharges. This document provides a method of setting priorities for regulatory response, and serves as a supplement to the Enforcement Management System guidance (EMS, revised February 27, 1986). As such, this document addresses only those discharges which are in violation of the Clean Water Act. As a general rule, the discharges covered by this guidance constitute a subset of all discharges from separate sanitary sewer systems.

Legal Status

In the context of this document, a "discharge from a separate sanitary sewer system" (or "discharge") is defined as any wastewater (including that combined with rainfall induced infiltration/inflow) which is discharged from a separate sanitary sewer that reaches waters of the United States prior to treatment at a wastewater treatment plant. Some permits have specific requirements for these discharges, others have specific prohibitions under most circumstances, and still other permits are silent on the status of these discharges.

The legal status of any of these discharges is specifically related to the permit language and the circumstances under which the discharge occurs. Many permits authorize these discharges when there are no feasible alternatives, such as when there are circumstances beyond the control of the municipality (similar to the concepts in the bypass regulation at 40 CFR Part 122.41 (m)). Other permits allow these discharges when specific requirements are met, such as effluent limitations and monitoring/reporting.

Most permits require that any non-compliance including overflows be reported at the end of each month with the discharge monitoring report (DMR) submittal. As a minimum, permits generally require that overflow summaries include the date, time, duration, location, estimated volume, cause, as well as any observed environmental impacts, and what actions were taken or are being taken to address the overflow. Most permits also require that any non-compliance including overflows which may endanger health or the environment be reported within 24 hours, and in writing within five days. Examples of overflows which may endanger health or the environment include major line breaks, overflow events which result in fish kills or other significant harm, and overflow events which occur in environmentally sensitive areas.

For a person to be in violation of the Clean Water Act: 1) a person must own, operate, or have substantial control over the conveyance from which the discharge of pollutants occurs, 2) the discharge must be prohibited by a permit, be a violation of the permit language, or not be authorized by a permit, and 3) the discharge must reach waters of the United States. In addition, discharges that do not reach waters of the United States may nevertheless be in violation of Clean Water Act permit requirements, such as those requiring proper operation and maintenance (O&M), or may be in violation of state law.

Statement of Principles

The following six principles should be considered as EPA Regions and States set priorities for addressing violating discharges from separate sanitary sewers:

1. All discharges (wet weather or dry weather) which cause or contribute significantly to water quality or public health problems (such as a discharge to a public drinking water supply) should be addressed as soon as physically and financially possible. Other discharges may, if appropriate, be addressed in the context of watershed/basin plans (in conjunction with state or federal NPDES authorities).

2. Discharges which occur in high public use or public access areas and thus expose the public to discharges of raw sewage (i.e., discharges which occur in residential or business areas, near or within parks or recreation areas, etc.) should be addressed as soon as physically and financially possible.

3. Dry weather discharges should be addressed as soon as physically and financially possible.

4. Discharges due to inadequate operation and routine maintenance should be addressed as soon as possible. (Physical and financial considerations should be taken into account only in cases where overflow remedies are capital intensive.)

5. Discharges which could be addressed through a comprehensive preventive maintenance program or with minor capital investment should be addressed as soon as physically and financially possible.

6. With respect to principles 1 through 5 above, schedules of compliance which require significant capital investments should take into account the financial capabilities of the specific municipality, as well as any procedures required by state and local law for publicly owned facilities in planning, design, bid, award, and construction. (See later sections on Schedules).

Stormwater Regulations

Phase I: The Municipal Stormwater Program

Under the WQA of 1987, U.S. EPA must issue NPDES permits to large- and medium-sized municipal separate storm sewer systems (MS4s). Under the statute, the permits:

- may be issued on a system or jurisdiction-wide basis;
- shall include a requirement to effectively prohibit non-stormwater discharges into the storm sewers;
- must apply a new standard to " require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and design and engineering methods" . 33 U.S.C. § 1342(p)(3)(B).

Large and medium MS4s are defined by EPA as those:

- located in an incorporated place with population of (i) 100,000 or more but less than 250,000 (medium MS4s) or (ii) 250,000 or more (large MS4s);
- located in counties with a population of 100,000 or more but less than 250,000 (medium MS4s) or located in counties with a population of 250,000 or more (large MS4s), excepting, in both instances, systems located in the incorporated places, townships or towns within such counties; or
- designated by EPA as part of a large or medium MS4 due to the interrelationship between the discharges of the designated MS4 and a large or medium MS4.

EPA has listed the jurisdictions that are covered under the definitions of medium and large MS4s in the permit application rule, and in Appendixes F, G, H and I to 40 C.F.R. Part 122. 55 Fed. Reg. 48073-74. The listing was based on the 1980 census. As data from the 1990 census becomes available, EPA will revise the list.

To date, EPA has only issued a rule with permit application requirements for MS4s. 55 Fed. Reg. 47990 (November 16, 1990). Permit applications for MS4s have two parts. Part 1 was due November 18, 1991 for large MS4s and May 18, 1992 for medium MS4s. 40 C.F.R. § 122.26(e)(3) and (4). Part 2 was due November 16, 1992 for large MS4s and May 17, 1993 for medium MS4s. Id. EPA was supposed to have issued final permits to large MS4s by October 1, 1993 and to medium MS4s by May 17, 1994. 40 C.F.R. § 122.26(e)(7).

The regulations define " municipal separate stormwater" as a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels or storm drains) owned or operated by a state or local government entity and is designed or used for collecting or conveying stormwater that is not a combined sewer or part of a POTW. 40 C.F.R. § 122.26(b)(8). Operators of combined sewer systems (systems designed as both sanitary and storm sewers) or POTWs are excluded from the permit application requirement because these systems should already be permitted under existing NPDES programs.

Operators of medium and large MS4s may submit a jurisdiction or systemwide permit application. 40 C.F.R. § 122.26(d). Where more than one public entity owns or operates a municipal separate storm sewer system within a geographic area (including adjacent or interconnected MS4s), such operators may be co-applicants to the same application.

Part 1 of the MS4 permit application must include the following elements:

- General Information. Information about the permit applicant or co-applicant.
- Legal Authority. A description of the legal authority to control discharges to the MS4. If existing legal authority is inadequate to control pollutants in stormwater discharges, a plan to augment existing legal authority must be submitted.
- Source Identification. Detailed identification of all discharges to the MS4, including a topographic map, location of municipal outfalls, projected growth, location of structural controls, and location of waste disposal facilities.
- Discharge Characterization. Information characterizing the nature of system discharges including existing quantitative data, the results of field screening analysis to detect illicit discharges, identification of receiving waters, a plan to characterize discharges from the system, and a plan to obtain representative data.
- Management Programs. A description of the existing management programs to control the discharge of pollutants from the system, including a description of existing structural and non-structural controls.
- Fiscal Resources. A description of the financial resources currently available to complete Part 2 of the application.

Part 2 of the permit application provides information to supplement Part 1 and gives municipalities an opportunity to propose a program of structural and non-structural measures to control the discharge of pollutants" to the maximum extent practicable." 55 Fed. Reg. 48045. Part 2 requires:

- Satisfaction of the Criteria. A demonstration that the legal authority of the permit applicant to control discharges of pollutants to the system satisfies the criteria set out in 40 C.F.R. § 122.26(d)(2)(i).
- Supplementation of the Source Identification Information Submitted Under Part 1. This includes identification of all " major outfalls" (a defined term) and an industrial activity description of each facility which may discharge stormwater associated with industrial activity to the system.
- Characterization Data. Discharge characterization data from between 5 and 10 outfalls or field screening points designated by EPA or the state as representative of commercial, residential and industrial land use activities based on Part 1 information. The data shall also include estimates of the annual pollutant load of the cumulative discharges to waters of the United States, a proposed schedule to provide seasonal pollutant load and event mean concentration data for any constituent detected in any required sampling, and a proposed monitoring program for representative data collection for the term of the permit.
- Proposed Management Program. A proposed stormwater management program to reduce the discharge of pollutants to the maximum extent practicable.
- Assessment of Controls. Estimated reductions in loadings of pollutants from system discharges resulting from the municipal stormwater management program.
- Fiscal Analysis. An analysis of capital, operation and maintenance expenditures, by fiscal year for each year of the permit term, to complete the characterization data requirements and stormwater management program requirements.

The centerpiece of the Part 2 application is the proposed stormwater management plan. This plan's purpose is to reduce the discharge of pollutants to the "maximum extent practicable using management practices, control techniques, and system design and engineering methods" 40 C.F.R. § 122.26(d)(2)(iv). Under the regulations, proposed programs will be considered by the permit writer when developing permit conditions. Id. The management plan allows the permittee to propose, in the first instance, the components of a program it believes are appropriate for preventing or controlling the discharge of pollutants. 55 Fed. Reg. 48052.

Stormwater management programs are to be based on:

- a description of structural and source control measures to reduce pollutants from runoff from commercial and residential areas;
- a description of a program, including a schedule, to detect and remove or permit illicit discharges and improper disposal in the system;
- a program to monitor and control pollutants in stormwater from municipal landfills, hazardous waste treatment, disposal and recovery facilities, industrial facilities subject to section 313 of SARA Title III, and other municipal facilities identified as contributing a substantial pollutant loading to the system; and
- a program to implement and maintain structural and non-structural best management practices to reduce pollutants from construction sites.

The stormwater management program must address illicit discharges to the system. The regulations define illicit discharges as any discharge to an MS4 that is not composed entirely of stormwater, except discharges pursuant to an NPDES permit and discharges resulting from fire fighting activities. 40 C.F.R. § 122.26(b)(2). However, as noted in the requirements for a stormwater management plan, not all such flows must be prohibited. Certain types of flows such as landscape irrigation, groundwater infiltration, air conditioning condensate, lawn watering, and street wash waters only need to be prohibited when such flows are identified as significant sources of pollutants. 55 Fed. Reg. 48037.

Phase II: Stormwater Regulations

The 1987 Water Quality Act required EPA to establish a two-phased approach for the control of stormwater discharges. Phase I consists primarily of permitting stormwater discharge associated with industrial activity or stormwater discharges from large or medium municipal separate storm sewers. Phase II covers all stormwater discharges not addressed under Phase I and could include all other municipalities, as well as light industrial and commercial activities.

CWA Section 402(p)(5) requires EPA to conduct two studies on Phase II stormwater discharges. The first study will identify those classes of discharges that may be addressed in Phase II and evaluate the nature and extent of pollutants in such discharges. The second study will evaluate procedures and methods to control Phase II stormwater discharges to the extent necessary to mitigate impacts on water quality. EPA has requested public comment on ways to implement the second phase of the stormwater permitting program for sources and activities not regulated under Phase I. 57 Fed. Reg. 41344 (September 4, 1993). EPA specifically requested comment on a variety of options that range from comprehensive permitting of all municipal, light, industrial, and commercial activities that generate stormwater runoff to little or no NPDES permitting of Phase II sources. EPA's final approach to the Phase II stormwater permit program will be developed in the near future.

Summary of Current Statewide SW Management Programs

The following is a summary of some of the current statewide stormwater management programs gathered from late 1997 to mid 1998:

Alabama

Alabama has NPDES-delegated authority from the U.S. EPA Alabama Department of Environmental Management (ADEM) issues general permits through its Industrial Branch as well as its Mining and Nonpoint Source Section. ADEM requires municipal stormwater permits for Birmingham, Huntsville, Montgomery, and Mobile. Construction site sedimentation and erosion control regulations are implemented by the Mining and Nonpoint Source Section of ADEM. Along the Gulf of Mexico construction site discharges and other industrial operations are regulated by the Coastal Zone Management Program (Thompson). Local communities can also provide additional requirements. As an example, Mobile has experienced flooding problems for many years. An engineering study identified 92 separate stormwater drainage projects having an estimated cost of about $100 million (Steeves and Chapman 1988). This study recommended that a stormwater management utility be established within the city's Department of Public Works. In 1987, after many public meetings, Mobile adopted a water management plan and approved the concept of a user's fee to pay for these needed stormwater drainage improvements. Besides flood control objectives, this utility would also monitor water quality and plan for future water quality improvement projects. The annual operations and maintenance budget for this utility was estimated to be about $3.5 million. The estimated fees to pay for this service would be about $3 per household per month.

Alaska

Alaska does not have NPDES permitting authority. However, permits issued by the USEPA become state permits once the Alaska Department of Environmental Conservation demonstrates its ability to issue and enforce these permits. Aside from the basic EPA stormwater permit requirements, the state of Alaska also requires a "qualified personnel provided by the discharger" to inspect certain areas. These areas include disturbed areas of construction sites that have not been stabilized, storage areas exposed to precipitation, structural control measures, and locations of entrance and exit to the site. These designated areas must be inspected within 24 hours of any rain event greater than 0.5 inches.

Arizona

Stormwater permits in Arizona are issued by the USEPA, as the state does not have permitting authority. Therefore the stormwater permit requirements are nearly identical to those in the general nationwide program, with a few additional requirements. Arizona requires a secondary containment system able to hold the entire contents of *the largest single tank plus adequate freeboard to accommodate* a 25-year, 24-hour rain event for industries storing chemicals defined as priority under SARA. Best management practices have been outlined with regard to runoff control. These BMPs are currently required for agricultural operations using nitrogen fertilizers. Other sources of runoff, such as urban stormwater runoff, resource extraction, grazing, and silviculture, will soon be subject to BMP compliance as well. Several cities in Arizona have additional regulations to prevent pollution from stormwater discharge. Examples are the cities of Phoenix, Tempe, and Mesa, which all require retention basins to control construction site runoff.

Arkansas

Arkansas has delegated stormwater permitting authority, meaning it issues and regulates its own permits based on the guidelines set forth by the EPA. In addition to these guidelines, the state has established some numeric effluent limitations. For example, coal pile runoff should not exceed concentrations of 50 mg/L maximum suspended solids and pH must be within 6-9. The state has determined parameters which must be measured by permittees as well. Primary metal industries and wood treatment facilities must sample for BOD5, and land disposal facilities must test for ammonia and nitrate plus nitrite nitrogen.

The Arkansas Department of Pollution Control and Ecology publishes guidance for detention ponds and erosion control. If a study of a proposed development indicates flooding problems, a development permit would be denied without stormwater control. Examples of acceptable controls are onsite storage, offsite storage, or an improved drainage system. The method used for stormwater detention is the modified rational hydrograph method. This guidance includes tables and graphs for determining time of concentration and rain intensity. The required volume of detention is evaluated according to the following methods:

Volume of detention for projects of less than 50 acres shall be evaluated by the "simplified volume formula." Volume of detention for projects 50 acres or greater but less than 200 acres may be evaluated either by the "simplified volume formula" or the "modified rational hydrograph method." For projects larger than 200 acres, the owner's engineer shall submit a proposed method of evaluation for sizing the retention basin or detention basin to the Department Public Works. The method will be evaluated for professional acceptance, applicability, and reliability by the city engineer. No detailed review for projects larger than 200 acres will be made before the method of evaluating the retention or detention basin is approved. Other analytical methods of evaluating volume of detention require approval by the city engineer.

California

California is an NPDES-delegated state with general permitting authority; however, the state has instituted a fairly large number of requirements stricter than those outlined by the EPA. In contrast to the EPA permit, California has established that the primary activity at a facility does not necessarily determine the category of industrial activity at a location. Each area of the facility is treated differently. For example, at a school, although its primary activity is education, the vehicle service area is nevertheless treated as a transportation area. Whether the activity is primary or auxiliary is of no concern under the regulations; each use is considered individually under the permit. Strict guidelines are also in effect as to sources considered to be point sources. Sheet flow from a parking lot is considered to be a point source requiring a permit. This is not the case in most states. Monitoring programs are also stricter than those in effect nationally; guidelines for establishing these programs and the objectives they must accomplish are clearly outlined in the regulations. Sampling must include pH, total suspended solids, specific conductance, and total organic carbon, as well as toxic chemicals specific to an individual site. The state has determined that it is not feasible at this time to establish numeric limits for those parameters not listed under a specific industry. Construction site permits require erosion and sediment controls, post-construction stormwater controls, and inspection of the site before and after storm events to evaluate the effectiveness of the measures taken.

Colorado

Colorado issues its own stormwater permits as an NPDES-delegated state. The state has established some numeric effluent limitations. Concentrations of pollutants are limited for the following industries: phosphate manufacturing, fertilizer manufacturing, petroleum refining, cement manufacturing, and coal pile runoff. Construction sites having stormwater permits must be inspected every 14 days and after any precipitation or snowmelt event that causes surface runoff. Coal mining permits establish specific numeric limits for effluents at active and post-mining outfalls. In addition to these limits, control measures also govern drainage control, subsidence, acid runoff control, grading, and other reclamation activities. Any drainage from coal mines must flow into a treatment pond, which is then treated as a point source discharge. In order to obtain a municipal stormwater permit, an area must first establish a record of all stormwater outfalls requiring a lot of monitoring. Secondly, a stormwater management program must be established. Ben Urbonas of the City of Denver, at a 1987 Maryland training program, reported that simple peak runoff rate controls were not adequately protecting Denver's streams. Urbanization increased flooding flow rates by about two times in the Denver area, but the critical pollutant carrying flows associated with common storms were increased by several hundred times. Denver then began concentrating on the use of on-site detention, along with sand filters coupled to extended detention facilities, to better control stormwater quality.

Connecticut

NPDES permitting authority has been delegated to the state of Connecticut by EPA. Permit guidelines have been made more stringent for some specific permits. Industrial sites must have additional means by which to store potentially hazardous materials and measures must be made so that chemicals are stored under a roof to minimize stormwater contamination. Salt storage piles must follow the same general guidelines. Monitoring must be done for a range of pollutants three times a year. Acute biomonitoring tests must be conducted yearly for a large number of permittees. Also, industrial stormwater permits disallow visible floatables including scum, except for those naturally occurring. Construction permits, too, have a relatively large number of additional requirements. Sediment basins must accommodate drainage areas greater than 5 acres of disturbed soil; full descriptions of measures to be taken to eliminate or reduce stormwater runoff when construction is finished must be included; permittees need to install stormwater management programs that will remove 80% of total suspended solids from stormwater; and velocity dissipation devices are also required.

Delaware

Delaware is an NPDES-delegated permitting state, following for the most part the general guidelines set forth by EPA. The state has established additional regulations to address stormwater runoff from construction activities. No more than 20 acres of a single development may be disturbed at a time, and any site that is not worked for more than 14 days must be stabilized. In new developments, stormwater management measures are required. Permanent measures must remove 80% of the total suspended solids for the site and be capable of storing runoff from storms up to 100 years. Acceptable BMPs are detention ponds, retention ponds, or sand filter systems. The method encouraged by the state is the development of wetlands to manage the stormwater.

District of Columbia

The District of Columbia does not have NPDES permitting authority and therefore permits for this region are issued by EPA. It follows that this region's regulations are nearly identical to those enforced nationally. However, there have been some additional restrictions put on industrial dischargers. A numeric limit of 50 mg/L total suspended solids has been set for effluent consisting entirely of coal pile runoff. It is unlawful to meet this limit by merely diluting the runoff with other flows, such as stormwater. Values for pH from coal runoff must fall between 6 and 8.5. In the Chesapeake Bay drainage, industrial dischargers must provide control measures to achieve a 40% reduction in nitrogen and phosphorous loads entering the waters of the bay.

Florida

Florida has had stormwater regulations since 1979 (Livingston 1988). The initial stormwater rule was revised in 1982 and requires a stormwater permit for all new stormwater discharges and for modifications to existing discharges that were changed to increase flow or pollutant loadings. This state permit program had to be implemented within the framework of the Clean Water Act. Required best management practices must be designed according to site-specific conditions and are to be monitored to ensure correct performance. If the monitoring indicates poor performance, the controls must be corrected.

Controls that may be required for specific projects include grass drainage swales, percolation ponds, wet detention ponds with filtration, and wetland treatment. Florida has encouraged innovative control designs that promote multiple uses and can be located on city-owned property. Examples of recent innovative controls include the construction of a spreader swale that causes stormwater to overflow onto a city park for percolation. Existing lakes are also being modified to enhance their stormwater control capabilities.

Florida is a state with NPDES permitting authority. Additional regulations have been placed on several industries. For example, SWP3 site descriptions for construction sites must include rational method estimates of runoff coefficients for before, during, and after the construction project. Post- construction controls are to be designed to remove at least 80% of the average annual pollutant loads from a given site that has discharge flows into outstanding Florida waters. These controls may include stormwater detention structures, retention structures, the use of vegetated swales, or other such similar measures. Velocity dissipation devices must be employed to supply non-erosive outfall discharges. The main goal of these stipulations is to "equalize pre and post development stormwater peak discharge rates and volumes." The state has stormwater management programs at the state, watershed and local level. In 70 communities in the state, stormwater utilities have been set up and financed by local user fees. Charges are applied based on parcel size and proportion of impervious area to natural area.

Georgia

The Georgia Erosion and Sediment Control Act of 1975 requires that a permit be obtained for many land disturbing activities. These permits examine specific development and erosion control plans but were not required to specifically address stormwater quality controls.

Local governments can adopt ordinances to enforce this law, but the Environmental Protection Division of the Georgia Department of Natural Resources will have permitting and enforcement responsibilities if no local regulations are passed. However, local review of erosion control plans by the regional Soil and Water Conservation District must be provided. The Natural Resources Conservation Service (NRCS) is commonly asked to provide technical assistance in these reviews..Georgia erosion control plans are prepared with little specific guidance from the Erosion and Sediment Control Act and therefore rely on close working relationships with the local NRCS offices.

Georgia is a permitting state under the NPDES program. The major difference in Georgia's stormwater regulation is the addition of the Georgia Erosion and Sedimentation Act of 1975. This act requires a permit for any land disturbing activity larger than 1.1 acres.

Hawaii

Hawaii has NPDES-delegated permitting authority. All permittees in this state must comply with the state's basic water quality criteria, which lists prohibited substances. Examples of these are oil, materials that will form objectionable sludge, substances that will affect the taste or odor of water, pathogenic organisms, and others. Discharges are further restricted as to the specific concentrations allowed. They can not contain pollutants in 24-hour average concentrations greater than the values obtained by multiplying the minimum dilution by the applicable standards, and non-carcinogenic pollutants in 30-day average concentrations. For construction sites, BMP plans must be implemented to control construction runoff; these controls must be checked weekly during dry periods and within 24 hours after any rainfall of 0.5 inches or greater. Pre-construction groundcover may not be disturbed more than 20 days before construction begins. Temporary soil erosion measures must be used where construction will continue for 30 days or more. Measures must be taken to ensure that runoff does not cause erosion. Examples of these measures are: runoff must be discharged through a lined channel or pipe; and "all surface water" flowing toward a construction area should be diverted. Muddy waters that have been pumped from a construction site must be held in a settling basin and treated before being released. In addition to the state regulations, many local city and county governments have additional regulations for controlling stormwater pollution.

Monitoring requirements are outlined for industrial dischargers. Stormwater pollution control plans (SWPCPs) must be developed and implemented by industrial dischargers. These SWPCPs parallel EPA's baseline SWPCPs. Hawaii requires a secondary containment system for industries handling chemicals defined as priority under SARA.

Idaho

Idaho does not have NPDES permitting authority; its permits are issued by EPA Region 10. The state has an additional voluntary program for controlling agricultural nonpoint source pollution. Idaho has additional regulations for runoff from silvicultural and mining sites. The following tables on pages E-5 and E-6 "summarizes the current regulations for storm water pollution control" in Idaho.

Illinois

Illinois has NPDES delegated permitting authority from U.S. EPA. The Illinois EPA has general permitting requirements similar to the EPA's baseline general permit for the following: industrial dischargers, stormwater pollution prevention plans (SPW3), and construction sites disturbing 5 acres or more of land. Individual municipalities have provisions in their building codes to regulate construction site erosion. The state of Illinois does not regulate detention ponds used for flow attenuation purposes. Those facilities are regulated by some Illinois counties. The Illinois EPA publishes the Illinois Urban Manual which includes soil conservation service conservation practice standards "Impoundment Structure – Full Flow" and "Impoundment Structure – Routed." This agency also distributes U.S. EPA publication, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

Land Use Activity	Agency of Local Function	Permit, Approved Process, or Authority	Type of Construction
Plan Review			
Storm Water Pollution Prevention Plan Review (optional at local level)	U.S. Environmental Protection Agency (EPA)	National Pollutant Discharge Elimination System (NPDES) discharge permits	industrial, commercial and residential over 5 acres
Drainage Plan review	Local public works or building department	Consult local authority	commercial, residential
Storm Water Discharges			
To a right-of-way	Local or county highway district	Consult local authority	industrial, commercial, residential
To a natural waterway	EPA and/or local/watershed-based authority	NPDES discharge permit	industrial, commercial, residential
To a privately owned canal or drain	Local canal or drainage district or EPA	Permission from local canal company or drainage district, NPDES discharge permit	industrial, commercial, residential
To a Bureau of Reclamation (BOR) canal	BOR, EPA	Permission from BOR, NPDES discharge permit	industrial, commercial, residential
From selected industrial facilities	EPA	NPDES stormwater discharge permit	Industrial
Storm Water Disposal			
To subsurface through an injection well	Idaho Department of Water Resources (IDWR) regional office	Underground Injection Control (UIC) Program	Industrial, commercial, residential

Indiana

Indiana has NPDES-delegated general permitting authority from EPA. Indiana issues general stormwater permits for industrial dischargers and construction sites disturbing 5 acres or more of land. IDEM (Indiana Department of Environmental Management) also regulates stormwater runoff from certain industries using NPDES wastewater permits. Examples of these industries would include the steel and coal mining industries. There are no state level requirements for stormwater (only) detention ponds. A facility is free to build one if and how it chooses. Sometimes to control flooding at the local level, there are requirements for stormwater detention. If a pond is going to receive wastewater in addition to stormwater (i.e., process wastewater) then it would be considered a water pollution treatment/control facility, and there are criteria that must be met.

Iowa

Iowa has NPDES-delegated permitting authority. State regulations dictate that facilities in sensitive watersheds that contribute to the water quality problems of the area must follow more stringent guidelines. Coal pile runoff is subject to numeric limits of less than 50 mg/L total suspended solids, and pH must be between 6 and 9. The state has also passed sedimentation and erosion regulations for agricultural and construction sites. These laws are enforced on a complaint-driven basis and can lead to an order to undertake corrective action.

Site Preparation/Construction			
All new development/ redevelopment	Local public works or building department	Local or county ordinance(s)	commercial, residential
Construction over 5 acres	EPA	NPDES stormwater permit	industrial, commercial, residential
Development project potentially affecting an existing highway	Idaho Transportation Department, local or county highway district	Idaho Code, Title 18, Chapter 39, Section 7-8	industrial, commercial, residential
Development project potentially affecting an existing drainage facility	Local public works or building department, canal company, drainage district	Local or county ordinance(s)	industrial, commercial, residential
Dewatering			
Discharges to right-of-way	Local or county highway district	Consult local authority	industrial, commercial, residential
Discharge to a privately-owned canal or drain	Local canal company, Drainage district	Permission from canal company or drainage district, NPDES discharge permit	industrial, commercial, residential
Other Permits			
Stream Channel Alteration	IDWR	Stream Channel Alteration Permit	industrial, commercial, residential
Filling of wetlands, other natural waterways of the U.S.	U.S. Army Corps of Engineers 343-0671	404 (dredge and fill) permit	industrial, commercial, residential

Kansas

NPDES permitting authority has been delegated to the state of Kansas by EPA. The Kansas Department of Health and Environment (KDHE) administers the NPDES program which follows the EPA's baseline general permit with additional requirements for conforming to water quality standards established by the state. Construction site permitees are required to prepare stormwater pollution prevention plans (SPW3s). However, industrial stormwater dischargers are not required to develop SPW3s. A sediment basin is required for construction sites were 10 or more acres of land are disturbed at one time. The basin will provide at least 3,600 cubic feet of storage per acre drained, unless the flows are diverted around both the disturbed area and the sediment basin. KDHE has a nonpoint source pollution program and the Department of Agriculture has statewide authority to develop pesticide management areas. One of these has been instituted for the area over the Delaware River.

Kentucky

Kentucky is another state with NPDES delegating authority. In Kentucky, this program falls under the Kentucky Pollution Discharge Elimination System (KPDES) permit program administered by the Kentucky Division of Water. This program applies to construction sites that will disturb 5 acres or more of land and other industrial facilities. Required BMPs for industrial dischargers are similar to EPA's baseline general permit. Construction site permits suggest BMPs that are baseline and are mostly voluntary. However, mandatory requirements at local municipality levels are required to be included and implemented.

Louisiana

Louisiana is an NPDES-delegated state with the authority to issue its own discharge permits. In addition to the guidelines set forth by EPA, Louisiana has implemented some supplementary standards. Numeric limits have been set for industrial dischargers, limiting the amount of total organic carbon that may be discharged to 50 mg/L and oil and grease discharges are limited to 15 mg/L. Oil and gas exploration activities have standards for COD (daily max 100 mg/L), total organic carbon (50mg/L), and oil and grease (15 mg/L). These activities are also limited in the amount of chlorides they may discharge into brackish waters. Facilities covered by industrial permits must have a stormwater pollution prevention plan that outlines how numeric limits will be achieved. This plan must also identify potential pollution sources and describe the practices that will reduce pollution and fulfill permit requirements. Louisiana has also developed state stormwater regulations that require a Louisiana Water Pollution Discharge System permit if the potential for water contamination exists, or large volumes of stormwater will be discharged, or in areas where industrial materials are stored. Coastal areas are also of great concern and are therefore subject to additional regulations. Projects within coastal areas must be designed to avoid discharge of nutrients into coastal waters, and to prevent the alteration of oxygen concentration. Development may not damage streams, wetlands, or other features of the environment, and must attempt to avoid the destructive discharges of sediment, pathogens, or toxic substance and to prevent reductions in the productivity of the waters. Attention must also be paid to dissolved oxygen content and heavy metals.

Maine

Maine does not have NPDES permitting authority; therefore its permits are issued by EPA Region 1. The program requirements are similar to EPA's baseline; however, the Maine Department of Environmental Protection (DEP) Bureau of Land and Water Quality wrote the Natural Resources Protection Act that imposes additional regulations intended to protect the quality of the receiving water. Under this act, nearly all types of water bodies, as well as dunes, fragile mountain areas, wildlife habitats, and wetlands are protected through regulations covering activities of concern. Permits are required when the soil will be altered, or discharges (including fill) may be introduced into these areas. Maine's Stormwater Management Law requires construction permits for proposed projects in the direct watershed of a water body most at risk with 20,000 square feet or more impervious area, or in any watershed with 1 acre or more of impervious area or 5 acres or more of disturbed area. This law contains rule standards regarding construction site stormwater quantity and quality. The peak flow of stormwater must not exceed the peak flow prior to construction and does not increase the peak flow of the receiving waters. To protect the quality of the receiving waters three standards are contained in the rule: total suspended solids (TSS), phosphorous, and basic stabilization. The table on the following page is a summary of these standards.

Maryland

Maryland enacted its first statewide erosion control legislation in 1970 (McElroy and Halka 1985). This initial legislation required an erosion control plan before a building permit was granted. It also required that all Maryland cities and counties adopt grading and sediment control ordinances acceptable to the Maryland Water Resources Administration. After ten years experience with this legislation, it was deemed ineffective because of the lack of consistency in local ordinances, inadequate local administrative commitment, inadequate field inspections, and inadequate enforcement processes. It was concluded that most of the communities did not have the necessary financial resources to adequately fund the program. Therefore, several changes were made to the legislation. As of 1978, all project engineers or foremen in charge of onsite clearing were required to attend a state training program. In 1984, all inspection and enforcement operations were assumed by the state and the inspection staff was increased to 34 people.

The objective of the Maryland stormwater program was to maintain as nearly as possible natural runoff characteristics. Infiltration and detention facilities are important control practices used to meet this objective. The state found that a more comprehensive approach was needed to control stormwater runoff than was provided with a peak flow criterion alone. It therefore gave consideration to volume reduction, low flow augmentation, water quality control, and ecological protection.

Maryland prepared a model stormwater ordinance in 1985 for consideration by local governments. Because of its involvement in ongoing efforts to improve water quality in the Chesapeake Bay, Maryland is also retrofitting stormwater controls in existing developed areas. The state's nonpoint pollution control program also includes agricultural sources, shoreline protection, retention of existing forestland, providing conservation easements, controlling dredging and fill projects, controlling mining area runoff, and repairing failing septic tanks.

NPDES permits are issued through the state. Releases of oil and other hazardous substances must be prevented or minimized in stormwater discharges. The state has also established a sediment and erosion control

Project Location/Type	Standards
Watershed of a lake not most at risk. Project with <3 acres of impervious area or £ 5 acres of disturbed area	Basic Stabilization Standard
Watershed of a lake most at risk (severely blooming lake)	Basic Stabilization Standard and Phosphorous Standard
Watershed of a lake most at risk (not severely blooming lake). Project with ≥ 3 acres of disturbed area	Basic Stabilization Standard and Phosphorous Standard
Watershed of a lake most at risk (not severely blooming lake). Project with <3 acres of impervious area and <5 acres of disturbed area	Basic Stabilization Standard and 80% TSS Standard or Basic Stabilization Standard and Phosphorous Standard
Direct watershed of a lake other than a lake most at risk and project with > 3 acres of impervious area	Basic Stabilization Standard and Sliding Scale TSS Standard or Basic Stabilization Standard and Phosphorous Standard (may be waived by DEP)
Direct watershed of a lake other than a lake most at risk and project with ≥5 acres of disturbed area and <3 acres impervious area	Basic Stabilization Standard and Phosphorous Standard
Direct watershed of a coastal wetland most at risk	Sliding Scale TSS Standard
Watershed of a river, stream, or brook most at risk and the project drains to the water body at or above a public water supply intake	Basic Stabilization Standard and Sliding Scale TSS Standard
Watershed or a river, stream, or brook identified as a sensitive or threatened area and drains to the water body at or within two miles above a public water supply intake	Basic Stabilization Standard

Source: *A Developer's Guide to the Maine Stormwater Management Law (Organized Areas)*

program for implementation at construction sites, which includes requirements for runoff controls. Stormwater management is a requirement at construction sites both during and after construction activity. Developers must implement runoff controls for 2- and 10-year storm events that will restrict the flow from exceeding the pre-development level. A list of recommended BMPs is provided by the state, with the most preferred being infiltration devices, followed by vegetative swales, retention ponds, and detention ponds.

Massachusetts

Permits in Massachusetts are issued by EPA as the state does not have permitting authority. It does however impose some state-specific regulations on the permits. New or increased stormwater discharges to coastal or outstanding resource waters are ineligible for permits. In order to minimize erosion, outfall pipes must be set back from receiving waters whenever the discharges are increased, or the system altered in any way. BMPs are also outlined for use in stormwater management in the state, and the best practical method of treatment must be employed in maintaining the goals of the program.

Michigan

The Michigan Environmental Protection Act of 1970 imposed a duty on all governmental agencies and individuals to prevent and minimize water pollution while carrying on normal activities (Dean 1981). A number of

Michigan court cases thereafter determined that local governments had the responsibility to consider the environmental effects of new subdivision developments, including stormwater effects. Previously, the Michigan Subdivision Control Act of 1967 required local drain commissioners to review subdivision plat proposals only to assure adequate drainage.

A number of county drainage laws in Michigan now also affect stormwater quality. As an example, Oakland County prefers the use of infiltration of stormwater in wetlands, lowlands, and depressions to the use of dry detention basins in providing drainage control. Infiltration can have a positive effect on preventing surface water quality degradation caused by stormwater discharges, while dry detention ponds have little stormwater quality benefit. In addition, almost all of the 35 Oakland County local governments encourage the use of swales and other on-site controls. Wet detention ponds are also used when necessary. However, many local governments are concerned by the lack of maintenance of detention facilities and therefore discourage their use.

Michigan issues its own permits under the delegated authority of EPA. Of particular note is Michigan's requirement for certification of stormwater operators. Each industrial facility with a general permit must have treatment and control measures, and these must be carried out by a certified individual. A list of requirements are also provided for applicants for the permit; some of these are: erosion controls must be properly implemented, inspection of controls must be performed on a pre-determined basis, containment for spills of material must be provided, waste material produced in the treatment of stormwater must be properly disposed of, and there are several guidelines as to certified operators.

Minnesota

Minnesota has NPDES-delegated authority. Construction site controls more stringent than the national standard have been applied in this state. They are as follows: temporary protection must be provided for areas of exposed soil with a continuous positive slope within 100 feet from a water of the state or other devices connected to a water of the state; and exposed soils on positive slope areas must be protected with either temporary or permanent cover within certain time frames:

Type of slope	Area has not been or will not be worked by contractor for
Steeper than 3:1	7 days
10:1 to 3:1	14 days
Flatter than 10:1	21 days

In addition, the bottoms of temporary drainage ditches must be stabilized within 100 feet of the receiving water within 24 hours of the ditch being connected to the water. In order for a pipe to be connected to a drainage ditch, it must first be equipped with a velocity dissipation device. Sedimentation BMPs must be installed on the down-gradient perimeters of the site before any up-gradient activities may begin. These BMPs must remain in place until the site has been permanently stabilized. Vehicle transport of sediment must also be minimized.

Temporary sedimentation basins must be provided to collect runoff from disturbed sites of 10 or more continuous acres. Basins shall provide 1,800 ft3 per acre drained storage below the outlet pipe. The basin outlets must be designed to prevent short circuiting and discharge of floating debris.

The Minnesota Pollution Control Agency (MPCA) publishes a best management practice manual entitled *Protecting Water Quality in Urban Areas*. The MPCA issues NPDES/SDS general stormwater permits for industrial and construction activity. These permits list the requirements at the federal and state level. The industrial activity permit covers "facilities discharging storm water associated with industrial activity as defined in 40 CFR 122.26(b)(14)." This permit requires a storm water pollution prevention plan, including drainage maps, significant materials inventory, and exposure evaluation; BMPs categorized as source reduction, diversion, and treatment; implementation schedule; inspections and maintenance; reporting; etc. The construction activity permit covers erosion control and inspection and maintenance requirements for construction activities that disturb 5 or more acres of total land area.

Mississippi

Permits are issued by the state of Mississippi under authority delegated to it through EPA NPDES program. Mississippi issues nine different types of general stormwater permits including one for construction sites and one that is a baseline permit. Special criteria for chlorides, sulfates, and total dissolved solids apply to all discharges into the Mississippi River. Stormwater permits state that discharges must be free of debris, oil scum or other floating material except in trace amounts, eroded soils that will form objectionable deposits, suspended solids, turbidity, and color at levels higher than the receiving water, and chemical concentrations higher than the state limits allow.

Stormwater controls, including erosion control measures, are required for all construction sites. These must divert flow away from disturbed soils, keep exposed soil time and area to a minimum, implement BMPs and remove sediment from stormwater before it leaves the site. Sediment basins are required for sites with drainage areas over 5 acres. The recommended capacity of the basin (SCS manual) should be 67 yd^3 per acre drainage area, with maximum surface area and an outlet as far from the inlet as possible. Stormwater controls must be described with respect to vegetative controls, structural controls, post-construction controls, and measures to minimize vehicle transport of sediment.

Missouri

Missouri has a unique method for funding nonpoint runoff controls. In 1983, the Missouri legislature passed a constitutional amendment to raise the state sales tax by 0.1 percent to increase state funding for parks and historical sites, and for soil conservation (Howland 1985). State voters, in turn, passed the amendment in the 1984 general election. This tax increase was only to be in effect for 5 years (from 1985 to 1990), and the soil conservation portion (about $15 million per year) was mostly to be used for cost-sharing of agricultural runoff controls. However, this funding method could also be used to fund urban stormwater controls.

Missouri has NPDES-delegated permitting authority. Construction site permits similar to EPA's general construction permit are required for sites disturbing 5 or more acres of land, over the life of the project. Construction sites over 10 acres are required to construct sedimentation basins. The basin shall be sized to contain 0.5 inch of sediment from the drainage area and be able to contain a 2-year, 24-hour storm. Industrial-specific stormwater pollution prevention plans are required for general industrial permits. Permits for some activities in this state place numeric effluent limits on stormwater discharges with respect to oil and grease, total suspended solids, pH, and other pollutants.

Montana

Montana has NPDES-delegated permitting authority. The Montana Department of Environmental Quality (DEQ) issues three general permits: a permit authorizing discharges from construction sites, a permit authorizing discharges associated with industrial activity, and a permit for oil and gas and mining activities.

Nebraska

Nebraska has NPDES-delegated permitting authority. Nebraska Department of Environmental Quality (NDEQ) issues two general permits: a permit authorizing discharges from construction sites of 5 acres or more and a permit authorizing discharges associated with industrial activity. Permittees of either general permit are required to develop and implement a stormwater pollution prevention plan (SWPPP) that will minimize erosion on disturbed areas, minimize the discharge of sediment and other pollutants in stormwater runoff, and maintain compliance with the requirements of the permit. A detention pond is required on construction sites where slopes are equal to or steeper than 3:1. Clay soils are present in many areas of Nebraska, and when erosion occurs suspended clay particles are not efficiently removed simply by use of a detention facility. Therefore, use of a detention pond does not circumvent the need to implement erosion and sediment controls. NDEQ does not have authority related to flow management issues, only water quality issues. Many local municipalities require new developments to construct permanent detention basins for the purpose of stormwater flow management. These requirements are intended to help prevent and reduce downstream flooding that would otherwise result from the increase in runoff that typically occurs with development. SWPPs for industrial permittees do not require use of detention basins.

Nevada

Nevada has NPDES-delegated permitting authority. The state general permit is identical to EPA's baseline NPDES stormwater program. Construction sites disturbing 5 or more acres, industrial facilities, and mining sites are covered by this permit. Specific BMPs are not required. Detention facilities are regulated by local governments. In the Lake Tahoe area there are stricter regulations administered by the Tahoe Regional Planning Agency.

New Hampshire

New Hampshire does not have NPDES permitting authority. Its permits are issued by EPA Region 1. The program requirements are identical to EPA's. In addition, the state has a shoreline protection program that issues site-specific permits for construction sites in or on the border of surface waters with contiguous area of 50,000 ft^2 if within a protected shoreline, or 100,000 ft^2 or more in all other areas.

New Jersey

New Jersey has NPDES-delegated permitting authority. The Department of Environmental Protection (DEP) issues two general permits: a permit authorizing discharges from construction sites of 5 acres or more and a permit *authorizing discharges associated with industrial activity.* Industrial dischargers must implement a SWPPP. Construction sites disturbing 5,000 ft2 of land are regulated by state erosion and sediment control laws.

New Mexico

New Mexico is a non-delegated state for the NPDES program. The NPDES program is under the direction of EPA Region 6 in Dallas, Texas. Questions about this program can be directed to the Stormwater Hotline at 1-800 245-6510.

New York

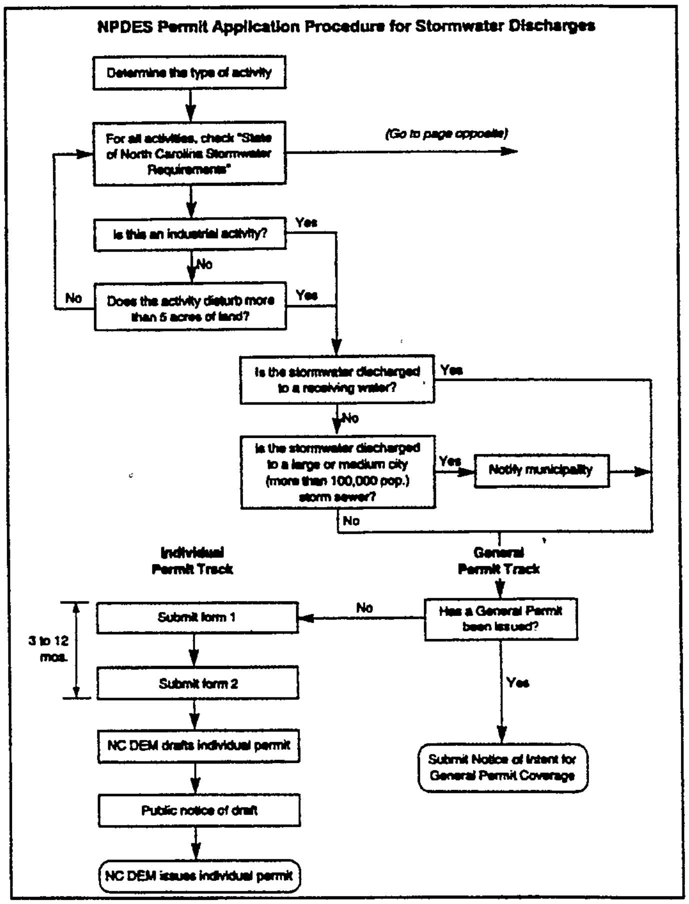
New York has NPDES-delegated permitting authority. The state includes some additional requirements in its construction permits. Structural practices must be built to divert stormwater from exposed soils and limit runoff from these areas. State guidelines also mandate that there may not be any visible and substantial changes with respect to color, taste, odor or turbidity downstream from construction sites. Vegetative and structural practices must be used to ensure that stormwater discharges do not vary significantly from pre-development conditions.

North Carolina

North Carolina has NPDES-delegated permitting authority. North Carolina presently issues 23 types of general permits including a permit for construction sites disturbing 5 or more acres of land and permits for various types of industrial activities. All types of permits require the implementation of a SWPPP. The state also imposes a set of regulations specific to stormwater for coastal waters, outstanding waters of the state, high quality waters, and water supply waters. To help the public determine what regulations are applicable for a project or industrial activity the following flow charts are published by the state in its Stormwater Management Guidance Manual.

North Dakota

North Dakota has NPDES-delegated permitting authority. The North Dakota Department of Health (NDDH) issues three general permits: a permit for construction sites disturbing 5 or more acres of land, a permit for industrial activity, and a permit for mining activities.



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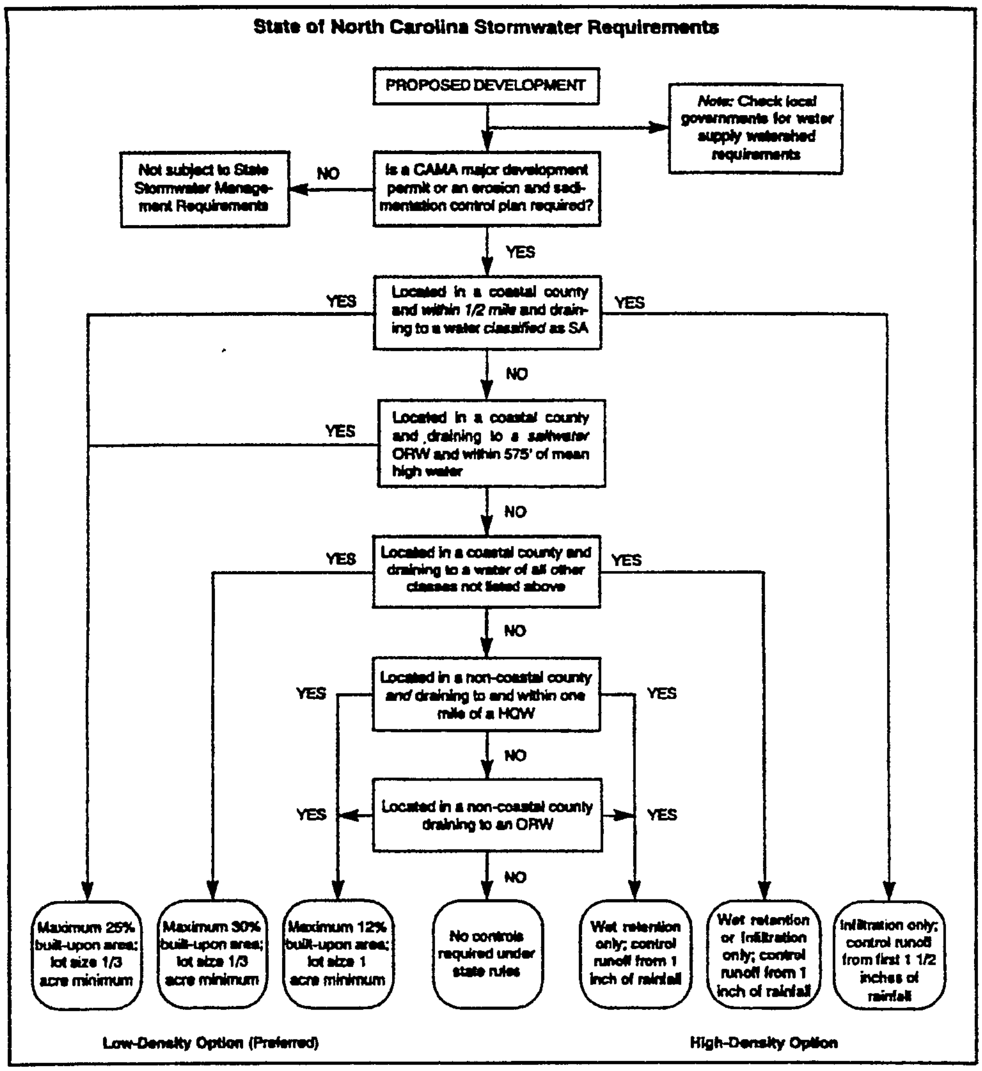

Ohio

Ohio issues its own NPDES permits under authority delegated by EPA. The state imposes additional runoff guidelines. Revegetation of construction sites must be achieved on a specified time scale, regulations apply to the protection of waters flowing near a site, and statewide regulations require the use of sediment ponds if sediment fences are determined to be insufficient. Ponds capable of holding 67 cubic yards of runoff per acre are required.

Oklahoma

NPDES permits in Oklahoma are issued by the state. Oklahoma Pollution Discharge Elimination System (OPDES) administers the NPDES program. OPDES's permit is identical to EPA's construction permit. Several cities in Oklahoma require builders and developers to design detention facilities so that the rate of runoff from a new building or development does not exceed the historic rate before development or construction runoff.

Industries in the state are subject to additional regulations. Oklahoma plans to adopt EPA's multi-sector permit for industrial sites. Whole effluent toxicity testing is required for dischargers twice annually. The Oklahoma Conservation Commission coordinates the runoff programs in the state, which are voluntary and provide assistance in making management decisions.

Oregon

Oregon has delegated NPDES permitting authority. Discharge limits are set for some industrial stormwater dischargers for certain parameters. These parameters typically include settleable solids, debris, conductivity, and *enterococci*.

Pennsylvania

The state of Pennsylvania has NPDES-delegated permitting authority. The general permit for industrial dischargers resembles EPA's baseline with the following numeric limits: 7 mg/L for dissolved iron, pH from 6 to 9, and a limit of 50 mg/L total suspended solids for coal pile runoff. The state's general construction permit covers sites between 5 and 25 acres unless the runoff from the site will be discharged into a protected water of the state. Any disturbed area, regardless of size, must implement erosion controls. For disturbed areas less than 5 acres, sedimentation traps with the capacity of 2,000 ft^3 may be used. A sedimentation basin is required at construction sites disturbing more than 5 acres. The basin must have a capacity of 7,000 ft^3 per acre, have a 24" freeboard, and have outlets designed to pass a minimum flow of 2 ft^3 per second per acre. A permit is required for timber harvesting operations that would disturb more than 25 acres of land. Water quality based limits may be established for any discharger to ensure adequate water quality in receiving waters.

Rhode Island

Rhode Island has NPDES permitting authority. The state has developed some additional regulations above baseline EPA guidelines. Rhode Island has standards for stormwater practices that include BMPs that must be incorporated into developments. Local governmental agencies may regulate stormwater discharges, but their regulations must be at least as strict as the state regulations. To limit suspended solids releases, the state's Coastal Zone Management Program requires new developments within 200 feet from a shoreline to remove 80% of the suspended solids discharged from a site after development.

South Dakota

South Dakota has NPDES-delegated permitting authority from EPA. The South Dakota Department of Environment and Natural Resources (DENR) has general permitting requirements similar to EPA's baseline general permit for industrial dischargers and construction sites disturbing 5 or more acres of land.

Tennessee

Tennessee has NPDES-delegated permitting authority. In addition to the basic requirements, the state has developed some additional provisions. At construction sites, vegetative and structural management techniques must be applied. Examples of these are: clearing and grubbing is minimized, soil exposure must be minimized through sequencing, large projects must be built in stages; strict checking and maintenance of controls is required; a responsible individual must be established and temporary and permanent soil stabilization measures must be used.

Texas

Austin has had a watershed protection ordinance since 1981 after it was found that continued urban development was having adverse affects on the local groundwater supply. This ordinance was amended in 1986 and contains specific standards for development within critical watersheds (Austin 1986). The Austin program is currently funded by a combination of user's fees and city general revenues. Common controls in all proposed land uses include buffer zones adjacent to all streams where no development is allowed, severe building restrictions on slopes greater than 15 percent, and required setbacks from springs, seeps, and sinkholes. Many innovative erosion and stormwater controls have been used in Austin, including sand filters, portable filter fence supports, and suspension of all city-required building inspections for any site in violation of its erosion and stormwater control plan. Porous pavement is not considered an effective stormwater quality control when protecting groundwater and is therefore not given any credit when calculating allowable impervious covers. Austin also has an ongoing monitoring program to evaluate the performance and required maintenance of stormwater controls.

Texas is in the process of becoming an NPDES-delegated state. Until that time, its permits will be issued by EPA. Texas has established probably the most extensive list of numeric standards for stormwater discharges There are discharge limits for arsenic, barium, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver and zinc.

Utah

Utah has NPDES-delegated permitting authority. In addition to the basic permit requirements, the state imposes supplementary regulations in some cases. Coal mining facilities are subject to restrictions on the total maximum flow and concentrations of total suspended solids in their discharges. To remediate these concerns, mines must use sedimentation controls, such as detention ponds, and mine site dewatering. Dewatering discharges are subject to limits in the concentration of iron, total dissolved solids, pH, suspended solids, and grease. The Salt Lake City Stormwater Utility has been established and institutes a user fee for use of stormwater systems. Several other cities in Utah have adopted similar plans.

Vermont

The state of Vermont has permitting authority under the NPDES program. A statewide permitting program has also been established that requires treatment and volume control measures to manage runoff from new developments once construction is completed. These management plans, including project designs, hydrologic calculations, and planned controls, must all be submitted to the DEP. Permits are issued on a site-specific basis. These are often issued with the stipulation that the post- development discharge rate does not exceed the rate before development. Sites have guidelines to follow during construction, as well. Ten environmental criteria have been established, addressing wetlands, headwaters, floodways, streams, shorelines, traffic concerns, water and air pollution, waste disposal, esthetics, and impacts on wildlife habitats.

Virginia

Virginia has NPDES-delegated permitting authority. As with most states, Virginia has instituted some additional guidelines. With respect to development, post-construction pollutant concentrations must not increase compared to pre-development concentrations. The Chesapeake Bay area uses phosphorous as an indicator pollutant. Sites that undergo redevelopment must implement measures to achieve a 10 percent reduction in average pollutant loads. Construction activities sponsored by the state also have a set of stormwater regulations they must follow.

Washington

The city of Bellevue has had a storm drainage utility since 1974. Its primary mission is to "manage the storm and surface water system, to maintain a hydrologic balance, to prevent property damage, and to protect water quality for the health, safety, and enjoyment of citizens and for the preservation and enhancement of wildlife habitat" (Bissonnette 1985). Bellevue stresses the use of natural drainage systems to transport and dispose of stormwater. Swales, lakes, ponds, wetlands, and detention ponds form important parts of this system. In 1985, the utility's operating budget was more than $5 million and the 1980 to 1985 capital improvement budget was about $13 million. The necessary revenues are obtained through user service fees, assessed according to the amount of runoff and pollutants generated for each area served.

A number of cities throughout the U.S. currently have storm drainage utilities, mostly modeled after Bellevue's. These utility districts all charge a fee to provide urban runoff control services. Bellevue's runoff and receiving waters were extensively studied during the Nationwide Urban Runoff Program. It was found that the beneficial uses of the streams were being seriously impaired by excessive flows, erosion, and sedimentation (Pitt and Bissonnette 1984). These problems are currently being reduced by runoff and erosion controls. Metallic and organic toxicants will also need to be controlled in future years in Bellevue.

West Virginia

West Virginia has been granted NPDES permitting authority by EPA. West Virginia issues two general permits, one for industrial dischargers and one for construction sites disturbing 3 or more acres of land. Construction sites having a drainage area of 5 acres or less should have a sediment trap with a storage volume equal to 3,600 ft^3 per acre. Sites over 5 acres should have a sediment basin which will provide a storage volume equal to 3,600 ft^3 per acre. The state has established additional numeric effluent limitations for coal piles with respect to pH and total suspended solids.

Wisconsin

Wisconsin has had a priority watershed protection program for more than 15 years. This program involves extensive state-funded cost sharing to retrofit nonpoint water pollution controls in watersheds that cannot meet water quality objectives with point source controls alone. Initially, this program almost exclusively involved agricultural water pollutant sources, with little urban runoff controls. In 1983, the state legislature passed legislation requiring the preparation of a model ordinance to control construction site erosion and stormwater runoff (Pitt 1986). The state will spend about $100 million over the next twenty years in retrofitting urban runoff controls in the priority watersheds. In order to protect this investment, all state funded and conducted construction, along with urban areas participating in the priority watershed program, are required to follow these ordinances.

The Wisconsin model ordinance for the control of construction site erosion has been adopted by many communities, including Milwaukee. This ordinance includes basic controls to reduce such erosion sources as vehicle tracking and dewatering of excavations, along with required diverting of up-slope waters, mulching of disturbed areas, and the use of downstream sedimentation controls. Extensive plan reviews and site inspections are also included in the ordinance. The ordinance is supplemented with a manual to ensure uniform design and appropriate applications of construction control practices.

Wisconsin has NPDES-delegated permitting authority. The DNR limits its stormwater program to municipalities in urban areas with documented water quality problems. These municipalities are required to collect data and assess their specific stormwater problems as well as develop a plan to address these concerns. Permits mandate that municipalities make and meet a timeline for development of a stormwater program, implement a successful program that reduces and prevents stormwater pollution, screen all storm sewer outfalls for sewer connections and other improper waste disposal; estimate pollutant loadings to the waters of the state; calculate the concentrations and constituents of pollutants in stormwater; monitor stormwater with respect to pollutant loads; assess the effectiveness of their stormwater program; and report on their progress.

Wyoming

Wyoming has NPDES-delegated permitting authority. The state has imposed additional controls on construction site activities. Sites that discharge into perennial water bodies must not increase the turbidity by more than 10-15 turbidity units above the background. Discharges into water bodies that are ephemeral are exempt from this standard but may not deposit sediment that degrades the habitat. All stormwater control devices must remove 80% of total suspended solids. Sites must establish structured runoff control plans with a designated responsible individual. Sites with a high potential for soil erosion should identify and implement BMPs to control erosion.

Historical Review of Wet Weather Pollution Management

Throughout history, many strategies have been implemented to control wet weather pollution for reasons such as flood control, water quality improvement, aesthetic improvement, waste removal, and others. To provide guidance for developing communities, a reference manual for wet weather flow systems in newly urbanizing areas is being developed as part of a cooperative agreement among the Urban Watershed Management Branch of EPA, the University of Alabama at Birmingham (Pitt, et al. 1997) and ASCE (Heaney, et al. 1997). The following historical review is a summary from this effort (Pitt, et al. 1997) and was mostly prepared by Steven J. Burian, a Ph.D. student at the University of Alabama.

F.1 Wet Weather Pollution Management: Ancient Times

Management of wet weather pollution is an age-old problem. Several ancient civilizations can be credited with implementing successful surface water drainage systems. Evidence exists that the dwellers of the city of Mohenjo-Daro (now part of West Pakistan) used sanitary sewer systems and had drains to remove stormwater from the streets (Webster 1962).

Mesopotamian engineers planned and built effective drainage and sanitary works, including vaulted sewers and drains for household waste, gutters and drains for surface runoff, and other appurtenances made of baked brick and asphalt (Maner 1966).

Of all the societies of western Asia and Europe, from antiquity until the 19th century, only the Romans set out to build a carefully planned road system with properly drained surfaces (Hill 1984). Virtually all that the early Romans knew about engineering came to them out of the civilizations of the eastern Mediterranean (Kirby, et al. 1990). Specific drainage structures used by the Romans included occasional curbs and gutters to direct surface runoff to open drainage channels alongside roadways (Hill 1984). To improve drainage, the roads would be graded in such a fashion to direct the surface runoff from the streets toward the drainage channels.

Draining excess water was not the only function of the system. It was soon discovered that disposal of wastes in these trenches removed the waste from the immediate area. However, the trenches relied on heavy rainfalls to adequately flush them of waste and debris, since overflow discharges from aqueducts were not sufficient to effectively convey the wastes. The wastes would therefore accumulate and cause unsanitary, not to mention repugnant, conditions. The solution to this was to cover the trenches; these covered trenches eventually evolved into planned sewers.

The Romans planned and constructed the "cloacae," or sewers, to drain their uplands to the nearby network of low-lying streams (Gest 1963). These sewers were originally open streams that drained most of the land prior to urbanization. The philosophy was to use the existing natural drainage channels to remove wet weather flows and pollution. It was decided that the proper way to use the channels was to build the city over them and provide drains from the surface to the underground streams. As time progressed, the Romans became more elaborate with their construction of sewers (Gest 1963).

F.2 Wet Weather Pollution Management: Middle Ages to the 1800s

The first sewers built in Europe following the fall of the Roman Empire were simply open ditches. Examples of this type of sewerage system in Europe are evident in Paris and London as well as in a few other European cities during the 1300s and 1400s (Kirby and Laurson 1932; Reid 1991). The open ditches used for drainage of stormwater were usually constructed in existing drainage pathways (Kirby and Laurson 1932) or down the centers of streets (Reid 1991). Besides being conveyances for stormwater, the open drainage channels became receptacles for trash, kitchen wastes, and sanitary wastes, the accumulation of which caused hazardous and nuisance conditions. To remedy this situation, Europeans simply covered the drainage channels, or sewers, which were emitting terrible odors and producing unsightly conditions. Interestingly, this solution is similar to that used 1,500 years earlier by the Romans during the construction of the "cloacae."

From the time of the Roman Empire to the 1800s, wet weather pollution management strategies experienced very little noteworthy advances, and in fact regressed considerably in terms of sanitation. However, towards the start of the Middle Ages, as disease epidemics occurred in major metropolitan areas of Europe, some believed proper sanitation was partly dependent on adequate sewerage.

Paris and London provide examples of European cities that developed piecemeal drainage systems in response to crisis situations and funding availability. A consequence of developing wet weather and sanitary systems in this way was an incoherent and varied overall system. In addition to the poor design and construction practices at the end of the Middle Ages, maintenance and operation of the systems were virtually neglected in most situations. Sewer systems of urban areas in Europe during the 1600s and 1700s were grossly under-planned, poorly constructed, and inadequately maintained.

F.3 Wet Weather Pollution Management: 1800s

The enlightened, post-renaissance society began to realize that adequate sewerage was necessary to promote proper sanitation. The early part of the 1800s marked the beginning of a series of decisions and technical advances that resulted in improvements related to wet weather pollution management.

F.3.1 Improvements in Design and Construction Practices

Innovations in construction materials improved sewerage systems in the early 1800s. As an example, in Paris until the 1820s, sewers had been constructed of cut stone or brick with rectangular or roughly rounded bases, which led to solids deposition problems (Reid 1991). Engineers substituted millstone and cement mortar for the hewn stone, which allowed for the construction of curved and smooth sewer floors. This lessened the flushing effort required for sewer cleansing. The quality of brick and clay pipe also improved during this time and became the materials of choice. The next major improvement in sewer materials was the use of concrete, which did not occur until the end of the 1800s (Metcalf and Eddy 1928).

In addition to improvements in construction, several advances were made in the design of sewer pipes. Sewers could now be constructed in curved shapes instead of simply rectangular shapes. These curved shapes included egg-shaped, oval, and v-notched patterns for combined sewer systems and provided improved hydraulic transport efficiencies over the rectangular sewer shape. Studies in England indicated that the lower part of a v-notch channel could carry sanitary waste well, while the upper portion could provide sufficient capacity to transport stormwater from the streets (Gayman 1997).

Another problem with sewers was the grade at which they were constructed. Often, caution was not exercised either during design or construction, and the sewers did not have a sufficient slope to transport wastewater during dry weather periods. Sewers began to be constructed on slopes sufficient to prevent ponding in the system.

F.3.2 Beginnings of Comprehensive Sewerage Design

The improvement in construction practices and pipe designs did not eliminate the problems with sewer systems in Europe. System design strategy became the focus of the next wave of innovations in sewerage practice. Hamburg, in 1843, is considered to have implemented the first comprehensively planned sewerage system (Metcalf and Eddy 1928). The circumstances were advantageous for this, as a large part of the city had been destroyed by fire in 1842.

London followed suit with a detailed study by many engineers of note, resulting in the decision to devise a comprehensive sewerage plan. In 1852, Joseph William Bazalgette was commissioned to plan and design the system (Kirby and Laurson 1932). Actual work on the main drainage of London began in 1859 and was practically completed in 1865.

Meanwhile, the sewers of Paris were still being constructed without any coordinated plan until 1823. At that time, construction practices began to improve, which allowed engineers such as Duleau to plan an adequate system of drainage for portions of the city. The interceptor sewer concept dates to this period in Paris and London (Kirby and Laurson 1932).

The 1800s saw rapid urbanization in the United States. In response to this urbanization in the United States, comprehensive design of wet weather pollution management systems began to be practiced. Chicago had the first comprehensive design implemented by a major American city. E.S. Chesbrough designed the system in a report completed in 1858 (Metcalf and Eddy 1928). He and other contemporary engineers soon consulted on similar comprehensive plans for additional U.S. cities (J.W. Adams for Brooklyn, New York for example).

The planning of early American sewerage was influenced by two general factors, the topography of the city and the place of disposal (Metcalf and Eddy 1928). The grade of the ground surface affected decisions concerning the mode of sewer transport, the size of the sewers, and the arrangement of small- and large-sized sewers, with gravity being the desired vehicle for transportation. In most situations, the use of natural drainage patterns in conveying stormwater was preferred, especially when streets were planned according to the lay of the land. The second factor mainly concerned the direction and distance that the sewage would be conveyed. Specific considerations included the dilution capability of the receiving stream and determination of the proper disposal location.

The comprehensive designs implemented in the U.S. made use of empirical data obtained from European practice for capacity and probable quantities of rainwater to be carried by the sewers (Webster 1921). It is noteworthy that among the branches of engineering, American sewerage is observed to have developed many of its features through experience, rather than experimenting (Metcalf and Eddy 1928).

F.3.3 Combined Versus Separate Systems of Sewerage

Although sanitary waste was a constant input to the stormwater systems of Europe, designs did not recognize the addition of sanitary wastewater in combined systems until 1843 in Hamburg. This does not imply that illegal connections of sanitary wastewater were not present, as this was often the case. The first types of wastewater legally allowed into the sewer system were dishwater and other liquid kitchen wastes. When the flushing toilet (water closet) came into general use in the early 1800s existing cesspools became overwhelmed. Eventually, this led to the permitted discharge of sanitary wastes into the sewers previously restricted to surface runoff, creating combined sewage. London did not allow legal sanitary connections to its sewer system until 1847 (Kirby and Laurson 1932), and Paris followed suit in 1880 (Reid 1991).

The combined sewage scheme became widely implemented in spite of the opponents who thought it sensible to keep the sanitary wastes and stormwater separate. Edwin Chadwick and John Phillips, both from England, were two of the earliest proponents of the separate system of sewage. Phillips proposed the separate system for London in 1849, but eventually Bazalgette's combined system with interceptors was implemented (Metcalf and Eddy 1928). Although supporters for separate systems existed, combined systems were mostly constructed because they were usually cheaper to design and build.

Bourne (1866) made one of the first American arguments for separate sewerage. He advocated the separate system for reasons of sanitation. Benezette Williams designed one of the earliest comprehensive separate systems in the U.S. in 1880 for Pullman, Ill., which was eventually implemented (Odell 1881). Another adamant supporter of separate sewer systems in the U.S. was Col. George E. Waring, Jr. (Waring 1879). Waring designed several early separate systems, including one for Memphis, Tenn. in 1880. Other cities that implemented separate sewer systems, constructed only sanitary sewer lines for the most part, with no pipes for stormwater (gutters and ditches carried this water) (Tarr and McMichael 1977). Some systems performed adequately, but others failed miserably with repeated blockages and backups in the sanitary sewer lines. Waring's designs called for the size of the house connection to the lateral sewer to be small (typically 4 inches) (Metcalf and Eddy 1928). This small size (in comparison to other designs of 6 inches or more) is what many believed to be the basic cause of failures in Waring's systems.

To learn more about separate and combined sewer systems, an American named Rudolph Hering visited Europe in 1881 at the behest of the U.S. National Board of Health. His findings from the trip became a report to the National Board of Health on the benefits and drawbacks of each type of system (Hering 1881). Hering's recommendations included using combined systems in large or rapidly growing cities, while using separate systems for areas where rainwater did not need to be removed underground. Despite Hering's report and the support of his conclusions by many, the debate continued between the advocates of the two types of sewerage.

F.3.4 Identification of Water-Borne Diseases

Several individuals throughout history have conjectured that sanitary and other types of wastes and unsanitary living conditions could be linked to diseases (Tarr and McMichael 1977). During the early 1800s, evidence pointed to the link between sewage discharges, polluted receiving waters, and disease outbreaks. A key factor was the new knowledge that had come from the researches of noted scientists such as L. Pasteur, R. Koch, R. Warington, T. Schlösing & A. Muntz into the nature and activities of bacteria.

A publication by Dr. Jack Snow in 1849 discussed the communication of cholera by contaminated water; he later had a hand in identifying the source of the Broad Street cholera epidemic in London during 1854. But it was Pasteur, in 1857, who established the formative theory that infectious disease is caused by germs or bacteria (Kirby, et al. 1990). By the 1880s the theory was firmly established by Koch and others. This research led to the attempt to filter drinking water during the late 1800s to remove water-borne disease-causing organisms.

F.3.5 Treatment of Separate Sanitary and Combined Wastewater

Regardless of the type of sewerage (combined or separate), the primary method of disposal was still discharging to local receiving waters in the late 1800s; control and treatment of sewer discharges was very limited. Typically, combined sewage, sanitary wastewater, and stormwater were simply discharged into a stream or river of adequate capacity to dilute the waste. The sewerage systems would be designed such that the maximum amount the receiving water system could dilute would be discharged. In the late 1800s, sewage was treated primarily by three methods: irrigation of farmlands, intermittent filtration, or chemical precipitation (Whipple, et al. 1906; Tarr and McMichael 1977). These systems of treatment were more conducive to the smaller and easier controlled sanitary sewage flows from a separate system. Centralized municipal wastewater treatment facilities were just beginning to be constructed in the late 1800s.

Whipple, et al. (1906) discussed the combined sewage treatment operations being used in the U.S. at the beginning of the 1900s. The usual method for combined sewer systems entailed sending as much of the storm flow/sanitary sewage mixture to a dry weather wastewater treatment plant by way of an intercepting sewer. In most cases, the interceptor sewer conveyed a certain amount of the waste stream to the plant, with the remainder being overflowed directly to the receiving water system, thus creating a combined sewer overflow (CSO). Treatment plants and collection systems were typically designed to treat twice the flow rate, or more, of the typical dry weather flow (Whipple, et al. 1906). During wet weather, sewer system flows were observed to increase by a factor of 100 over dry weather flows on occasion. Occurrences such as this could not be economically considered in conveyance or treatment system design, and thus, excess sewage flows greater than the design capacity of the conveyance system would result in frequent overflows.

Although research had displayed the connection between sewage-polluted waters and disease, sewage treatment was not widely practiced. It was debated whether it was more economical to treat the sewage prior to discharge or treat the water source before distributing as potable water. It was argued that the sewage could be assimilated or treated in the receiving water and would be much less polluted by the time it was withdrawn for drinking water supplies. This argument had validity, except it neglected the fact that sewage discharges were detrimental to the receiving water in addition to the drinking water supply.

F.3.6 Urban Hydrology

In the mid-1800s, estimating surface runoff was based on empirical results. For example, much of the European engineering community used Roe's table to size sewer pipes draining a specified size catchment (Metcalf and Eddy 1928). The table was supposedly empirically derived from Roe's observations of London sewers in the Holborn and Finsbury divisions over a span of 20 years.

In the second half of the 1800s the hydrologic and hydraulic design methods used to size sewers were enhanced. Most notably, Mulvaney (1851) and Kuichling (1889) developed the rational method in this time period. The rational method, in general, was based on the assumption that a realistic flow of the chosen frequency can be obtained if the rain intensity of duration similar to the travel time of water in the sewer system was applied to the drainage catchment. The flow was subsequently used to design the size of the sewer pipes. Prior to the rational method, runoff determinations took the form of empirical formulae. These equations were all derived based on site-specific data; consequently, they yielded poor results when applied to other drainage basins (Buerger 1915).

Intensive efforts in rainfall data collection and analysis occurred in the U.S. during the second half of the 19th century (Berwick, et al. 1980). The primary motivation was to study the relationship between the intensity of the rain and its duration for the needs of storm drain design. Talbot, in 1899, performed some of the initial work, using U.S. Weather Bureau records at 499 stations to plot storm intensities versus duration on a cross-section paper. Two envelope curves were drawn, one depicting the very rare rainfalls, and the other the ordinary rainfalls. These curves became the forerunner of the present day intensity-duration-frequency curves for drainage design. Since the time Talbot constructed his curves, many cities, public agencies, and engineering firms have developed similar equations for specific locations (Berwick, et al. 1980), while some still use Talbot's results directly.

F.4 Wet Weather Pollution Management: 1900s

F.4.1 Urban Hydrology Continued

The engineering community did not immediately accept the rational method. Well into the 1900s, the older empirical formulae mentioned above were still being used (Buerger 1915). Only after a slow transition in the early part of the 1900s did the rational method become the dominant technique for drainage design in the U.S. and worldwide.

The early 1900s also witnessed attempts to describe the rainfall/runoff process more accurately (Rafter 1903; Gregory 1907; Justin 1914; Buerger 1915; Grunsky 1922). By the 1920s the use of rain gauge records enabled more typical "design storms" to be used, in which rainfall intensity rose to a peak and then died away. The unit hydrograph (UH) concept is an example of these enhanced procedures based on design storms. Sherman (1932) developed the concept of the UH for gauged watersheds, and subsequently others modified it and applied it in different manners (Pettis 1938; Brater 1939). Until the introduction of unit hydrographs, few design techniques had considered using the storm hydrograph and runoff hydrograph; only the peak rate of runoff was used. Horner and Flynt (1936) first applied hydrograph techniques to storm sewer design (Horner and Flynt 1936; Eagleson 1962).

Following the UH applications, a renewed interest in the rainfall/runoff process was observed in the 1940s. Previous methods for determining runoff from rainfall had been mostly based on coefficients to account for losses of rainfall. In the late 1930s and early 1940s, rainfall abstractions became a concentrated topic of research. Horner and Jens (1942) developed a methodology to mathematically describe the process of infiltration, among other abstractions, and applied hydrograph techniques to a small basin.

F.4.2 Environmental Awareness and Receiving Water Impacts

During the 1960s, wet weather pollution was recognized by many as causing receiving water quality problems. To mitigate the problems, methods of control and treatment for urban runoff and CSOs were devised. Although it was known that controlling wet weather flows and pollution would not eliminate the problem, such methods were considered helpful in reducing the problems and in certain situations to be more cost effective than improving the capacity for dry weather wastewater treatment.

With the interest in reducing receiving water impacts through control and treatment of wet weather pollution, numerous research projects were initiated in the 1960s and 1970s. The main focus of these projects was to evaluate the effectiveness of control and treatment alternatives for combined sewer overflows. The control and treatment alternatives included physical/chemical methods such as detention, swirl technology, filtration, screening, and disinfection; biological methods such as rotating biological contactors, contact stabilization, trickling filters, treatment lagoons, and activated sludge; and storage/treatment methods.

The next step in the 1970s was the attempt to evaluate problems on a larger scale. This was manifested in Section 208 (from the Federal Water Pollution Control Act of 1972) planning studies and the watershed-wide planning philosophy that gained attention in the late 1970s and early 1980s. The planning studies focused on mitigating the impacts of urban runoff on receiving waters on a watershed scale versus a single outfall or a single stream reach.

In the early 1980s, problems remained with attempting to predict relationships between wet weather discharges and receiving water impacts. To remedy this problem, data was sought that would characterize the pollutants of concern and the impacts they would have on receiving waters. One of the major research efforts was the Nationwide Urban Runoff Program (NURP), conducted in the United States by EPA and USGS (EPA 1983). The overall goal of NURP was to collect data and develop information for use by local decisionmakers, states, EPA, and other interested parties.

F.4.3 Technical Tools and Design Methods

In the late 1960s and early 1970s computer development and its applications to the field of wet weather pollution management had a significant impact on the direction of development of wet weather pollution management. Computer applications were used in modeling environmental systems and processes, such as STORM (HEC 1973) and SWMM (Metcalf & Eddy Engineers, et al. 1971), and analysis and design of wet weather conveyance systems became more dependent on new computer applications.

In addition to computers, the mathematical and statistical methods being applied to wet weather pollution management were also improving. The use of statistics was seen in the analysis of long-term simulation results, the analysis of collected rainfall, runoff, water quality data, the evaluation of the optimum urban runoff control system configuration, among other uses (Howard 1976; DiToro and Small 1979; Hydroscience, Inc. 1979). The 1980s involved improving much of the technology and ideas initially introduced in the 1960s, 1970s and early 1980s. Personal computer advancements during the late 1980s and early 1990s were such that most wet weather pollution management technology currently revolves around the use of personal computers. Computational aids such as GIS, databases, and model pre- and post-processors have seen many advances during the 1990s, the use of which has improved the planning, design, and operation stages of wet weather pollution management significantly in terms of time, effort, and money.

F.5 Wet Weather Pollution Management: Lessons Learned from the Past

An advantage of developing user-friendly design methods and tools is the reduction in the time lag between development and implementation. Practitioners generally embrace technology that is simple to understand while still providing the means to perform the job in the most cost-effective manner possible. The methods and tools that have gained acceptance through history have been simple to implement and easy to understand, although not necessarily the most accurate or appropriate.

Considering the other points previously discussed, a sustainable system development will have the benefit of significantly reducing the environmental impacts associated with a project over time, while promoting economic stability as well. The literature is replete with examples of entire systems (Paris in the Middle Ages) or parts of systems that were designed without considering the long-term sustainability of the project. The systems performed poorly and resulted in additional time, effort, and money being used to rehabilitate and maintain the design.

Another consideration noticed during the review of the literature is that past design engineers and planners were forced to consider the socioeconomic, political, and legal ramifications associated with their plans and designs. These topics can be the primary inhibitors to the implementation of innovative technology and in the future must be addressed for progress to be made (Berwick, et al. 1980).

WERF QUESTIONNAIRE

QUESTIONNAIRE
WATER ENVIRONMENT RESEARCH FOUNDATION
ASSESSMENT OF DECISION CRITERIA USED TO DETERMINE BENEFITS OF CSO/SSO/SW INVESTMENTS

The Water Environment Research Foundation has contracted with Moffa & Associates to assess decision criteria used to determine benefits of CSO, SSO and stormwater investments. The objectives of this project are to document or benchmark policy interpretations of EPA regions and state regulatory agencies and the progress of various municipalities in achieving water quality goals. This information will be structured in the form of matrices wherever possible so that a municipality could better appreciate their relative position in developing solutions to their CSO, SSO and stormwater problems.

Your assistance in providing this information is needed to produce these guidance documents.

General Information

Date Completed:

1. Contact Person | Title | Organization Name

Street Address | City | State | Zip Code | Phone No.

2. What type(s) of wet-weather pollution are you responding about? (Circle all that apply)

(a) CSO (b) Stormwater (c) SSO

3. What type(s) of receiving water are impacted by the wet-weather pollution? (Circle all that apply)

(a) River (b) Stream (c) Lake (d) Ocean (e) Estuary
(f) Other

4. (a) Total Population:______________________ (c) Ownership of Sewer System:______________________

(b) Area of Sewer System:______________________ (d) Area of Watershed:______________________

5. (a) Annual Rainfall: (b) Number of Raindays:

Public Participation

1. What are the concerns of the public?

2. Is there a public participation program? (Circle) Yes No

If Yes, describe how the public participation program engages / educates the pubic.

Conveyance System Information

1. Has the conveyance system been mathematically modeled? (Circle)

CSO:	Yes	No
SSO:	Yes	No
Stormwater:	Yes	No

2. Number of discharge sources:

CSO: | Stormwater: | SSO:

3. Frequency of discharges per year:

CSO: | Stormwater: | SSO:

4. Volume of discharge per year, if available:

CSO: | Stormwater: | SSO:

QUESTIONNAIRE
WATER ENVIRONMENT RESEARCH FOUNDATION

Watershed Approach

1. Has a watershed approach been considered for planning wet-weather pollution abatement? (Circle) Yes No

2. Has a watershed approach been used to plan wet-weather pollution abatement? (Circle) Yes No

   If Yes, what are the other sources of pollution? (Circle all that apply)

   (a) Municipal Point Source (b) Industrial Point Source (c) Agricultural Runoff (d) Urban Runoff
   (e) Other:

   If Yes, has the watershed been mathematically modeled? (Circle) Yes No

3. Has a watershed approach been used to manage wet-weather pollution abatement? (Circle) Yes No

4. What pollution sources are currently being addressed? (Circle all that apply)

   (a) Municipal Point Source (b) Industrial Point Source (c) Agricultural Runoff (d) Urban Runoff
   (e) Other:

5. What pollution sources are going to be addressed in the future? (Circle all that apply)

   (a) Municipal Point Source (b) Industrial Point Source (c) Agricultural Runoff (d) Urban Runoff
   (e) Other:

Water Quality

1. When did your organization recognize the wet-weather pollution?

2. Why did your organization take action to abate the wet-weather pollution? (Circle all that apply)

   (a) Planned Sewer System Improvements (b) Regulatory Requirements
   (c) Significant Pollution Event (d) Litigation/Lawsuit

3. Describe the significant pollution event:

4. Are any wet-weather facilities permitted? (Circle)

CSO:	Yes	No
SSO:	Yes	No
Stormwater:	Yes	No

   If yes, how many CSO: __________; how many SSO: __________; how many Stormwater: __________

5. Describe the critical permit requirement(s).

Technical Considerations

1. Is a Facility Plan completed? (Circle) Yes No

2. Is a Facility Plan being developed? (Circle) Yes No

QUESTIONNAIRE
WATER ENVIRONMENT RESEARCH FOUNDATION

3. What is the basis for technical considerations? (Circle all that apply)

(a) Regulatory Requirements (Federal, State)

(1) CSO
a. Demonstrative Approach
b. Presumptive Approach

(2) Stormwater
a. Regulations

(3) SSO

(b) Receiving Water Criteria

(1) Bacteria (2) Floatables (3) BOD (4) Dissolved Oxygen (5) Nutrients (6) Solids (7) Other

(c) Public Concern

4. How were the technical controls selected? (Circle all that apply)

(a) Cost - Benefit Analysis (b) Regulatory Requirements (Federal, State) (c) Other

If Regulatory Requirements or Other, describe.

5. What control technologies have been or will be implemented to abate wet-weather pollution? (Circle all that apply)

CSO
(a) BMPs
(b) Vortex
(c) Out-of-System Storage
(d) Screening
(e) In-System Storage
(f) Disinfection
(g) Flow Balance Method
(h) Netting
(i) Other:

SSO
(a) I / I Reduction
(b) Other

Stormwater
(a) Source Control
(b) Other

6. Describe the effectiveness of the control technologies, if available.

7. Describe the impact of the control technologies on receiving water quality, if available.

Financial Considerations

1. What are the total capital costs for wet-weather pollution abatement? (do not include life-cycle replacement) (Include year dollar figure represents)

Past: $________________ In 19_____ dollars

Projected $________________ In 19_____ dollars

2. What are the impacts on annual sewer rates?

Percent Increase:

3. What are the sources of funding? (Circle all that apply)

(a) Revolving Loan
(b) Federal Grant Money
(c) State Grant Money
(d) Increased Taxes
(e) Increased Sewer Rates
(f) Other:

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Aesthetics: Of or pertaining to the sense of attractiveness.

Assimilation: In water bodies, the process that removes pollutants and/or their impacts.

Best management practices (BMP): Non- and low-structurally intensive wet weather flow and pollution control methods that can have multi-benefits, including drainage network enhancement and flood control; groundwater recharge; aesthetic enhancement; pavement cleansing and reduction of dust, dirt, litter, and debris; subpotable water reuse; etc.

Biochemical oxygen demand (BOD): An operational measure of potential for depletion of dissolved oxygen by the biological and chemical degradation of organic material by bacteria.

Biological treatment processes: Means of treatment in which bacterial or biochemical action is intensified to stabilize, oxidize, and nitrify the unstable organic matter present. Trickling filters, activated sludge processes, and lagoons are examples.

Catchbasin: A chamber or well, usually at the street curbline, for the admission of surface water to a sewer or subdrain, having at its base a sediment sump to retain grit and detritus below the point of overflow; whereas, a stormwater inlet does not have a sump and does not trap sediment.

Catchment: The area producing the runoff passing a particular channel or stream location.

Collection system control: A method of abating wet weather flow or pollution in the collection or drainage system.
Combined sewer: A sewer receiving intercepted surface (dry and wet weather) runoff, municipal (sanitary and industrial) sewage, and subsurface waters from infiltration.

Combined sewer overflow (CSO) Flow from an outfall (discharge conduit) of a combined sewer collection system in excess of the interceptor capacity that is discharged into a receiving water and/ or an auxiliary CSO control (storage) treatment system.

Computer model: A model in which the mathematical operations are carried out on a computer.

Cost-benefit relationship: The relationship between unit costs to unit benefits usually represented as a curve.

Cost-effective solution: A solution to a problem that has been identified as being financially optional (e.g., the solution associated with the knee-of-the-curve of a cost-benefit relationship).

Critical design conditions: Environmental and flow conditions chosen to represent the conditions under which compliance with water quality standards, criteria, or objectives is desired.

Detention: The slowing, dampening, or attenuating of flows either entering the sewer system or within the sewer system by temporarily holding the water on a surface area, in a storage basin, or within the sewer itself.

Detention time: The time period that flow is detained in a storage/sedimentation basin or tank.

Disinfection: The killing or inactivation of human disease-causing microorganisms or pathogens.

Dispersion: Pollutant or concentration mixing due to turbulent physical processes.

Dissolved oxygen deficit: Difference between saturated dissolved oxygen and ambient concentrations.

Domestic sewage: Sewage derived principally from dwellings, business buildings, institutions, and the like. It may or may not contain groundwater.

Dry weather flow (DWF): Usually referred to as the flow in a combined sewer system without stormwater.

Dual treatment: Those processes or facilities designed for operating on both dry and wet weather flows.

Ecological habitat: The environmental niche in which an organism lives.

End-of-pipe impacts: Impacts that occur in the immediate vicinity of an outfall.

Engineering News Record (ENR): A recognized magazine providing accepted construction-cost indices.

Eutrophication: The process of aging whereby the increase of mineral and organic nutrients favors aquatic plants over animal life and results in increasing daily variations in dissolved oxygen concentrations, reduced biologic diversity, and reduced water clarity.

First flush: The condition, often occurring in wet weather flow discharges, in which a disproportionately high pollution load is carried in the first portion of the discharge or overflow.

Floatables: Large floating material sometimes characteristic of sanitary wastewater and storm runoff.

Frequency of return: The rate at which a particular type storm can be expected to occur (e.g., 1 year), such storms being classified by storm intensity and duration.

Infiltration: The process whereby water enters a sewer system from underground through such means as defective pipes, pipe joints, connections, or manhole walls. Infiltration does not include, and is distinguished from, inflow.

Inflow: The process whereby water enters a sewer system through such means as cellar and foundation drains, roof leaders, surface drainage, and cross connections from storm drains and catch basins. Inflow does not include, and is distinguished from, infiltration.

In-line storage: A type of storage that has no pumping requirements and can consist of either storage within the sewer (in-sewer/in-pipe) or channel, or storage in the in-line basins.

Interceptor: A sewer designed to receive dry weather flow from a number of transverse combined sewer trunks and additional quantities of intercepted surface runoff during low-flowing sanitary sewage periods and to convey such waters to a point for treatment.

Knee-of-the-curve: The point along a cost-benefit curve at which there is a noticeable change in the quantity of cost for an increment of benefit.

Lateral: A sewer that has no other common sewer discharging into it.

Longitudinal dispersion: One-dimensional dispersion (mixing) occurring along the length of the stream or estuary.

Mathematical modeling: Application of mathematical formulae to represent the processes and effects of natural and manmade systems for the purpose of forecasting responses to different conditions and inputs.

Model: Any representation of a system by something other than the system itself.

Model calibration: Refinement of mathematical model parameters and coefficients through comparison to data by making scientifically consistent and rational adjustments.

Model parameter: A quantity that cannot vary in a particular model run.

Model variable: A quantity that can vary in a particular model run.

Nonpoint: Diffuse; not attributable to a particular location.

Nonpoint source pollution: Any unconfined and nondiscrete conveyance from which pollutants are discharged.

Off-line storage: A type of storage that requires detention facilities (basins or tunnels) and facilities for pumping storm flow either into or out of the detention facilities.

Pathogen: A disease-causing microorganism.

Pathogenic bacteria and viruses: Bacteria and viruses capable of causing disease in humans.

Physical treatment processes: Means of treatment in which the application of physical forces predominate. Screening, sedimentation, flotation, and filtration are examples. Physical treatment operations may or may not include chemical additions.

Physical with/without chemical treatment processes: Means of treatment in which the removal of pollutants is brought about primarily by physical processes, with or without chemical addition to enhance removal efficiency.

Receiving waters: Natural or manmade water systems into which materials are discharged.

Recurrent frequency. The historical frequency at which a condition or situation occurs.

Regulator: A structure that controls the amount of sewage entering an interceptor by storing in the upstream trunk line or by diverting some portion of the flow to an outfall.

Sanitary sewer: A sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with relatively low quantities of ground-, storm-, and surface waters that are not admitted intentionally.

Sanitary sewer overflow (SSO): A sanitary sewer overflow is flow from an outfall (discharge conduit) of a sanitary sewer collection system in excess of the interceptor capacity that is discharged into a receiving water. Sanitary sewer overflows are the result of the unplanned relief of a sewer system intended only for sanitary sewage. An SSO typically occurs when the flow exceeds the carrying capacity of the system and although SSOs can, and do, occur during dry weather, they are most commonly associated with wet weather events.

Sanitary wastewaters: Wastewater of human origin.

Satellite facilities: Storage/treatment facilities at remote locations upstream of the dry weather flow sewage treatment plant and usually at the regulator/overflow site.

Sediment oxygen demand: Biochemical consumption of dissolved oxygen in overlying waters by decaying sediments across the water-sediment surface.

Sensitivity analysis: The variation of model parameters to determine the sensitivity of the model to each parameter.

Sewer: A pipe or conduit generally closed, and normally not flowing full, for carrying sewage or other waste liquids.

Sewer flushing: Flushing applied to combined sewer systems during dry weather flow periods to remove settled material periodically or as it accumulates, and to hydraulically convey it to the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm-flow periods and lessening the need for CSO treatment.

Sewerage: System of piping, with appurtenances, for collecting and conveying wastewaters from source to treatment and/or discharge.

Simulation: The application of a model.

Source control: A method of abating wet weather flow or pollution at the upstream, upland source where the pollutants originate and/or accumulate.

Storage The slowing, dampening, or attenuating of storm-generated or combined sewer flows either entering the sewer/drainage system or within the sewer/drainage system by temporarily holding the flow on a surface area, in a storage basin, within the sewer itself, or within a receiving water.

Storm duration: The period over which rainfall occurs.

Storm flow: Overland flow, sewer flow, or receiving-stream flow caused totally or partially by surface storm runoff, storm-related subsurface infiltration, or snowmelt.

Storm frequency: See *frequency of return.*

Storm intensity: The rate of rainfall usually expressed as inches per hour.

Storm sewer: A sewer that carries intercepted surface runoff, street wash and other wash waters, or drainage, but excludes domestic sewage and industrial wastes except for unauthorized cross-connections.

Storm sewer discharge: Flow from a storm sewer that is discharged into a receiving water or to a sewer system.

Stormwater: Water resulting from precipitation that percolates into the soil; runs off freely from the surface; or is captured by storm sewer/drainage, combined sewer, and, to a limited degree, sanitary sewer facilities.

Subcatchment: A portion of a catchment producing the runoff that passes a channel or stream location upstream of the location defining the catchment.

Supernatant: The relatively clear liquid layer above the sediment layer in the vertical column.

Surcharging: The transition between open channel flow and pressure flow in sewers.

Surface runoff: Precipitation and water (e.g., street wash) that falls onto the surfaces of roofs, streets, ground, and so on, and is not absorbed or retained by that surface, thereby collecting and running off.

Swirl regulator/concentrator: A cylindrically-shaped CSO control device that provides the dual function of a regulator and a solids-liquid concentrator. As a concentrator, it achieves good removal of the heavier settleable solids fraction in CSO. (See also *regulator.)*

Toxicity: The degree to which a pollutant causes physiological harm to the health of an organism.

Trace metals: Metals present in small concentrations. From a regulatory standpoint, this usually refers to metal concentrations that can cause toxicity at trace concentrations.

Trunk: A sewer, also known as a main sewer, that receives the discharge of one or more submain sewers.

Urban runoff: Surface runoff from an urban drainage area that reaches a stream or other body of water or a sewer/channel.

Water quality criteria: A threshold value or concentration for a pollutant or pollutant effect as chosen by regulatory agencies to distinguish between acceptable and nonacceptable environmental conditions; usually chosen based on laboratory observations of organism response.

Water quality standard: A threshold value or concentration enforced by law as a requirement to maintain acceptable environmental water quality conditions; usually chosen based on laboratory observations of organism response.

Wet weather flow: Usually referred to as the flow in a combined sewer system with stormwater, but may also constitute the flow in a separate storm or sanitary drainage system with stormwater.

Wet weather pollution: The discharge from a conveyance system resulting from wet weather flows. This discharge may occur to a receiving water as well as streets and basements (street and basement flooding).

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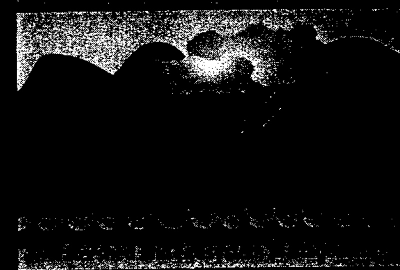

Benchmarking Decision Criteria for Urban Wet Weather Abatement

Combined Sewer Overflow

Sanitary Sewer Overflow

Stormwater

Abatement

Decision Criteria Benchmarking

Project 97-CTS-6
1999

Water Environment Research Foundation

Urban wet weather pollution manifests itself in three different ways: combined sewer overflows (CSO), sanitary sewer overflows (SSO), and stormwater runoff (SW). Urban wet weather pollution is a reflection of the watershed or sewershed from which it is generated and the climatic patterns the area experiences. The result is a wide-scale challenge that requires very site-specific solutions.

This report presents data from CSO and SSO and SW communities. The major data categories include public participation, issues driving technical considerations, financial considerations, watershed approach and water quality issues. The data is presented in such a way as to facilitate benchmarking. This report also presents guidance issues including public participation, watershed framework approach, receiving water impacts, monitoring, modeling of impacts, and cost effectiveness analysis.

Twenty-six CSO, sixteen SSO, and fourteen SW communities participated in this project. The findings suggest that: (1) since the publication of the Federal CSO policy in 1994, many CSO communities have begun the process of CSO abatement, (2) while SSOs are common, the lack of federal guidance has stalled the initiative for SSO abatement and (3) communities using the watershed approach have moved forward with SW abatement.

PROJECT 97-CTS-6

BENCHMARKING DECISION CRITERIA FOR URBAN WET WEATHER ABATEMENT

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SSO Case Histories:

The following SSO case histories were used with authorization of EPA Office of Water.

Houston, Texas
Johnson County, Kansas
Oklahoma City, Okla.
Wayne County (Downriver Communities), Mich.

These SSO case histories will be published in an EPA report entitled, *Developing Case Studies on Sanitary Sewer Overflow Abatement Programs*, by Limno-Tech Inc. as a sub-contractor to Parsons Engineering Science.

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BENEFITS

- Presents the most current federal combined sewer overflow, sanitary sewer overflow, and stormwater policies.
- Provides communities essential criteria to use as guidance for wet weather pollution abatement. These criteria include public participation, technical considerations, financial considerations, watershed approach, and water quality.
- Benchmarks policy interpretations and progress of various municipalities in achieving water quality goals.
- Provides communities with data that may be useful for wet weather pollution stakeholders engaging in self-evaluation activities.
- Provides cost-benefit analysis procedures.
- Presents a history of wet weather pollution management control strategies.

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R0018405

Executive Summary

Criteria by which municipalities make decisions for abatement of wet-weather pollution are as variable as the very subject itself. This variability is due to the site specific nature of the tributary area as it relates to the receiving-water in question; interpretation of regulations which can differ among U.S. Environmental Protection Agency (U.S. EPA) regions as well as states; and sense of urgency which may be permit related or related to a particular episode. Wet weather pollution manifests itself as combined sewer overflow (CSO), sanitary sewer overflow (SSO), and stormwater (SW). Although these wet weather discharges can affect receiving waters in a similar way, each is distinctly different in the manner in which it is regulated, how the regulations are enforced, and the sense of urgency to abate the related pollution.

This report identifies the experiences of municipalities as well as regulatory agencies in dealing with wet weather issues. The data are presented in such a way as to facilitate benchmarking of decision criteria. Benchmarking, as used in this report, identifies the status of various municipalities and their progress toward achieving water quality objectives; such benchmarking can provide to any municipality the benefit of real experience.

CSOs generally were recognized as a significant source of pollution in the late 1960s and specifically identified at the federal level through the landmark 1972 Amendments to the Federal Water Pollution Control Act. Much of the CSO work was started through federal R & D programs initiated in the early 1970s. These programs were also instrumental in identifying SSOs as a pollution source. Subsequent sewer system evaluations revealed SSOs as a real, but illegal, component of sewer systems.

The activity directed toward CSOs has been greater than SSOs and SW owing to the earlier awareness and recognition of this type of pollution and, perhaps more important, the urgency associated with the health risks stemming from the sewage component. The intensity of regulatory and municipal activities sharply increased in September 1989 when U.S. EPA published the draft National CSO Control Strategy. Until then, in the absence of clear guidelines, most municipalities were unwilling to forge ahead.

SSOs were specifically identified as part of the facility planning required under the 1972 amendments. However, remediation of many SSOs has been slow due to the lack of a definite federal policy or state guidelines. In many cases, the demand by regulatory agencies that SSOs simply be eliminated has met with resistance and active debate. One of the major issues has been whether or not SSOs that react directly to rainfall could or should in fact be treated as CSOs.

It wasn't until some years later after CSO and SSO problems were addressed by the regulating community that SW became a focus. The significance of SW pollution was understood as an outgrowth of many CSO characterization studies. In a similar manner to CSO, SW activities increased sharply with the release of federal regulations on Nov. 16, 1990. Nevertheless, SW abatement activities on a national scale have been spotty owing largely to variability in enforcement. In those EPA regions and states where CSOs have been a major problem, SW has taken a back seat. In those EPA regions and states where there is a prevalence of separately sewered areas, SW activities have been greater.

In consideration of the above-stated differences, this report categorizes the CSO, SSO and SW experiences separately. As expected, the CSO activity and number of municipalities reported are by far greater than either the SSO or SW activities reported: 26 CSO communities versus 16 SSO communities and 14 SW communities.

SSO activities may be far more numerous than has been recorded, since such discharges are viewed as illegal and are not always openly acknowledged. Also, virtually all moderately aged separated sanitary sewers will overflow a during severe, infrequent storm event, and this phenomenon probably will continue. Stormwater activities are more openly documented; limitations in activity are more a reflection of other factors such as regulatory pressure and specific water quality needs.

ES.1 CSO

The communities included in this CSO benchmarking survey represent a range of geographic locations, population, demographics, CSO system sizes, abatement strategies and schedules. Annual rainfall for these communities ranged from 20 in. to more than 40 in.; however, the majority had annual rainfall greater than 30 in. Most discharge CSO into rivers.

The data collected show that public concern for water quality expressed through state initiatives started the abatement process for many communities. Such initiatives took the form of requirements for CSO facility planning which included alternative and cost-benefit analyses. The most prevalent parameters were and continue to be bacteria and floatables. Solids, biological oxygen demand (BOD) and nutrients are of some concern, with dissolved oxygen and metals being the parameters least of concern.

Upon the release of the Draft National CSO Control Policy in 1994, many CSO facility plans were revisited to determine compliance with either "presumption" or "demonstration" provisions and to develop the required long term control plan (LTCP). The same number of communities followed the presumption approach as followed the demonstration approach; however, the majority of smaller communities followed the presumption approach.

The most prevalent form of implementation has been best management practices (BMP) due to the "housekeeping" nature of such steps and the low cost-to-benefit relationship. Reductions of annual CSO volume from BMPs were reported as high as 90%.

Abatement beyond BMPs was implemented by only a limited number of communities prior to the national policy. In some cases, communities with high enough state priorities were able to take advantage of federally available grant funds. For the most part, however, abatement has taken place after 1994 and has not included federal grants. State revolving funds have become available in place of the previous U.S. EPA Construction Grants Program.

As a consequence of little or no federal or state funding currently available for design and construction, financial considerations have become that much more important, resulting in a greater emphasis on cost-benefit evaluations and reviewing the affordability guidelines within the policy.

The watershed perspective has been introduced only in the last few years. States have embraced this approach largely upon the release of U.S. EPA's total maximum daily load (TMDL) guidelines, which relate to a watershed approach. The TMDL guidelines provide a basis for proceeding in the absence of a basin-wide wet weather plan which is the responsibility of states to develop. However, almost no communities used a watershed approach to determine CSO abatement needs. A limited number of communities have recently started either a watershed or TMDL approach to verify total wet weather readings and identify needs to achieve water quality goals.

Most communities acted to abate their CSOs due to regulatory requirements which can take the form of permit renewals, administrative orders or consent orders. Generally communities acted upon requirements more or less in that order. Most responding communities have completed their LTCP. However, only 20% of the responding communities have completed abatement, and only one, Rochester, N.Y., completed abatement through the construction grant monies made available in the 1970s. Most responding communities received funding from one or more of a variety of sources, including construction grants, state revolving funds and increased taxes.

Two parameters that are serving as the focus for abatement and permits are floatables and bacteria. Concerns are often expressed for other parameters, such as solids, BOD, nutrients, and heavy metals, but limits can and have been challenged, and in some cases watershed efforts are being undertaken. Floatables limits have taken the form of substantial removal or capture up to a specific size storm, for example a one-year frequency. Generally bacteria are specified as a maximum or average concentration for a specific event or monthly basis.

In setting permit parameters, little consistency exists from case to case, which is understandable in light of their site-specific nature and related health risks. States prefer to await site-specific information so that the most practical permit limits can be established. The most notable parameters that vary are:

- design storm frequency;
- bacteria type, concentration and violation frequency; and
- methodology for assessing annual impacts.

ES.2 SSO

The Urban Institute (1984) estimated that as an annual average there are 825 sewer backups and 140 sewer breaks every year for every 1,000 miles of sewer. The Urban Institute survey attributed backups to a variety of factors: the location of pipe in trouble-prone areas, the pipe material, the size of pipes, the material, construction methods, local soils, and maintenance practices.

In 1994, the Civil Engineering Research Foundation found that three-quarters of the sanitary sewer systems function at 50% of capacity or less. Root penetration, corrosion, soil movement and inadequate construction are the cause of most structural failures.

As a result of reduced sewer capacity and failures, SSOs during wet and dry weather are a reality. The Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) found that 3% of municipal systems have at least an occasional dry weather SSO.

In a Water Pollution Control Federation study (1989), 1,003 wastewater treatment plants identified facility performance problems. Infiltration and inflow (I/I) was the most frequent performance problem cited.

Different National Pollution Discharge Elimination System (NPDES) authorities have historically provided different emphasis on oversight of sanitary sewer collection systems. In addition, some of the NPDES regulatory provisions addressing sanitary sewer collection systems are unclear, and different NPDES authorities have provided different interpretations regarding SSOs. For example, the ASIWPCA (1996) study found that many states do not issue permits for smaller sanitary sewer systems that discharge into a larger system; however, some states issue permits to all sanitary sewer systems. The ASIWPCA study also found that some states authorize wet weather control facilities that provide some level of treatment or flow control, while other states do not authorize such facilities.

The communities included in this SSO benchmarking survey represent a range of geographic locations, demographics, abatement strategies and schedules. The majority of responding communities serve a population of less than 500,000 and manage total drainage areas of more than 55,000 acres. Annual rainfall for these communities ranged from 20 in. to more than 40 in. Most discharge SSO into rivers or streams.

Most communities have not defined their annual discharge quantity, unlike the case of CSO. Wayne County, Mich., was one of the few exceptions. Flow monitoring in 13 Wayne County communities was used to evaluate the relative contribution of each to the wet weather pollution.

Public participation has been minimal compared to CSO and SW. Public concerns have ranged from aesthetics and water quality to flooding. The major water quality parameters of concern have been bacteria, BOD and dissolved oxygen.

The major abatement solution has been I/I reductions at the source based upon cost-benefit analysis. In a few select cases, such as Johnson County, Kan., and Houston, Texas, satellite treatment of SSOs has been approved. Satellite treatment technology included screening, settling tanks or ponds, and disinfection. Such an approach provided a cost-effective means of complying with water quality requirements.

ES.3 Stormwater

In most cities, very little has been done beyond basic SW drainage. In a few communities (as this report documents), early concerns by the public on declining water quality resulted in attempts to manage SW quality. After drainage problems were brought under control, usually through master planning and the construction of large-scale facilities, construction-erosion control was usually implemented in those communities. With these important considerations addressed, some of the communities were able to address SW quality. Some stressed controls with new development, while a very few examined retrofit opportunities.

With the SW NPDES permit program in place, SW quality management has been brought to the attention of most medium and large cities in the country (communities > 100,000). In October 1999, the permit program will be expanded to smaller municipalities (< 100,000).

Because of the large number of communities involved in the first and second phases of the NPDES SW permit program, the federal and state approach has been to define basic requirements for the permits, with little specified in the way of controls. Obviously, the submission of all the municipal industrial SW permits has produced a financial, logistic, and management problem for the state agencies and EPA regions.

The requirements included in the issued permits rarely specified any control or management needs beyond conducting an outfall monitoring program of about three storms a year at about five land use sites. The permits are generally issued for five years, with the expectation that specific control requirements would be added during later permitting periods as local problems become better defined. However, after almost ten years of the SW NPDES program, medium sized cities have also submitted permit applications; most have received their initial permits, and some small communities will be included in the program within a year. Therefore, the SW permit program has increased the burden on regulatory agencies. This has resulted in little opportunity for increased site-specific control objectives to be included in the permits.

Most of the specific accomplishments of improved SW quality have occurred in communities with flooding/drainage problems, scarce water resources, and the financial ability (usually through local funding). Specific requirements by local communities, and some state agencies, are the driving force behind these major accomplishments.

Decision criteria are usually expressed as meeting the federal SW regulations, with only a few exceptions where local residents expressed early and loud concerns over declining water quality.

In general, monitoring of urban SW runoff has indicated that the biological beneficial uses of urban receiving waters are most likely affected in terms of habitat destruction and contaminated sediment, while documented effects associated from acute exposures to toxicants in the water column are rare. Receiving-water investigations of runoff events have not indicated significant short-term receiving water problems, but long-term problems are common.

It is therefore difficult to relate such pollution to conventional numerical standards. Nevertheless there is interest in developing special wet weather standards.

In order to investigate the current state of thinking in SW design, in 1997 University of Alabama at Birmingham distributed a survey to which 85 communities responded. About 75% of the respondents indicated that local or county authorities specified drainage system levels of service (design storms). The most common design storm was a 10-year storm (10% probability of occurrence in any one year) for all land uses (42%). Several responses also indicated that most systems were checked for flooding with respect to the 100-year storm. About 86% of all survey respondents routinely used computerized tools for storm drainage design. The respondents also identified water quality concerns that were associated with SW runoff. More than 60% of the participants indicated sediment as a pollutant of concern. Nutrients (35%) and metals (34%) were the other most frequent answers. Other common answers were oils and grease, bacteria, toxicants, floatables, and salts.

The communities included in this SW benchmarking survey represent a range of geographic locations, demographics, abatement strategies and schedules. All the responding communities manage total drainage areas of more than 1,000 acres and had more than 50 outfalls. Annual rainfall for these communities ranged from 20 in. to more than 40 in. Most discharge SW into rivers or streams.

Most communities indicated a public participation program. General water quality, along with basement flooding, were the most commonly listed public concerns.

Almost all the communities had completed a SW facility plan or are currently developing one. Almost all respondents indicated that regulatory requirements were the main driving force in their SW quality management efforts. A wide range of technologies was considered by these communities, including construction site erosion controls, public works practices, infiltration, and sedimentation.

Most SW communities did not have significant past investments in a SW abatement infrastructure. However, there is some indication that more money will be spent in the future. The funding sources were varied, with fees from utility districts being most common, followed by federal grant money, state grant money, and increased taxes.

About one-half of the responding communities used mathematical models of their SW systems and almost all indicated that a watershed approach has been taken or is in progress.

CHAPTER 1.0

INTRODUCTION

1.1 Introduction

Urban wet weather pollution manifests itself in three different ways: combined sewer overflow (CSO), sanitary sewer overflows (SSO), and stormwater runoff (SW). CSOs are the result of the "designed" relief of a sewer system that intentionally carries SW and sanitary sewage. SSOs, on the other hand, are the result of the unplanned relief of a sewer system intended only for sanitary sewage but also carrying rainfall-induced infiltration, illegal SW connections, and invasions of SW. Stormwater runoff discharges include flows that have been collected in a separate storm sewer system or a surface drainage system.

Urban wet weather pollution is a reflection of the watershed or sewershed from which it is generated and the climatic patterns the area experiences. The impacts of wet weather discharges are determined by a variety of complex relationships. These relationships include the type and magnitude of pollutant loads being transported, the ecological and hydraulic nature of the receiving water, as well as the designated beneficial uses, and the desires and expectations of stakeholders. The result is a wide-scale challenge that requires very site-specific solutions.

Solutions to wet weather pollution require investigation of a wide variety of management options and the relationship between the costs of management and water quality benefits. Benchmarks for effectiveness are also useful to determine if the control program is working. The most successful control programs are often part of an overall watershed management strategy.

Benchmarking as used in this report identifies the status of various municipalities (to include sewerage agencies) and their progress in achieving water quality objectives.

1.2 Objectives

The objective of this project is to document federal regulations and benchmark policy interpretations of U.S. Environmental Protection Agency (U.S. EPA) and select state regulatory agencies, and to document the progress of various municipalities in achieving water quality goals. Information is presented in case histories and summarized in matrices. Such benchmarking information can provide municipalities with real experiences to better develop solutions to their own CSO, SSO, and SW challenges. This report identifies where municipalities are, what has been achieved, and where they are going; but it must be recognized that each municipality reflects site-specific conditions and any comparisons are highly dependent on such conditions.

CHAPTER 2.0

BACKGROUND

2.1 Chronicle of Water Pollution Regulations

The first comprehensive federal involvement in controlling water pollution was the Water Pollution Control Act of 1948 (PL 80-845). It required the Surgeon General to develop programs to eliminate or reduce the pollution of interstate waters and was the first statute to provide federal financial assistance to state and local governments for water pollution control programs. This law was specific in limiting federal enforcement activities to involvement in pollution of interstate waters.

Federal interest in controlling water pollution increased through the 1960s. The Federal Water Pollution Control Act of 1956 (PL 84-660), the 1961 amendments to that act (PL 87-88), the Water Quality Act of 1965 (PL 89-234), and the Clean Water Restoration Act of 1966 (PL 89-753) all resulted in increased federal funding of water pollution control efforts and in the enforcement of environmental laws. The Water Quality Act of 1965 created the Federal Water Pollution Control Administration, the predecessor of U.S. EPA. Water quality standards also were a prominent feature of that law and were used to define actual occurrences of water pollution in interstate waters.

Throughout the 1960s public interest in environmental affairs heightened as the seriousness of pollution became painfully evident when the Cuyahoga River caught fire. The Cuyahoga River fire, along with the pesticide dangers documented in Rachel Carson's Silent Spring, President Lyndon Johnson's declaration that the Potomac River near Washington, D.C., was a "national disgrace," and a major oil spill off the coast of Santa Barbara, Calif., influenced people to take action to protect the environment.

In the 1970s, increased environmental awareness resulted in mounting public frustration over the slow pace of cleanup efforts. Congress overrode a presidential veto to enact the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500). While the title implied that it amended the previous legislation, it actually represented a fundamental change in the structure and organization of U.S. water pollution control programs. The 1972 Amendments brought a shift of program responsibility from the states to the federal government.

The major provisions of PL 92-500 state that all discharges are illegal unless they are in compliance with requirements set forth by the act and that all point source discharges must obtain a permit. This permitting requirement encouraged the formation of the National Pollutant Discharge Elimination System (NPDES). The purpose of these authorities is to administer permits establishing pollution limits, and specifying monitoring and reporting requirements for point source pollution. The objective of the act was to restore and maintain the physical, chemical, and biological integrity of the nation's waters, the so-called "swimmable-fishable designation." The act was notable in terms of both its national comprehensiveness and its specificity; virtually all forms of pollution were recognized. The act also provided citizens the right to bring a civil action against any person in violation of an effluent standard.

In the early '70s, attempts were made to identify and prioritize pollution sources and their relative importance through a national "needs surveys" required of all municipalities by the federal government. These surveys served as the basis for planning the Federal Construction Grants Program. This resulted in a special report to Congress on CSOs (EPA -430/9-78-006), as well as in a 1978 needs survey entitled *Cost Methodology for Control of Combined Sewer Overflow and Stormwater Discharge* (EPA -430/9-79-003). The latter estimated the capital costs to meet the "swimmable" goal to be $61.7 billion (in year 2000 dollars).

In the 1970s, funding assistance was increased to municipalities; but with the increased funding came more program requirements and involvement of federal and state regulators. The U.S. EPA , through numerous research and demonstration grants to municipalities, made significant advances in the areas of receiving water/water impact analysis, impact analysis, sewer-system characterization, control and treatment technology, and cost effectiveness analysis. As a result of these studies, technology-based effluent limits were established.

The Clean Water Act of 1977 (PL 95-217) included revisions in the areas of construction grants funding and the definition of conventional, unconventional, and toxic pollutants. It also allowed states to assume responsibility for federal programs, thereby encouraging the formation of the State Pollutant Discharge Elimination System (SPDES) Authority.

The "208" planning studies were an incentive to local governments to develop their own plans, with minimal federal input. These plans were to characterize all point and nonpoint pollutant discharges in designated areas and to develop treatment schemes that would allow the goals to be met. Unfortunately, most of these plans were conducted in short time periods with limited technical success. Control measures were recommended with few local demonstrations of their potential success. Recognizing these technical shortcomings, Congress authorized the Nationwide Urban Runoff Program (NURP) to demonstrate the applicability of various urban runoff control measures in about 30 cities. These studies were completed in 1983 (EPA , 1983).

In 1981, Congress revised the municipal construction grants program as part of the Construction Grant Amendments of 1981 (PL 97-117). This law marked the beginning of the end of the grants program, with limitations on grant-eligible categories and a reduction in the level of grant assistance for eligible projects. The Construction Grant Amendments of 1981 empowered state governors to use 20% of the states' federal allotment of construction grant funds for the correction of CSOs, if deemed a major priority. Also, a separate material fund of $200 million annually was established for marine bays and estuaries. The Water Quality Act of 1987 (PL 100-4) established the revolving loan program as the successor to the grants program. This law also continued the efforts to address controlling toxins in wet weather pollution and designated water use, and began efforts to address nonpoint sources of pollution.

After the 1987 Water Quality Act amendments, the U.S. EPA issued new regulations that required states to provide scientific justification if surface water was not designated to protect aquatic life and recreational uses. In the event that the designation turned out to be inappropriate, the U.S. EPA provided the means for making adjustments by way of the Use Attainability Analysis (UAA). UAA is a structured scientific assessment of the chemical, physical, and biological conditions in a water body. The comprehensive evaluation focuses on water quality, available habitat, and flow regimes. The UAA offers the best potential to direct scarce resources where they will provide the greatest environmental benefits. However, this process is time-consuming, expensive, and potentially controversial because of the lack of clear legal and scientific decision criteria.

U.S. EPA regulations to control SW runoff were first published in the Dec. 7, 1988 issue of the Federal Register. These regulations initiated a permit process for urban runoff, but the reporting information required and the schedules vary depending on the land use and the size of the community. Large- and medium-sized communities are currently developing SW permits under the Phase I SW policy, and small communities will be targeted in the future under the Phase II SW policy. The general application requirements stress descriptive information concerning the drainage area, with minimal runoff monitoring requirements.

Throughout the 1980s many citizens exercised their right to bring a civil action against persons in violation of effluent standards. In 1987, the number of civil actions increased, partly due to the publicity produced by the *Gwaltney of Smithfield, Ltd. v. Chesapeake Bay Foundation Inc.*, U.S. Supreme Court decision. The court ruled that citizens may bring civil action in federal court if they make a good faith allegation of continuous or intermittent violation. The plaintiffs need not prove their allegations of ongoing noncompliance before the civil action, since the statute does not require that a defendant "be in violation" at the commencement of the suit, but only that the defendant be "alleged to be in violation." The public realized that these suits are an effective deterrent against polluters and provide additional enforcement power to that of the regulatory agencies.

In 1989, U.S. EPA published the draft National CSO Control Strategy that established the foundation for states to develop their own strategies and for communities to begin to appreciate the ramifications of CSO abatement. Following extensive review by several "stakeholder" groups, U.S. EPA published the Final CSO Control Policy in April 1994. Very few states were willing to embark upon their own requirements until the federal government issued its own policy. Some communities did proceed with CSO abatement planning and certain best management practices (BMP) in the early 1980s but at the risk of not complying with forthcoming requirements. Generally, communities were concerned that if they forged ahead, they would be required to change their approach if it did not meet the forthcoming requirements. The national strategy served to initiate dialogue and to some extent accommodate such concerns.

The CSO policy was developed as the result of input from individuals, communities, public interest groups, regulatory agencies, and professional organizations such as the Water Environment Federation, CSO Partnership, and Association of Municipal Sewerage Agencies. Consequently, it evolved into a document that accommodates the latest technological approaches to defining the pollution and associated impacts, and at the same time addresses the needs of communities both large and small. Most important, it recognizes the site-specific nature of CSOs.

In 1992, the U.S. EPA initiated a consultative process to help develop framework documents for controlling CSOs. A work group was established with membership from public interest groups such as the National League of Cities, Environmental Defense Fund, and Lower James River Association. The objective of the group was to develop a set of criteria to be used in determining long-term CSO control programs and implementing NPDES permits.

In 1994, the general lack of clarity and consistency in the nationwide approach to SSOs led a number of municipalities to approach the U.S. EPA Office of Water and ask that an advisory committee be formed to make recommendations on how to apply the NPDES program to SSOs (SSO Federal Advisory Subcommittee, 1996). As a result, the SSO Federal Advisory Subcommittee was formed and began meeting in late 1994. The subcommittee was instrumental in developing draft federal policy and this is acknowledged in the March 7, 1996 memorandum accompanying a new addition to the Enforcement Management System (EMS) Guide. The EMS Guide establishes guiding principles and priorities for the various U.S. EPA regions and NPDES states in responding to separate sanitary sewer discharge violations (U.S. EPA , 1996a).

In 1996, more than 1,100 viewers participated in the live satellite seminar, "The Clean Water Act: New Directions." Experts noted that more collaboration among regulators, the regulated community, and the public could produce cleaner water more cost effectively while addressing the needs of individual communities. As a result of the 1996 seminar, the U.S. EPA is leading an "Adopt Your Watershed" campaign. Through this effort, U.S. EPA challenges citizens to join together to protect and restore our water resources.

2.2 Combined Sewer Overflow

CSOs originate from sewer systems that collect both SW runoff and sanitary sewage in the same pipe. During dry weather, these sewer systems convey sanitary sewage directly to a wastewater treatment plant (WWTP). However, during wet weather events the volume of SW runoff and sanitary sewage can exceed the capacity of the sewer system or WWTP. Under these conditions the combined sewer systems are designed to overflow and discharge excess SW runoff and sanitary sewage into streams, rivers, lakes, or estuary receiving waters.

Overflows from combined sewers during storm events result in the discharges to receiving waters of untreated sanitary sewage, which also may contain pre-treated industrial wastewater and untreated SW. Combined sewer overflows contain pollutants that are present in the domestic and industrial wastewater, as well as pollutants in the urban SW runoff that enters the combined sewer system. CSOs are among the major sources responsible for beach closings, shellfishing restrictions, and other water body impairments

In many cases, these discharges have an adverse effect on receiving water quality and attainment of designated uses. In recent years, there has been an enhanced regulatory focus on CSOs and their control, and communities with combined sewer systems are being called upon to develop and implement programs for control of CSOs.

Combined sewer systems serve roughly 950 communities throughout the U.S. with about 40 million people. Most communities with CSOs are located in the Northeast and Great Lakes regions, particularly in New England, Pennsylvania, Indiana, Ohio, Illinois, Michigan, New York and West Virginia. Although large cities like New York, Philadelphia, and Atlanta have combined sewer systems, most communities with combined sewer systems have fewer than 10,000 people.

2.2.1 U.S. Combined Sewer Overflow Policy

The National CSO Control Policy was signed by Carol Browner, the Administrator of the U.S. EPA , on April 8, 1994. This signing culminated a lengthy process of policy development and negotiation among CSO communities, U.S. EPA , the states, and environmental groups. Based upon the NPDES program, the CSO policy establishes a consistent national approach for controlling CSOs.

Consistency within the CSO policy is established by requirements for all CSO communities to implement Nine Minimum Controls (NMCs). The NMCs are technology-based controls that can be used to abate CSO impacts without extensive engineering studies or substantial construction costs. The NMCs place emphasis on maintenance and proper operation of the combined sewer system to ensure maximum use of the collection system and treatment capacity of the WWTP. The NMCs are documented in Appendix A. Consistency is also established by requiring CSO communities to develop comprehensive long term control plans (LTCP) tailored to site-specific conditions. The development of LTCPs is a comprehensive effort that leads to the identification and implementation of technically feasible, effective and affordable controls. Key principles of the LTCP are documented in Appendix A.

The significance of the CSO policy is its recognition of the site-specific nature of combined sewer systems and the variability of receiving water conditions and impacts. Non- and low-structurally intensive pollution controls (i.e., BMPs) are normally the first item that has to be addressed in accordance with best professional judgment. Communities unable to mitigate serious water quality impacts with the implementation of BMPs alone are normally required to provide additional control measures based on water quality requirements.

The features of the CSO policy that can be considered perhaps the most helpful in assisting communities to address their CSO challenges are:

- identification of the presumption and demonstration approaches, and
- guidance on affordability.

The presumption and demonstration approaches provide CSO communities with targets for controls that achieve compliance with the Clean Water Act, particularly the protection of designated uses. Under the demonstration approach, water quality modeling or other tools are used to demonstrate that predicted CSO discharges resulting from the LTCP would be sufficient to attain water quality standards. The presumption approach is based on the premise that a LTCP that meets certain minimum defined performance criteria in terms of expected frequency of overflow, or percent capture of the CSO pollutant load would be presumed to provide an adequate level of control to meet the water quality-based requirements of the Clean Water Act. Key principles of the presumption and demonstration approaches are documented in Appendix A.

The purpose of guidance on affordability is to provide criteria for assessing financial capability and to relate that capability to an appropriate compliance schedule. Its goal is to provide general boundaries to aid all parties in negotiating reasonable and effective schedules for implementing CSO controls. Key principles of the guidance on affordability are documented in Appendix A.

The CSO policy also provides flexibility to CSO communities so that control programs can be developed to fit local needs. The policy contains specific considerations for small municipalities. For example, populations under 75,000 may only need to comply with the nine minimum controls, public participation, and sensitive areas portions of the policy.

2.2.1.1 U.S. EPA Regional Combined Sewer Overflow Policy Interpretation

Some variability exists among U.S. EPA regions with respect to CSO policy interpretation; however, much of the variability may be from the interpretation of the federal CSO policy by delegated states. For example, 91% of the CSO discharges throughout the U.S. are in EPA Regions 1, 2, 3 and 4; all of these CSO states have delegated program authority. However, the EPA regions are required to oversee these states, so it is likely that these regions generally acknowledge and try to accommodate the states' interpretation of the federal CSO policy. For example, within Region 1 there is significant variability in state interpretation. Maine and Massachusetts, for example, do not recognize the presumptive approach. Some of the more obvious differences among the EPA regions are with respect to the use of modeling and certain control technologies and in the implementation of the NMCs versus a LTCP. These differences are often dependent upon the individuals involved and their comfort level with approaches and technologies. To reduce this variability, U.S. EPA produced a memorandum for the purpose of discussing the federal CSO policy and identifying areas where heightened efforts are needed. This memorandum can be found in Appendix B.

2.2.2 States Combined Sewer Overflow Policy

The federal CSO policy has shifted the burden of implementation from the federal government to the states. Of the 33 CSO states and Washington D.C., 30 states submitted CSO permitting strategies consistent with the 1989 federal draft CSO policy and received U.S. EPA approval, while one state received conditional approval. U.S. EPA serves an oversight role for these delegated states, and EPA regional offices bear the burden of permitting for non-delegated states.

The delegated states and U.S. EPA regional offices, as appropriate, are designated authority to implement the CSO policy. In the case of the delegated states, CSOs are permitted through a SPDES that follows the federal CSO policy and additional state requirements. It is the responsibility of SPDES authorities to ensure permits meet the requirements of the Clean Water Act, and that CSO permittees develop long-term CSO control plans, where appropriate. Additionally, they are responsible for coordinating review of the long-term CSO control plan and permit development in association with the states authority to determine if specific revisions to water quality standards are needed. Water quality standards are state or federal requirements which serve as the legal basis for the water quality- based NPDES permit requirements under the Clean Water Act. Water quality standards consist of state-designated uses for water bodies and the criteria to protect these uses.

A summary of several of the state and EPA region CSO requirements is provided below. This summary is not intended to address all CSO programs, but rather to provide the reader with an idea of the federal policy implementation variability throughout the United States.

New York is a delegated NPDES state; therefore, SPDES permits are issued in accordance with the state's CSO control strategy and the federal CSO policy. The state's CSO control strategy encompasses two major elements, BMPs and additional control measures. New York has 13 BMPs that are equivalent to the NMC measures specified in the federal CSO policy. Additional control measures are water quality-based permit requirements that are necessary for SPDES permittees unable to mitigate serious water quality problems through the BMPs alone. These measures are equivalent to the LTCPs specified in the federal policy.

Indiana has three submittal requirements for its CSO discharge permit requirements that include (1) technology-based controls that meet the requirement of the federal NMC measures, (2) a stream reach characterization that exceeds the NMC measures, and (3) a cost-benefit analysis of alternative CSO abatement controls. The use determination in Indiana is "fishable and swimmable."

Illinois has a CSO policy more stringent than the federal presumption or demonstration approaches. Complete treatment is required for flows produced by the 1-year, 1-hour storm with a peak of 1.2 inches per hour (in./hr). Flows in excess of the specified storm must receive primary treatment sized at 10 times the dry-weather capacity. Illinois was very progressive; CSO regulations have existed there since 1962, and many of the CSO communities used Construction Grant monies to fund their CSO abatement in the 1970s.

Ohio also is implementing the federal CSO policy through the NPDES permit program. Ohio has 92 CSO communities, of which 70 have populations of less than 10,000. Most Ohio CSO communities are required to implement the NMC measures; however, several small communities are spending their money on sewer separation projects instead of implementing the NMCs. Approximately 50% of Ohio's CSO communities have implemented LTCPs, are in the process of implementing them, or have requirements to do so in their permits. Many communities are being asked to characterize and monitor before developing a LTCP (Hun, 1998).

Some delegated states have very few CSO communities. For example, California has two CSO communities (Sacramento and San Francisco) and Virginia has four CSO communities. California's CSO policy was developed solely for San Francisco and included control of CSOs to specified frequencies, capture of floatables, measuring water quality, and implementation of the NMC measures. Virginia's CSO communities were only required to implement the NMC measures.

In contrast to these other states, Iowa, Kansas, Missouri, and Nebraska are not delegated states and are therefore represented by EPA Region 4. Most cities in Region 4 have separated sewer systems; therefore none of the states accepted the responsibilities of program authority. Because CSOs are not an extensive problem, Region 4 has focused most of its efforts on WWTPs. The only CSO requirement is to provide technology-based controls. No LTCPs are required.

2.2.3 Canada Combined Sewer Overflow Policy

The Ministry of Environment and Energy CSO regulations is entitled *Determination of Treatment Requirements for Municipal and Private Combined and Partially Separated Sewer Systems.* These regulations are similar to those set forth in U.S. CSO policy. The Ministry of Environment and Energy regulations require a pollution prevention and control plan which is similar to the LTCP, implementation of minimum SSO controls that are similar to the NMCs, and a minimal level of treatment.

2.3 Sanitary Sewer Overflows

Sanitary sewer overflows are the result of the unplanned relief of a sewer system intended only for sanitary sewage. An SSO typically occurs when the flow exceeds the carrying capacity of the system, and although SSOs can, and do, occur during dry weather, they are most commonly associated with wet weather events. SSOs are caused by a variety of system faults, exacerbated by excess wet weather flows. These causes include (EPA, 1996b):

- rainfall or snowmelt entering the subsurface and subsequently entering the sewer system through defective or deteriorated pipes, joints, manholes, or connections. This is known as infiltration;
- stormwater entering the sewer system through illegal or unintentional connections. This is known as inflow. Together infiltration and inflow are referred to as rainfall-induced infiltration and inflow (I/I);
- pumps and sewers too small to handle the increased flows created by urbanization; and
- faulty equipment, power failures, blocked or broken sewers, and other acute system failures.

Although a large number of SSOs occur in the collection system, they may also occur at the WWTP. Wastewater treatment plants are often not capable of handling the excess flows that occur during large storms. As a result, the WWTP must allow some of the flow to bypass treatment and discharge directly into the receiving waters.

Regardless of the cause or location of the SSO, the end result is that untreated sewage is introduced in an uncontrolled manner into the environment, leading to concerns for public health and safety. The health, social, and economic costs of SSOs are significant. The health and environmental risks attributed to SSOs are a function of several factors including location and season, discharge frequency, discharge volume, the amount and type of pollutants present in the discharge, and the uses, conditions, and characteristics of the receiving waters (SSO Federal Advisory Subcommittee, 1996). The most serious health risks associated with SSOs involve discharges to water bodies and other areas with a potential for human contact. In addition, SSOs, along with other sources of pollution, impair or damage water bodies for one or more uses such as drinking water, swimming, fish and wildlife habitat, and non-contact recreation. Areas heavily affected by chronic and uncorrected SSOs can experience social and economic losses due to widespread health issues, beach closures, reduced property values, a reduced sense of community, reduced tourism, and loss of recreational opportunities, among others.

There are more than 18,500 sanitary sewer systems in the U.S.. All are capable, under the right circumstances, of producing SSOs (EPA , 1996a). In a 1994 survey conducted by the Association of Metropolitan Sewerage Agencies, 79 members reported SSO problems (AMSA, 1994). Another study estimated that SSOs closed beaches for 300 days in the U.S. during 1994 (National Resources Defense Council, 1995). The U.S. EPA noted that over 1,000 systems in the U.S. experience SSOs (EPA , 1997). While difficult to quantify precisely, it is clear that the sanitary sewer overflows are a widespread issue.

2.3.1 Federal Sanitary Sewer Overflow Policy

The Clean Water Act is the central piece of legislation governing the quality of the nation's waters, including SSOs (EPA , 1999). SSOs are point source discharges of pollutants and must be permitted. This is true for overflows that are released directly into a surface water or indirectly through subsurface flows or through streets and then into a storm drainage system. Operators of systems with SSOs not authorized by an NPDES permit must either eliminate the SSOs or seek a permit.

At this time standards for controlling SSOs are uncertain (EPA , 1999). The Clean Water Act requires secondary treatment for all publicly owned treatment works (POTWs) (i.e., WWTP). For all other point-source discharges, the Clean Water Act requires "best available technology economically achievable" for toxic and non-conventional pollutants and "best conventional pollutant control technology" for conventional pollutants. The system that conveys wastewater to a WWTP is included in the regulatory definition of a POTW, and thus it could be inferred that SSOs from these systems must meet the secondary treatment standard. However, the U.S. EPA has decided that for combined sewer systems, "bypasses" can occur at a WWTP after primary treatment; thus CSOs are not subject to the secondary treatment standard. Where SSOs fall in this quandary has not been decided.

A logical SSO control policy might be based on current CSO control policy. However, there are significant differences between CSOs and SSOs that preclude the direct application of the CSO Control Policy. The key differences are (U.S. EPA , Region 6, 1995):

- sanitary sewers have no diversion and discharge structures designed into the system to release the excess flows to receiving water bodies at controlled discharge locations; and
- the overflows in sanitary systems occur through manholes and defective lines, releasing the flows indiscriminately throughout the system.

Since there are no centralized discharge points in a sanitary system, the application of the technology-based and water quality-based standards of the Clean Water Act is difficult. However, if system improvements can be implemented to contain and divert SSOs to centralized locations, the differences between SSOs and CSOs lessen and a CSO-type approach becomes feasible. (The National CSO Control Policy is described in Section 2.2.1)

In 1994, the general lack of clarity and consistency in the nationwide approach to SSOs led a number of municipalities to approach the U.S. EPA Office of Water and ask that an advisory committee be formed to make recommendations on how to apply the NPDES program to SSOs. As a result, the SSO Federal Advisory Subcommittee was formed and began meeting in late 1994. The subcommittee was instrumental in developing draft federal SSO policy. This policy was documented as a new chapter in the EMS Guide on March 7, 1996. This chapter, "Setting Priorities for Addressing Discharges from Separate Sanitary Sewers," established guiding principles and priorities for the various EPA regions and NPDES delegated states in responding to separate sanitary sewer discharge violations (EPA, 1996a). This chapter is presented in Appendix C.

2.4 Stormwater

Stormwater is water from precipitation that flows across the ground and pavement when it rains or when snow and ice melt. The water seeps into the ground or drains into a storm drain system and discharges without treatment into streams, lakes, and estuary ecosystems.

Stormwater runoff contains pollutants that are collected as rainwater or snowmelt flow across the ground surface. Such pollutants include oil and grease, chemicals, nutrients, heavy metals, bacteria, viruses, and oxygen-demanding compounds.

Stormwater pollution has many sources. Three general source types are residential, industrial, and construction. The most common residential sources are from building materials (especially metal flashing), fertilizer and other landscape chemicals, pet waste, and pollutants associated with the use of automobiles. At industrial sites, chemical spills that contain toxic substances and uncovered or unprotected outdoor storage or waste areas can contribute pollutants to SW runoff. During construction, chemicals and materials can wash into ditches leading to waterbodies during rainy weather. Inappropriate discharge of sanitary and industrial wastewaters into storm drains can also contribute to the pollutant load of SW flows during dry periods. Environmental degradation associated with SW runoff may be magnified due to hydraulic changes in a developed area. When undeveloped land is urbanized, much of the land surface is paved with impervious materials (buildings, asphalt, and concrete). This increases the runoff volumes and rates during rains and decreases the receiving water flow during dry weather.

Regardless of the source of SW, the end result is that polluted water is introduced into the environment and leads to concerns for public health and safety. The U.S. EPA has identified urban runoff as one of several potential sources of more than 1,000 toxic organics that have been detected in drinking water supplies (45 FR 77870). Studies have also detected increased salt concentrations in shallow groundwater in areas where large quantities of salts are used on roads for ice control (Terry, 1974).

2.4.1 Federal Stormwater Policy

In 1973, U.S. EPA promulgated its first SW regulations in the form of an exemption. Any conveyances carrying SW runoff uncontaminated by industrial or commercial activity were exempt from the NPDES regulations. However, the Natural Resources Defense Council brought suit in the U.S. District Court for the District of Columbia, challenging the agency's authority to create such exemptions. The court ultimately held that U.S. EPA could not exempt discharges identified as point sources from regulations under the NPDES permit program.

Subsequently, U.S. EPA issued a rule in 1976 establishing a permit program for all SW discharges except for rural runoff uncontaminated by industrial or commercial activity. What followed was a series of suits brought by major trade associations and their member companies, a process that culminated in the NPDES Settlement Agreement in 1982.

During U.S. EPA 's evaluation of appropriate changes, Congress passed the Water Quality Act of 1987 (WQA) which amended the Clean Water Act of 1977 and included specific provisions related to SW.

The directives of the 1987 WQA were threefold. First, Congress specifically directed U.S. EPA to address SW discharges under the NPDES program and established statutory deadlines for the initial phases of the program. Second, Congress affirmed that SW discharges from industrial sites must be issued NPDES permits, and that the full panoply of traditional NPDES permit requirements, including technology-based and water quality-based standards, must be applied. Third, Congress established slightly different permitting requirements and standards for municipal SW discharges than for industrial SW discharges, including the new "maximum extent practicable" standard.

Through the WQA and amendments to the Clean Water Act, a two-phased approach addressing SW discharges was developed. A brief summary of the municipal SW portion of this policy can be found in Appendix D. Phase I, currently being implemented, requires permits for separate SW systems serving large- and medium-sized communities (those with over 100,000 inhabitants), and for SW discharges associated with industrial and construction activity involving at least five acres.

Phase II, which is currently under development (finalized Oct. 29, 1999), would expand this existing national program to smaller municipalities and construction sites that disturb 1 to 5 acres. In this expansion, U.S. EPA is proposing to allow certain sources to be excluded from the national program based on the lack of impact on water quality, as well as to pull in other sources not regulated on a national basis based on localized adverse impact on water quality. Finally, U.S. EPA is proposing to conditionally exclude from the NPDES SW program industrial facilities that have "no exposure" of industrial activities to SW, thereby reducing application of the program to many industrial activities currently covered by the program that have no industrial SW discharges.

2.4.2 States Stormwater Policy

Federal policy for SW management has also shifted the burden of implementation from the federal government to the states. Through the WQA and amendments to the Clean Water Act, a two-phased approach addressing SW discharges has developed. All states must follow guidelines that are no less stringent than the NPDES permit guidelines.

A summary of several state and regional SW management programs is provided below. This summary is not intended to address all SW programs, but rather to provide the reader with an idea of the federal policy implementation variability throughout the United States. A more detailed documentation of state SW policy can be found in Appendix E.

In response to U.S. EPA's SW policy, many states have imposed additional requirements. California is an U.S. EPA NPDES-delegated state with permitting authority that has instituted many more stringent requirements. For example, a regulated SW area is considered individually from the property's primary activity (the vehicle service area at a school would be considered a transportation area, requiring permitting). Point source guidelines are also more stringent (sheet flow from parking lots is considered a point source requiring a permit).

In contrast to California, Maine does not have NPDES permitting authority. However, the Maine Department of Environmental Protection Bureau of Land and Water Quality wrote the Natural Resources Protection Act that is used to protect the quality of the receiving waters by imposing additional regulations to those prescribed by the U.S. EPA . Proposed construction projects require permits directing adherence to SW quality and quantity standards.

Similar to the U.S. EPA guidelines, some states have imposed numerical standards. Hawaii, an NPDES- delegated state with permitting authority, requires that permitted discharges must comply with the state's basic water quality criteria. These criteria include prohibited substances. Discharges must conform to specific concentration allowances and cannot contain pollutants in 24-hour average concentrations greater than the values obtained by multiplying the minimum dilution by the acceptable standard. In addition, BMP plans must be implemented for construction SW runoff controls.

Arkansas has also established numerical guidance in addition to the U.S. EPA's guidelines. For example, coal pile runoff should not exceed 50 milligrams per liter (mg/L) maximum suspended solids and the hydrogen ion concentration (pH) must be within 6-9 standard units (SU). Iowa also has this limit. The Arkansas Department of Pollution Control and Ecology has specifications for detention ponds and erosion controls. Required detention pond volumes and sizing are determined using a "simplified volume formula" or the "modified rational hydrograph method."

Colorado, an NPDES delegated state, also issues permits requiring adherence to numerical limits. In addition to the numerical control limits, control measures also govern reclamation, acid runoff from mines, drainage control, subsidence, and grading activities.

Some states take a watershed approach to SW management instead of the point source approach. In response to contamination of its groundwater supply by continued urban development, Austin, Texas, passed a watershed protection ordinance in 1981. The 1986 amendment to the ordinance specifies standards for development within critical watersheds. These include buffer zones, building restrictions on slopes greater than 15%, and required setbacks from springs, creeks, and sinkholes.

Wisconsin also uses the watershed approach towards SW management and control. In 1983, the state initiated its priority watershed protection program, which involves retrofitting nonpoint source controls in watersheds where point source controls alone cannot meet water quality objectives.

The SW utility was pioneered by the city of Bellevue, Wash. Many cities now have SW utilities modeled after Bellevue's, which uses natural drainage systems such as swales, lakes, ponds, wetlands, and detention ponds to transport and dispose of SW. The primary mission of the Bellevue storm drainage utility is to "manage the storm and surface water system, to maintain a hydrologic balance, to prevent property damage, and to protect water quality for the health, safety, and enjoyment of citizens and for the preservation and enhancement of wildlife habitat" (Bissonette, 1985).

2.5 History of Wet Weather Pollution Management Control Strategies

Throughout history, many strategies have been implemented to control wet weather pollution for reasons such as flood control, water quality improvement, aesthetic improvement, waste removal, and others. To provide guidance for developing communities, a reference manual for wet weather flow systems in newly urbanizing areas is being developed as part of a cooperative agreement among the Urban Watershed Management Branch of the U.S. EPA , the University of Alabama at Birmingham (Pitt, et al. 1997), and ASCE (Heaney, et al. 1997). The reference manual includes a historical summary of wet weather pollution management control strategies (Pitt, et al. 1997), which is presented in Appendix F.

CHAPTER 3.0

APPROACH

3.1 Essential Wet Weather Pollution Abatement Criteria

To provide a sound program for abating wet weather pollution, a community should adopt a multi-faceted approach which includes encouraging public participation; monitoring and modeling impacts, including the impacts on receiving water; examining the usefulness of a watershed approach; and looking at the cost-effectiveness of any proposed program. These considerations, along with the experiences documented in the benchmark matrices and case histories, can be used as a starting point to develop site-specific wet weather pollution abatement programs.

3.2 Questionnaire Development

The project team used role-playing activities to identify wet weather abatement criteria. Participants included EPA regions, state regulatory agencies, municipalities, and the public. Each role player was responsible for identifying respective abatement criteria. The role-playing provided information used to facilitate the questionnaire development and interview process.

The questionnaire was categorized into six sections, namely public participation, conveyance system information, watershed approach, water quality, issues driving technical considerations, and financial considerations. A copy of the questionnaire is included in Appendix G.

The questionnaire was sent to CSO, SSO and SW communities throughout the United States and Canada. These communities were originally identified through data provided by U.S. EPA and private consultants. The communities represent a range of geographical locations, population, economic bases, and abatement strategies and schedules. In general, communities were initially reached via a personal telephone call. If the contact expressed interest in participating, then a questionnaire was sent to the attention of that person.

The number of questionnaires returned was less than anticipated. Of the approximately 150 questionnaires sent to communities throughout the United States and Canada, only 50 were returned. (Appendix H contains the list of questionnaire contact persons.) Despite this low return rate, the communities that participated do represent a wide range of geographic locations, demographics, and abatement strategies and schedules. More importantly, they provided meaningful data for the purpose of allowing other communities to benchmark their own wet weather

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pollution abatement progress. Though the data presented in this report is not representative of communities who have not begun wet weather abatement, those communities may find Chapter 4, Essential Wet Weather Pollution Abatement Criteria, and the benchmark data (Chapters 5-7) very useful in planning and starting their abatement programs.

3.3 Benchmark Matrices and Case Histories

Benchmarking is the process of documenting existing experiences for the purpose of culling out best practices, innovative ideas, and highly effective operating procedures that could assist in developing effective solutions.

The benchmark matrices and case histories for CSO, SSO and SW communities provide data that may be useful to stakeholders seeking to improve their wet weather pollution abatement process. Information is provided in two forms: benchmark matrices and case histories.

Data from the questionnaires were tabulated to facilitate interpretation. CSO, SSO and SW benchmark matrices can be found in Chapters 5, 6 and 7, respectively. The matrices are categorized into five sections, namely, general community statistics, public participation, systems characterization, issues driving technical considerations, and financial considerations.

Case histories for CSO, SSO and SW were developed for a select number of surveyed communities that exemplify common approaches to wet weather pollution abatement. These communities provided meaningful data for the purpose of allowing other communities to benchmark their own wet weather pollution abatement progress.

A discussion of decision criteria used to determine benefits of CSO, SSO, SW abatement follows the benchmark matrices and case histories in each chapter.

CHAPTER 4.0

ESSENTIAL WET WEATHER POLLUTION ABATEMENT CRITERIA

4.1 Criteria Development

The following guidance issues provide a fundamental approach to abating wet weather pollution. These guidance issues, along with experiences documented in the benchmark matrices and case histories, can be used as a starting point to develop a site-specific, wet weather pollution abatement program. These issues include public participation, watershed approach, receiving water impacts, monitoring and modeling of impacts and cost effectiveness analysis. The issues are structured in the form of a methodology, and are organized in a sequential manner. For example, public participation, while not always the highest priority for a municipality, should at least be considered early in the abatement process to gain the greatest returns from the program. The watershed approach, receiving water impacts and monitoring and modeling of impact issues pertain to understanding and gathering meaningful information about wet weather pollution sources and their impacts in terms of the entire watershed. Once the pollution sources and impacts are identified, a cost effectiveness analysis may be used to select alternatives and prioritize capital projects. Figure 4-1 illustrates the general methodology.

4.2 Public Participation

Public participation is the process of seeking the views and concerns of stakeholders and including them in the decision-making process. It includes open information sharing, teaming with stakeholders, gaining public input, and solving problems jointly. Stakeholders are any citizens or groups who have an interest or stake in the outcome of a decision made by the municipality. In that sense, every taxpayer in the municipality is a stakeholder. Stakeholders include federal agencies, state and local governments, environmental groups, labor organizations, citizen's groups, and community members.

The following are guides to and benefits of public participation:

- Public involvement in the process should occur early and often. Public participation takes more time and effort up front, but will result in a better decision that is less controversial and requires less outreach, education, and defense.

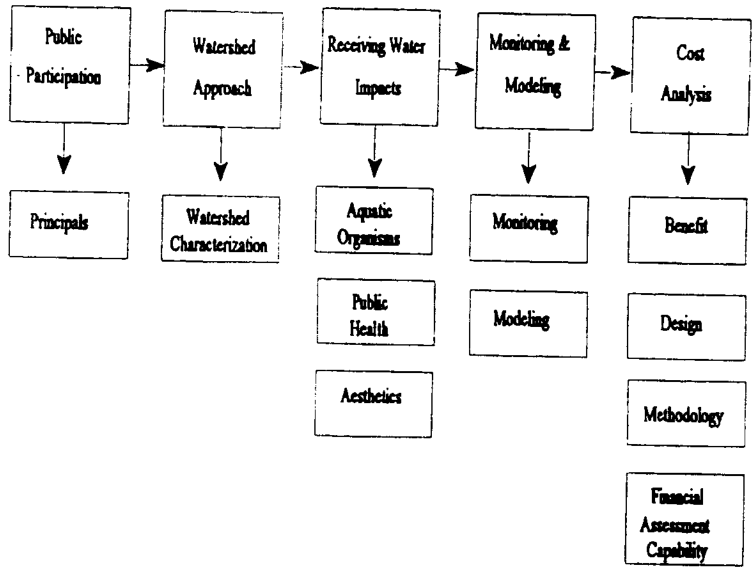

Figure 4-1. Wet Weather Issue Methodology Outline

- Public trust is earned through openness, outreach, consistency, and results. Public involvement is crucial to sound decision making. Public participation allows the municipality to enlist a much broader range of expertise than it has available in-house.
- Public dialogue increases understanding among all interests affected by decisions. Effective participation means two-way communication and the willingness of the public to take advantage of the various opportunities to participate. Public dialogue can aid both the regulated community and the public in understanding their individual expectations, resulting in more workable and widely acceptable solutions.
- Public input should be solicited from all sectors of society. Equal opportunity for comment and equal consideration of comments from the private and public sectors should be provided.
- The municipality should carefully consider all public comments, regardless of their origin, and provide a response through a comment and response document, not just an acknowledgment.

For the public to successfully participate in the decision-making process they should be informed of how and when they can get involved. The municipality should notify both the regulated community and the general public and ask for input regarding the wet weather pollution circumstances. There are many methods for obtaining public input. Each community and pollution scenario is different; therefore the most effective method, or combination of methods, should be selected on a case-by-case basis.

The following are a few methods of obtaining public input:

- ***Advisory Committees.*** An advisory committee is generally composed of volunteers from a wide range of occupations who are appointed by the municipality to represent the entire community. The committee generally serves as a sounding board for the public and an advisory board for the municipality. Advisory committees should be used to review technical documents and public comments and may also make recommendations to the municipality.
- ***Notice and Advance Notice of Proposed and Final Milestone Decisions.*** The advance notice of proposed and final decisions enables the municipality to solicit comments from the community prior to action. Information about the proposed and final decisions can be disseminated via quarterly newsletters, community newspaper articles, public service announcements, world wide web pages and local radio/television advertisements. These announcements should explain the status of the wet weather pollution abatement process and solicit input from the community. In addition, the municipality should distribute information and solicit comments through the appropriate advisory committee. In this way, the public has additional opportunities to comment on decisions, thereby developing solutions with greater community concensus.

- ***Public Information Meetings.*** The municipality should consider holding public information meetings on proposed decisions when it anticipates a need to inform the public on environmental impacts or explain a new wet weather pollution abatement scenario and respond to questions. Public meetings should be publicized using the forums listed above.
- ***Public Hearings.*** To receive comments on proposed decisions, the municipality should conduct public hearings, particularly when significant interest is generated by a proposal. These hearings should be used to officially record public comments. Public hearings should be scheduled at locations and times that allow for the greatest number of affected people to attend. Public hearings should also be publicized using the forums listed above.

4.3 Watershed Approach

4.3.1 Definition of Watershed Approach

Today's challenges require more comprehensive solutions to further restore and maintain the physical, chemical, and biological quality of our nation's waters. One such solution is the watershed approach, a coordinating framework for environmental management that focuses public and private sector efforts to address the highest priority problems within hydrologically defined geographic areas, taking into consideration both ground and surface water flow. The watershed approach has three key components:

- ***Geographic Focus.*** Watersheds are defined by natural boundaries. They are the areas that drain to surface water bodies. A watershed generally includes lakes, rivers, estuaries, wetlands, streams, and the surrounding landscape. Groundwater recharge areas are also considered.

- ***Continuous Improvement Based on Sound Science.*** Sound scientific data, tools, and techniques are critical to guide the process. Actions taken include characterizing priority watershed problems and solutions, developing action plans, and evaluating their effectiveness within the watershed.

- ***Partnerships/Stakeholder Involvement.*** Watersheds transcend political, social, and economic boundaries. Therefore, all affected interests should be involved in designing and implementing goals for the watershed. Watershed teams may include representatives from all levels of government, public interest groups, industry, academic institutions, private landowners, concerned citizens, and others.

4.3.2 The Urban Watershed

Within the watershed lies the urban watershed, a subset of the complete watershed bound by topography and city limits. It holds most of the population and contributes significantly to water quality problems.

At a minimum, the urban watershed includes, but is not limited to, SW runoff, sanitary- and combined-sewer discharges, and NPDES-permitted industrial and commercial discharges. Urban watersheds therefore include (1) all sources (point and nonpoint) originating within the urban center or urban fringe, and (2) water entering the urban watershed (surface and groundwaters entering from upstream sources, source waters supplying the urban population, and rain events). These contributions must be included to adapt to the situations exemplified by TMDL trading that allows upstream reductions to substitute for NPDES discharges. The urban watershed evaluation should also recognize the probability of the expanding urban geographic area as the national population is moving from the urban core to the surrounding areas.

4.3.3 Watershed Characteristics

The first step in abating wet weather pollution is to identify the sources and prioritize them before developing criteria for wet weather pollution abatement.

The most recent National Water Quality Inventory reports that runoff from urban areas is the leading source of impairments to estuaries and the third largest source of water quality impairments to surveyed lakes. Therefore, in characterizing a watershed, emphasis is placed on the subwatershed known as the urban watershed, even when the entire watershed may also include agricultural and suburban point and nonpoint pollution sources. The urban watershed can be characterized in three general categories: urban, environmental and infrastructure characteristics.

4.3.3.1 Urban Characteristics

The urban characteristics of a watershed may be illustrated by its physical properties, percent porosity and economic/social basis.

The physical nature of the urban watershed such as size, topographic relief, and local hydrologic conditions will determine the runoff and erosion from the watershed. Characteristics such as land use and the creeks and storm drainage system in the watershed may be used to delineate sub-watersheds, so that different attributes of the watershed may be clearly differentiated and addressed.

Nonporous urban landscapes like roads, bridges, parking lots, and buildings do not permit precipitation to percolate into the ground. Water remains at the surface, accumulates, and runs off in large amounts. When leaving the system and emptying into a stream, it erodes streambanks, damages streamside vegetation, and widens stream channels, resulting in lower water depths during non-storm periods, higher than normal water levels during wet weather events, increased sediment loads, and higher water temperatures. Native fish and other aquatic life cannot survive in urban streams severely affected by urban runoff.

Urbanization also increases the variety and amount of pollutants transported to receiving waters: sediment from development and new construction; oil, grease, and toxic chemicals from vehicles; nutrients and pesticides from turf management and gardening; viruses and bacteria from sewer systems; and heavy metals from industrial activity. Sediments and solids constitute the largest volume of pollutant loads to receiving waters in urban areas. Toxins from wet weather pollution can generally be considered a primary concern in industrialized areas that are served by combined sewers.

4.3.3.2 Environmental Characteristics

The primary concern for wet weather pollution abatement is the receiving water that must support the fishable and swimmable goals set forth in the Federal Clean Water Act Amendments of 1972. The approach to plan development should address the identification of specific environmental features that are adversely affected by wet weather pollution.

The receiving water body is usually the primary focus of attention in defining the environmental characteristics. These characteristics include:

- size relative to loadings,
- type (river, sea, estuary, ocean, reservoir, etc.),
- seasonal changes (flow, temperature, and ice cover),
- physical factors (slope, velocity, mixing zones, pools and riffles, etc.), and
- beneficial uses (historical, present, and future).

Characterizing aquatic life helps identify what types of pollutants are of concern, as well as whether adverse impacts are expected to be seasonal, transient, or long term. Differentiation can initially be made between bottom organisms (subject to sediment accumulation) and water column organisms. If fish are of concern, the most sensitive type of fish should be identified to develop an approach to protect them. Important factors are:

- seasonal aspects (migration and spawning),
- transient variances in dissolved oxygen and in ammonia and other toxins,
- type and diversity of other organisms required, and
- relative importance of the physiology of the water body.

Bottom organisms are often more important to consider than fish and other aquatic life in the water column because wet weather pollution contains such a significant amount of settleable solids. These settleable solids account for a significant portion of the heavy metals and other toxins found in wet weather pollution. In addition, the deposition of inert particles can cover bottom organisms and adversely affect the environment. Wherever these solids settle, the impact can be long term, affecting both the water column and aquatic life.

There may be other constraints to realizing water quality improvements if only wet weather pollution is abated. One constraint is the effect of the bottom deposits from wet weather pollution that have accumulated previously. These bottom deposits might be classified as toxic, which complicates their removal and safe disposal; unless removed, they will continue to exert a significant oxygen demand, remain a source of toxicity in the food chain, and/or retard improvements to the fishery (spawning, bottom organisms, etc.).

Stream physiology may also be a constraint. Factors of importance include current velocity, water temperatures, bottom structure and shading for spawning, barriers to migration and movement, and diversity of aquatic organisms. Navigation uses may adversely constrain other uses perceived as beneficial. Recreational uses can be constrained by barge traffic, access limitations, stream physiology, and other pollutant loads.

4.3.3.3 *Infrastructure Characteristics*

Combined, separated and SW sewers are a significant component of a community's infrastructure. Development of a plan to abate wet weather pollution should thus include consideration of the collection system, WWTPs, and other related infrastructure components.

Some collection systems are 50 to 100 years old. Other systems were designed for a smaller population or a less impervious land than currently exists. Such issues can affect the conveyance capacity of these systems.

An assessment of the structural condition is important for two reasons. First, it may provide a rational basis for separating the sewer system, an abatement strategy used for CSO. Second, it may provide a basis for estimating the financial resources required to maintain the present level of service. Collapsed or clogged sewers will require investment to improve or maintain service.

In some urban areas, in addition to concern for the receiving water body, a significant public health and safety concern from basement and street flooding may also exist. Increasing conveyance capacity to mitigate basement and/or street flooding could have a major impact on developing a plan for wet weather pollution abatement. In some areas, the importance of protecting basements relative to street flooding could point the program toward sewer separation or use of inlet controls to avoid overloading.

Wet weather pollution abatement facilities may affect existing WWTPs and residual solids handling. Use of existing WWTPs as part of a wet weather pollution abatement plan will affect the amount of land available for future upgrading or expansion. Consideration should also be given to converting decommissioned WWTPs to wet weather pollution treatment plants rather than abandoning them.

Wet weather pollution abatement facilities will require careful consideration in siting; however, disruption during construction and interference with other utilities can be expected. Investigation of other urban improvements, such as road repairs or flood control, may lead to ways of mitigating disruption and interference by undertaking multipurpose projects. Coordination of construction activities with road or street surface improvements could be a major cost saving. In some areas it may be prudent to keep utility corridors free from obstructions or to coordinate general locations and depths of crossings.

4.4 Receiving Water Impacts

The specific receiving water impacts from wet weather pollution vary depending on the urban, environmental, and infrastructure characteristics. Depending on the particular combination of these factors, wet weather pollution impacts can be visible and intense. The size and type of the receiving water body determine its ability to dilute and assimilate intermittent wet weather pollution without toxicity. Therefore, receiving water impacts should be evaluated based on each site's particular characteristics. In each case, wet weather pollution impacts can be evaluated with respect to three basic considerations:

- water quality changes and effects on aquatic organisms,
- public health risks, and
- aesthetic deterioration.

4.4.1 Water Quality Changes and Effects on Aquatic Organisms

The wet weather pollution impacts on receiving waters depend on the rate and volume of the discharge, the degree of mixing and dilution, and the receiving water's assimilative capacity. Obviously, the larger the water body and smaller the discharge, the better likelihood of minimal impacts. For example, in some large rivers and estuaries, wet weather pollution has minimal impacts because of rapid dilution and mixing. In contrast, small streams that receive wet weather pollution with little dilution can be severely affected even for small storms. Therefore, solutions to wet weather pollution require site-specific monitoring and evaluation.

Most water quality impacts are measured by a determination of the increases (or decreases) in receiving water concentrations of toxicants as they relate to a violation of water quality criteria or standards. Such criteria are generally used to assess the potential for effects on aquatic organisms and impaired use. Although wet weather pollution is intermittent, the resultant problems may not be temporary and can persist to varying degrees. Figure 4-2 provides preliminary guidance for the time frames to be considered for different water quality problems. These different time frames can require different strategies for monitoring and calculating wet weather pollution impacts.

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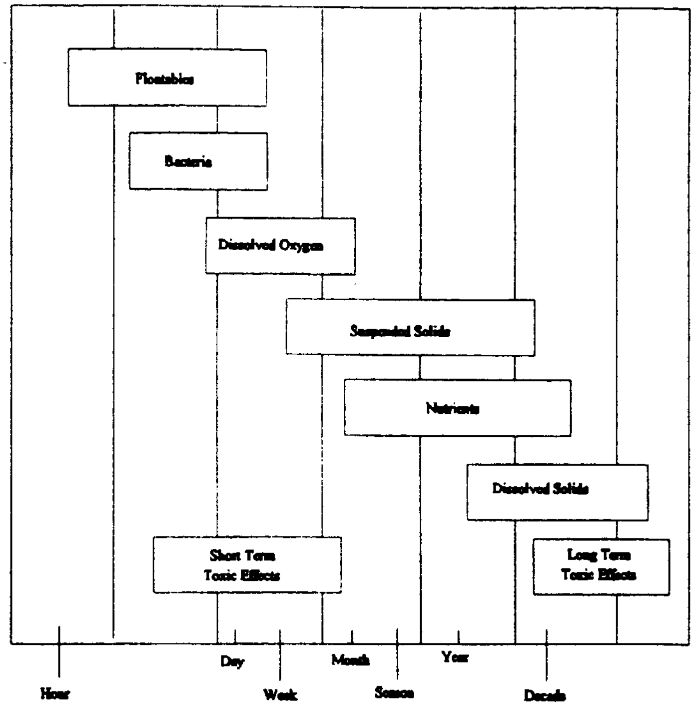

Figure 4-2. Time Scale for Wet Weather Pollution Water Quality Concerns (Moffa, 1997)

Dissolved oxygen levels, nutrient enrichment, sediment impairment, and toxicity are the major problems resulting from wet weather pollution.

Temporary depression of dissolved oxygen levels is a possible water quality problem attributable to wet weather pollution. Even though SW dilution minimizes the immediate impact, which generally lasts only hours, dissolved oxygen reductions may impair aquatic growth or reproduction and, in severe situations, cause biologic mortality. The severity, frequency, and duration of dissolved oxygen reductions caused by wet weather are dependent on the specific receiving water in question.

Nutrient enrichment from phosphorus and nitrogen is another potential problem resulting from wet weather pollution. Nutrient additions cause increased algae or aquatic weed growth. In turn, this may cause dissolved oxygen problems, reduce biological diversity, degrade aesthetics, or impair use for water supply. In fast-moving streams, nutrient contributions are typically flushed out before any impact can be realized, but in slower-moving water bodies the nutrients accumulate and assimilate into the biota. Sources of nutrients cannot easily be distinguished. However, performing relative comparisons of seasonal nutrient loadings at critical locations in the watershed can aid in the assessment of nutrient enrichment and eutrophication.

Another common problem from wet weather pollution is accumulated bottom-sediment contamination. Wet weather pollution typically has high levels of suspended materials that settle to the bottom in receiving waters. The accumulation and persistence of solids in sediments are typically long-term, not transient problems. The results can be high sediment oxygen demand due to biological oxidation and accumulation of toxic substances in the sediments. These conditions are usually present in slower-moving rivers, estuaries, or lakes, but not in fast-moving streams where sediments are routinely scoured from the bottom. Sediment criteria and standards for evaluating the severity of a problem are lacking. The U.S. EPA provides general guidelines for disposal of dredged sediments (EPA, 1997; EPA, 1977), but beyond these, the significance of sediment contamination should be evaluated on a site-specific basis.

Receiving water toxicity is the fourth general impact from wet weather pollution. In general, toxicity problems fall into two categories: (1) acute toxicity at higher concentrations, causing short-term mortality, or (2) chronic, long-term exposure to toxins, causing reduced growth and reproduction. Acute effects can often be observed as immediate fish kills or severely reduced biological diversity. Chronic effects are more subtle and harder to identify but at times can be observed by lower productivity and biomass (numbers of organisms), by bioaccumulation of chemicals, or by reduced biological diversity. Fortunately, chronic effects generally do not result from wet weather pollution because discharges are intermittent and infrequent in nature.

Toxic discharges from wet weather events can be a concern in industrialized areas served by combined sewers. Pretreatment programs are a good source of information to screen for potential toxicity from rainfall events. The more common toxicity concerns are for ammonia and dissolved trace metals, but concentrations generally are diluted enough to be of little concern. Preliminary screening for toxic effects can be performed using average dry weather discharge concentrations in combination with wet weather peak hourly flow rates for calculating a range of dilution. If such considerations are relevant to a site, then existing state and U.S. EPA water quality criteria are available for making preliminary assessments (EPA, 1986).

4.4.2 Public Health Risks

The major source of concern related to wet weather pollution, a concern in nearly all types of receiving waters, is the public health risk associated with diseases caused by pathogenic bacteria and viruses that may be carried in excrement. When people are exposed to contaminated receiving waters through wading, bathing, shellfish ingestion, and fishing, they risk becoming ill. Levels of bacteria observed in wet weather pollution varies. CSOs and SSOs have higher pathogenic bacteria counts than SW discharges; nonetheless, each type of discharge generally contains bacteria counts that are several orders of magnitude greater than applicable receiving water quality standards. For this reason, wet weather pollution can cause potential problems even in receiving waters with very high dilution. The potential risk is typically greatest at the beginning of a wet weather event, due to the "first flush" effect that delivers much of the waste that had accumulated during the preceding dry weather period. However, the risk can diminish quickly thereafter due to bacterial die-off, settling, and dilution. Significant public health risks from exposure to pathogens rarely persist more than two or three days after a storm overflow event. Wet weather pollution laden with bacteria is a special concern during warm weather when water contact recreation peaks and human exposure is greatest.

Protecting public health from exposure to microbial pathogens is complicated by the extreme difficulty in measuring concentrations of pathogenic organisms. For this reason, water quality standards are based on the presence of more easily measured indicator organisms. The most commonly used indicator of fecal materials has been fecal coliform bacteria, based upon work of the U.S. Department of Interior's National Technical Advisory Committee in 1968. Many state water quality standards are based upon this work, and consist of a standard of 200 fecal counts/100 milliliters (ml) for total body contact recreation, and 1,000 fecal counts/100 ml for partial body contact recreation. U.S. EPA revised these suggested numbers in 1986 to be based upon concentration of *Escherichia coli* and *enterococci.*

Generally, receiving water concentrations above 200-1,000 organisms/100 mL are considered to represent a greater disease risk. Concentrations of indicator bacteria in wet weather pollution usually number in the millions, and hence, dilution is rarely sufficient to eliminate all potential risk. Therefore, increased public health risks from wet weather pollution is a potentially serious issue. At times, the concern may be only transient and local (near discharge location), but in many systems the concern may extend for miles and days beyond the discharge. In all cases, wet weather pollution risks to public health should be given the highest priority.

4.4.3 Aesthetic Deterioration

Aside from physical/chemical contamination and public health risks, wet weather pollution can also impair the aesthetics of receiving waters. Wet weather pollution can contain an assortment of debris from runoff and wastes from sanitary sewage that are obvious and unsightly. Increased suspended solids, sanitary debris, plastics, floatables, and oils and grease are generally associated with wet weather pollution. Such debris is common to all receiving waters, but may persist for different periods depending on the current strength and dilution. Although aesthetic impairment may not reduce aquatic health or cause obvious human health risk, it does have socioeconomic significance. Debris and suspended solids from wet weather pollution can reduce recreational use and appreciation of receiving waters, thereby limiting recreational expenditures and near-shore development. Increased suspended solids can cause reduced water clarity, which also affects recreational use. Because aesthetics are typically an integral component of a water's designed use, aesthetic impairment can be considered a violation of water quality standards. Quantitative measures of aesthetic reduction are rare, but visual observations and resident interviews often adequately define the scope of the problem.

4.5 Monitoring/Modeling of Impacts

In every wet weather pollution abatement study, there is a recurring debate on the best means to define impacts and benefits of alternative control strategies. Should it be monitoring or modeling? Practically speaking, it is not an either/or decision, but rather how much of each. The two activities need to be balanced and designed for an integrated assessment. Monitoring is needed to identify existing problems, define baseline conditions, and support the development of reliable and verified mathematical models. Nothing provides stronger evidence of existing receiving water impacts than actual measurements and observations. However, monitoring alone has limitations; therefore, modeling should generally be used to complement monitoring and to forecast and analyze conditions other than those monitored.

4.5.1 Monitoring Impacts

Receiving water monitoring to document wet weather effects requires an integrated approach combining biological, chemical, and physical parameters, especially considering the biological community, the physical habitat, aesthetics, human health, contaminated sediments, and ambient water quality. Relying on water quality alone may be misleading. Monitoring programs should include initial wet weather pollution reconnaissance surveys involving a few stations downstream of a discharge and at least one station upstream. The reconnaissance monitoring should be conducted during seasons expected to encompass the most significant impacts and extend from a day before a storm to as much as four days afterwards. Parameters should include BOD, dissolved oxygen, temperature, bacteria, and other parameters suspected of having impacts, plus visual observations for debris and floatables. Occasionally, routine fixed-frequency monitoring data can be used to assess trends, the presence of impacts, and the periods or seasons when the receiving water is most susceptible to wet weather pollution. However, most often the timing of the fixed-frequency sampling does not coincide well with storm impacts. Therefore, surveys should be designed with this specific need in mind.

The reconnaissance surveys should be used as a basis to design more intensive surveys in terms of sampling location, duration, and frequency. Subsequent to the reconnaissance survey(s), at least two or three additional intensive surveys are recommended to better define impacts for different conditions and support model development. Often, impacts are only evident for large storms and not apparent for the smaller events. Hence, multiple surveys are recommended for defining the recurrence of problems and representing a fuller range of conditions.

In general, station locations and frequency for intensive surveys must be in sufficient numbers to clearly define spatial and temporal trends. Sufficient usually means sampling every 3 - 6 hours at stations located with time of travel between locations of approximately 6 - 12 hours. In rivers, the sampling logistics are the simplest because all impacts flow downstream. Station locations and timing are easy to define. For estuaries, choosing station locations is still relatively easy, but consideration of tidal movement and timing becomes important. Sampling at fixed times in each tidal cycle (usually a slack) are most desired to help standardize analysis and presentation of the data. For lakes, timing is less difficult, but station locations are more difficult to select due to multidimensional and sometimes erratic transport. In lakes, drogue or current studies can be used to define current transport. The circulation patterns in a lake may vary depending on wind stratification and other variable factors. Therefore, a network of lake stations should be set up to encompass the probable horizontal and vertical transport directions. Preliminary data can be used to refine the sampling network. Also, reconnaissance data may show minimal localized effects, in which case coarse whole-lake sampling may be more appropriate than a localized network. In all cases for rivers, estuaries, and lakes, the reconnaissance sampling is indispensable for defining adequate station locations and sampling frequency.

The sampling parameters should focus on the anticipated wet weather pollution related problems. However, all wet weather pollution impact surveys should routinely include measurement of bacteria, dissolved oxygen, BOD, and ammonia. Temperature and visual observations of cloud cover, sunlight, water transparency, floatables, debris, and other conditions are inexpensive and should also be routine. Daily composites are usually suitable for other parameters such as nutrients and chlorophyll. Toxic substances, such as trace metals, typically need only be measured immediately before the storm to define pre-storm conditions, immediately after the storm to define maximum impacts, and at the end of the survey to determine persistence. Diurnal dissolved oxygen variations due to photosynthetic activity can be very important and, if present, generally dictate the need for continuous monitoring and/or station measurements at 3-to-5-hour intervals. Photosynthetic activity can often confuse or mask the interpretation of wet weather pollution impacts on dissolved oxygen, especially since a reduction in both sunlight and photosynthesis usually accompanies storms. Therefore, if high productivity is present, careful evaluation of diurnal and light conditions is essential.

Some special note should be made concerning the scheduling of storm event monitoring. Obviously, it is impossible to "plan" for storms to occur conveniently for sampling, and it is also generally impractical to use automatic samplers for the receiving water. Therefore, a well-developed mobilization plan is essential to capture immediate post-storm impact, since impacts related to solids, bacteria, and toxins are best captured immediately after the storm, during the first flush of pollutants from the sewers. Weather forecasting services and routine fixed-frequency monitoring programs can also be valuable sources of pre-storm data and for identifying cumulative impacts.

4.5.2 Modeling Impacts

With data in hand, the planner/engineer can proceed to more fully analyze a wider range of conditions after developing and calibrating a mathematical model. Models are well suited for providing information not available from data alone. In particular, models can be used to simulate water quality for conditions not monitored. This could include larger, more intense storms, or more critical environmental conditions such as lower stream flow. It is generally infeasible to simply extrapolate to non-monitored conditions from data due to the large number of variable factors without the use of modeling. Modeling incorporates the mechanistic factors of a relationship, thus enabling more reliable projections under various conditions. The advantage of modeling is that virtually all such conditions can be assessed quickly. Furthermore, models can be used to examine impacts and benefits from proposed control strategies.

4.6 Cost-Effectiveness Analysis

In simple terms, a cost-effective solution is one in which the most value is received for money expended. When benefits are plotted against costs, the break, or the "knee" of the curve, is that point where additional benefits result in more rapidly rising unit costs, or the period beyond which there are diminishing returns, as illustrated by Figure 4-3. This approach becomes particularly important in light of the dwindling nature of federal and state monies and the greater reliance on local monies. Local authorities will require more information on the return on a major investment to improve water quality when making a decision regarding abatement alternatives.

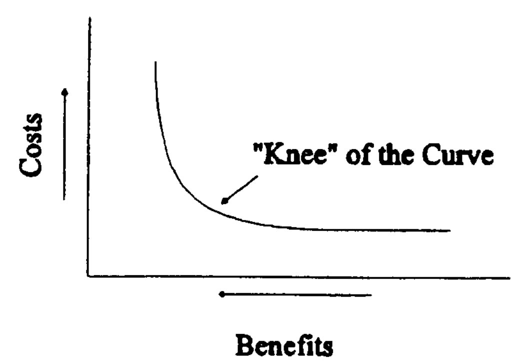

Figure 4-3. Cost-benefit Knee of the Curve

4.6.1 Benefits

There are four general methods for estimating benefits of water quality management projects (EPA-625/4-79-013):

1. The first method assumes that benefits will automatically be realized from the proposed activity and are large enough to justify the allocation of required resources. It completely avoids the benefit measurement problem. An example of this method is the federal requirement for secondary treatment at POTWs (i.e.,WWTPs).
2. In the second method, certain water quality standards are associated with the protection of water uses. Once standards to protect desired beneficial uses have been established, the comparison of projected water quality with the standards provides an estimate of benefit.
3. In the third method, estimates of increased water use potential are developed by translating improvements in water quality into numerical increases in usable length of beaches, swimming days, fishing days, or waterfront property values, to name a few possibilities. This method is, in effect, a refinement of the water quality standards approach, allowing benefits to be estimated directly.

4. The best known method is the classical cost-benefit analysis. In this method, each anticipated water usage has a dollar value assigned as a measure of unit worth or willingness to pay. The actual project usages are multiplied by the corresponding unit values, and the sum is compared directly to total project costs.

The first approach is unacceptable for wet weather pollution control planning because the benefits are not obvious; they are highly contingent on both SW volumes and the receiving water. The second approach poses a near-impossible situation for regulatory agencies to address, particularly during storms when the overflow and receiving waters are both changing rapidly. Using the second and third approach together (i.e., relating mandated water quality requirements to lost resources and real benefits of recovery) appears to offer the most effective means of obtaining approvals and funding from all levels. The fourth approach involves a great deal of subjectivity and could result in lengthy dialogue over the unit worth of various usages on both the local and regulatory levels.

4.6.2 Design Conditions

Once data are gathered and modeling is performed to characterize wet weather pollution and identify water quality impacts, a basic decision becomes necessary: What combination of storm event and receiving water conditions should be selected for abatement? To answer this question, the joint probability of a specific storm occurring at a specified receiving water stage must be understood. For example, a 1-year storm occurring during a high river stage condition may easily exceed a once in 10-year occurrence. Thus, it becomes necessary to review rainfall records in combination with receiving water flow records before selecting design conditions.

4.6.3 Methodology

This section outlines a general methodology for determining cost-effective solutions. The general approach for analysis of wet weather pollution abatement is illustrated in Figure 4-4.

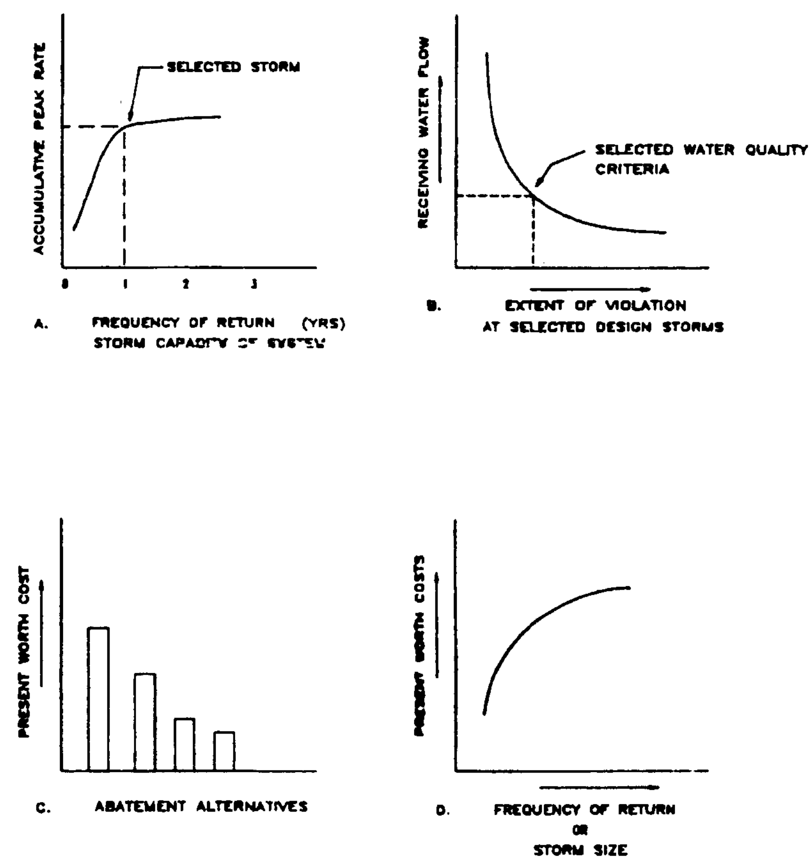

Figure 4-4. General Approach for Cost-Effective Analysis

Subfigure A illustrates the relationship between total volume discharged from a system and accumulative peak rate versus the storm size in terms of frequency of return. Generally, frequency of return is based on a constant duration such as two hours and varying rainfall intensity. The Storm Water Management Model (SWMM) can be used to develop total volume discharged, which represents total discharges irrespective of their location. This model is valid for developing a uniform set of design conditions throughout a system. In large systems with a wide range of receiving water types (e.g., small streams and large bays), it may be desirable to develop this relationship for each specific water body. Such a curve can also be developed for an accumulative peak rate, which is the summation of peak rates of all discharges at a given frequency storm, irrespective of the timing of the peak. This parameter is an indication of the peak carrying capacity of the system and complements the plot of total volume. These data can then be plotted to yield a curve as illustrated by Subfigure A, which can be used to designate the "selected storm" storm condition. At some storm frequencies, the system can no longer accept more SW flow, resulting in street ponding and either subsequent discharge to the system or evaporation or infiltration into the ground.

Subfigure B illustrates the relationship between receiving water flow and the extent of violation at the selected design storm (e.g., 1-year frequency of return). This relationship must be plotted for each of the water quality parameters of concern. This particular curve is more illustrative of the relationship for bacteria where the degree or extent of violation increases as the dilution from water flow decreases. At some point in the decision-making process, a receiving water flow must be selected which is reasonable when combined with the probability of the particular storm frequency chosen. A reasonable receiving water flow might represent the dry months of July, August, and September, when the highest intensity storms are expected. Once the evaluation for each of the water quality parameters is performed, the required removals can be determined.

Subfigure C, given the removals required, can then be developed on the basis of specific abatement technology. Various abatement alternatives that would accomplish the same reductions can be evaluated with respect to present-worth costs. Costs have been selected merely as a comparative term. In many cases, the Y-axis may represent a combination of regulatory, institutional, and local requirements, in addition to costs.

Subfigure D, given the selected abatement alternative, is a plot of the variation of different-sized facilities for that alternative, as required to treat different sized storms against the relative costs. In this way, a final evaluation of the most cost-effective sized facility can be determined.

4.6.4 Financial Capability Assessments

A community's financial capability is particularly necessary in the case of wet weather pollution abatement because there are no clear standards in most states, and the selection of a "design" storm has become a subjective decision based upon cost-benefit relationships. Additionally, other pollutants from a watershed may preclude the attainment of the fishable-swimmable goals of the Federal Clean Water Act Amendments of 1972.

A community's financial capability may be assessed by identifying the following seven factors:

1. median household income,
2. total annual wastewater and wet weather pollution abatement control costs per household as a percent of median household income,
3. overall net debt as a percent of full market property value,
4. property tax revenues as a percent of full market property value,
5. property tax collection rate,
6. bond rating, and
7. unemployment.

In 1996, the U.S. EPA released a draft guidance document on economic capability for communities with CSOs. The document, "Draft CSO Guidance on Financial Capability Assessment and Schedule Development," established boundaries for compliance schedules for CSO communities implementing U.S. EPA's national CSO policy. Although this information was written with respect to CSO, it is applicable to all wet weather pollution.

The following is a summary of the guidance developed by the CSO Partnership (The CSO Bulletin, April 1996).

The guidance proposes a two-step approach for calculating economic capability. The first step focuses on the financial impact of current and proposed wastewater and CSO controls on individual households. The second step examines the debt, socioeconomic, and financial condition of a CSO community. The results of both steps are then

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combined into a "Financial Capability Matrix" which is used to assess the financial burden attributable to CSO controls and to establish what U.S. EPA views as appropriate compliance schedules.

The first step calculates a residential indicator (RI), a measure of the CSO community's average cost per household for existing and proposed wastewater treatment and CSO controls, expressed as a percentage of local median household income (MHI). The guidance proposes establishing three ranges for RIs with RIs of less than 1 percent MHI characterized as imposing a "low" financial impact, RIs from 1 or 2% of MHI imposing a mid-range impact and RIs above 2% of MHI imposing a high impact.

The second step considers a community's financial capability indicators. U.S. EPA specifies six proposed indicators in the guidance for evaluating community debt, socioeconomic, and financial conditions that affect a community's financial capability to implement CSO controls. The results of the six indicators are used to classify the community's financial capability as "weak," "mid-range," or "strong."

The results these two steps are then combined in a financial capability matrix that provides the basis for the permittee and NPDES permitting authority to negotiate an appropriate compliance schedule. The financial capability matrix divides communities into three categories based upon their calculated burden under the guidance (low, medium, or high), with equal weight given to the community's RI and financial capability indicators.

Finally, the guidance proposes the following general boundaries for compliance schedules based upon a community's calculated burden:

Low burden:	0 - 5 year compliance schedule
Mid-range burden:	5 - 10 year compliance schedule
High burden:	10 - 15 year compliance schedule

According to the U.S. EPA guidance, communities in the "High burden" category may be able to negotiate compliance schedules as long as 20 years.

The lack of supporting information to explain and justify U.S. EPA's selection of the residential indicator categories and the financial capability indicator categories will make it difficult to evaluate whether the proposed categories are appropriate for CSO communities nationwide. For example, U.S. EPA does not provide any discussion of the number of CSO communities that can be expected to fall into the three categories proposed in the Financial Capability Matrix (low, mid-range, or high burden). Also, it is unclear how U.S. EPA arrived at its proposed ranges for the compliance schedules for communities falling within the three categories of financial burden.

An example of how a financial analysis can be performed is illustrated in the case history of Syracuse, N.Y. (Section 5.2.5).

CHAPTER 5.0

CSO Benchmark Data and Case Histories

5.1 Benchmark Data for CSO Communities

The following section includes benchmark matrices for general CSO community statistics (Table 5-1), CSO public participation (Table 5-2), CSO systems characterization (Table 5-3), issues driving CSO technical considerations (Table 5-4), and CSO financial considerations (Table 5-5).

5.2 Case Histories for CSO Communities

Case histories for CSO communities include Atlanta, Ga., Augusta, Me., Decatur, Ill., San Francisco, Calif., and Syracuse, N.Y. Each community represents an important and distinct element of the CSO abatement process. For example, the Atlanta case history highlights CSO policy interpretation, Augusta highlights the cost-benefit analysis, Decatur highlights one of many technical approaches, San Francisco highlights the evolving funding basis for CSO abatement, and Syracuse highlights a staged construction approach that meets the presumption and demonstration approaches of the federal CSO policy.

CSO Community Characteristics

♦ Population	700,000
♦ CSO Area	> 10,000 Ac
♦ Annual Rainfall	50"
♦ # of Discharge Points	7

Distinctive CSO Community Attributes

- Existing natural drainageways used as original sewers
- Intensive legal negotiations
- CSO policy interpretation

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Table 5.1 CSO Community Statistics

City	Astoria, OR	Atlanta, GA	Auburn, NY	Augusta, ME	Buffalo, NY	Chicago, IL	Cincinnati, OH	Cleveland, OH	Columbus, GA	Decatur, IL	Detroit, MI (Detroit R.)	Detroit, MI (Rouge R.)	Gardiner, ME	Hartford, CT	Louisville, KY	Mt. Clemens, MI	Newport, RI	New York City, NY	Portland, OR	Rochester, NY	Rockland, ME	San Francisco, CA	Seattle, WA	Syracuse, NY	Washington, D.C.	Winnipeg, Manitoba
Receiving H2O Type																										
Estuary	◆																◆						◆		◆	
Harbor																	◆	◆			◆	◆	◆			
Lake					◆	◆		◆		◆										◆						
Ocean / Bay																						◆	◆			
River	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆			◆		◆	◆
Stream		◆		◆				◆	◆				◆										◆	◆		
Population																										
<500,000	◆		◆	◆	◆				◆	◆			◆	◆	◆	◆	◆		◆	◆	◆			◆		
500,000 - 1,000,000		◆					◆	◆			◆	◆											◆		◆	◆
>1,000,000						◆												◆				◆				
CSO Area																										
<1,000 Ac			◆	◆									◆								◆					
1,000- 10,000 Ac	◆								◆	◆						◆	◆			◆				◆		
>10,000 Ac		◆			◆	◆	◆	◆			◆	◆		◆	◆			◆	◆			◆	◆		◆	◆
Annual Rainfall																										
0-20"																										◆
20-30"																						◆				
30-40"			◆			◆		◆			◆	◆				◆				◆			◆	◆	◆	
40-50"		◆		◆	◆		◆		◆	◆			◆	◆	◆		◆	◆	◆		◆					
> 50"	◆																									
# of Discharges to Public Waters																										
<10		◆	◆							◆			◆				◆			◆	◆					
10-50	◆			◆					◆		◆	◆		◆		◆						◆				
50-100					◆														◆				◆	◆	◆	◆
>100						◆	◆	◆							◆			◆								
Annual Wet-Weather Discharge Qty.																										
<10 MG													◆			◆	◆			◆						
10-100 MG			◆	◆																	◆					
100-1,000 MG	◆									◆													◆			
>1,000 MG		◆			◆	◆	◆	◆	◆		◆	◆			◆			◆	◆			◆		◆	◆	◆
Not Answered														◆												

Questionnaire Date: July 1998.

5.2.1 Atlanta, Ga.

Atlanta is a typical case where small, intermittent streams and rivers evolved into combined sewers. Before the city developed, these streams flowed from what is now the center of the city either west to the Chattahoochee River and on to the Gulf of Mexico, or east to the South River and on to the Atlantic Ocean. As the city grew, sanitary flows and SW were discharged into these waterways. Odor and health concerns led to the enclosure of the streams in pipes that became the present-day combined sewer system. As the city continued to expand, construction of combined sewer systems ceased and separated systems were initiated. The city's combined sewer system is located in the older, central business district and serves as headwaters to several small streams.

Improvements are currently being made to the WWTPs to meet effluent phosphorous limits (not to exceed 0.64 mg/l). In addition, the Georgia Environmental Protection Division is calibrating a new model that will be used to derive TMDLs. The results of this model may affect future permitting. The model considers the urban streams that are a direct result of overflows as point sources to the Chattahoochee.

Georgia first issued NPDES permits for CSO discharges in 1992. Atlanta's NPDES permits for all CSO treatment facilities are identical. The permits require that CSOs not violate water quality standards.

Atlanta's first CSO treatment facilities were built in the mid-1980s to address water quality problems in the South River Basin. The controls included two first-flush storage and treatment facilities and two small sewer separation projects. Additionally, five on-line screening and disinfection facilities were designed in 1989 to control CSOs in the Chattahoochee River Basin.

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Table 5.2 CSO Public Participation

City	Astoria, OR	Atlanta, GA	Auburn, NY	Augusta, ME	Buffalo, NY	Chicago, IL	Cincinnati, OH	Cleveland, OH	Columbus, GA	Decatur, IL	Detroit, MI (Detroit R.)	Detroit, MI (Rouge R.)	Gardiner, ME	Hartford, CT	Louisville, KY	Mt. Clemens, MI	Newport, RI	New York City, NY	Portland, OR	Rochester, NY	Rockland, ME	San Francisco, CA	Seattle, WA	Syracuse, NY	Washington, D.C.	Winnipeg, Manitoba
Level of Participation																										
Proactive	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆		◆	◆			◆	◆		◆	◆	◆			◆
Reactive																				◆						
Minimum required by Law										◆			◆			◆	◆							◆	◆	
Type of Participation																										
Brochures / Pamphlets	◆	◆						◆			◆	◆		◆	◆				◆	◆		◆	◆			◆
Newsletters		◆		◆				◆			◆	◆		◆	◆				◆	◆		◆			◆	◆
Public Addresses thru Media			◆	◆							◆	◆		◆	◆			◆		◆	◆		◆			
Telephone Hotline											◆	◆											◆			
Public Hearings/Meetings	◆	◆	◆	◆		◆		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Education & Awareness	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆		◆	◆				◆				◆			◆
Special Committee	◆	◆						◆	◆		◆	◆	◆					◆	◆	◆	◆		◆			◆
Public Concerns																										
Recreation				◆		◆		◆					◆	◆	◆	◆	◆		◆	◆	◆		◆		◆	◆
Aesthetics		◆				◆	◆	◆			◆	◆		◆	◆		◆	◆	◆	◆			◆		◆	◆
Facility Construction		◆				◆	◆	◆			◆	◆		◆	◆			◆		◆		◆				
Cost for Abatement	◆	◆	◆			◆		◆			◆	◆			◆				◆			◆			◆	
Street & Basement Flooding						◆		◆		◆				◆	◆	◆										◆
Public Health		◆	◆				◆	◆						◆					◆				◆			
Water Quality		◆		◆		◆		◆	◆	◆	◆	◆	◆	◆					◆	◆	◆		◆		◆	
Minimal																								◆		◆

Questionnaire Date: July 1998.

Before the facilities were constructed public dissension grew and the state legislature passed a bill mandating that "discharges from CSOs shall not cause a violation of water quality standards." As a result only three of the five CSO treatment facilities were constructed as originally designed and delays in construction caused the city to incur significant fines.

Citizen concerns continued and in 1996, a lawsuit was filed against the city claiming that CSOs violated water quality standards for metals and fecal coliform. In 1997, a federal district judge ruled in favor of the plaintiffs, saying that the concrete culverts into which CSOs discharge are waters of the state and therefore must meet water quality standards. The district court ruling and subsequent consent order are currently in negotiation. Various improvements to the CSO facilities include storage and treatment, relocation of outfalls, and separation. These improvements are estimated to cost between $400 to $600 million.

Motivated by the public dissension, in 1996 the Metro Atlanta Watershed Initiative was started to deal with citizen concerns and regulatory ambiguity; integrate and prioritize CSO controls to best use available money; and coordinate city agencies and stakeholders. As presented in Table 5-6, the watershed initiative faced many challenges.

The initiative started a comprehensive watershed study that was designed to determine the current conditions and uses of the urban streams, assess the type and magnitude of various impacts on these streams, and evaluate and recommend options for improving the water quality in the streams. However, the watershed study was dealt a major set back when a judge ruled that waters of the state begin at CSO discharges. Therefore, water quality standards need to be met in the small, intermittent streams that are solely produced by CSO discharges. As a result the watershed study was replaced by a mathematical model of the combined sewer system that simulates the impacts of the point-source CSOs.

Table 5.3 CSO Systems Characterization

City	Astoria, OR	Atlanta, GA	Auburn, NY	Augusta, ME	Buffalo, NY	Chicago, IL	Cincinnati, OH	Cleveland, OH	Columbus, GA	Decatur, IL	Detroit, MI (Detroit R.)	Detroit, MI (Rouge R.)	Gardiner, ME	Hartford, CT	Louisville, KY	Mt. Clemens, MI	Newport, RI	New York City, NY	Portland, OR	Rochester, NY	Rockland, ME	San Francisco, CA	Seattle, WA	Syracuse, NY	Washington, D.C.	Winnipeg, Manitoba
Mathematical Model for Flow Estimates																										
Yes	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
No					◆								◆													
Watershed Approach to Consider Other Wet-Weather Impacts																										
Yes		◆				◆		◆	◆			◆										◆	◆		◆	
No	◆		◆	◆	◆		◆			◆	◆		◆	◆	◆	◆	◆	◆	◆	◆	◆			◆		◆
Current Wet-Weather Abated Pollution																										
Municipal Point Source	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Industrial Point Source			◆	◆		◆	◆	◆		◆	◆	◆	◆						◆		◆	◆	◆	◆	◆	
Urban Runoff	◆	◆				◆		◆	◆		◆	◆		◆	◆				◆				◆		◆	◆
Agricultural Runoff											◆	◆			◆										◆	
Rural Non-Point															◆											
Future Wet-Weather Abated Pollution																										
Municipal Point Source	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Industrial Point Source			◆	◆		◆	◆	◆		◆	◆	◆	◆		◆				◆		◆	◆	◆	◆	◆	
Urban Runoff	◆	◆				◆		◆	◆		◆	◆		◆	◆	◆			◆			◆	◆	◆	◆	◆
Agricultural Runoff											◆	◆			◆							◆			◆	
Rural Non-Point															◆							◆				

Questionnaire Date: July 1998.

Current funding for the watershed initiative is $2.6 million. The City of Atlanta presently is the sole funding source, even though the watershed plan includes other communities and jurisdictions. The estimated cost for bringing the urban streams to good/fair standards for biotic indices, a goal created through the initiative, is approximately $1.4 billion.

References and Contacts:

U.S. Environmental Protection Agency and Water Environment Federation, *Draft Urban Wet Weather Case Studies*. Prepared for "Winning the Challenge of Urban Wet Weather Workshop," June 28, 1998, Cleveland, Ohio.

Ms. Tyler Richards, Operations Manager
City of Atlanta Wastewater Services
2440 Bolton Rd. N.W.
Atlanta, GA 30318

5.2.2 Augusta, Me.

The combined sewer area of Augusta, Me., comprises approximately 620 acres with 40 diversion structures and 29 active CSOs that discharge either directly to or into tributaries of the Kennebec River, which serves as an excellent fishery as well as a heavily used recreation area. Eleven alternatives were evaluated as part of the CSO facility plan. Evaluated storm frequencies were based upon the system capacity curves shown in Figure 5-1. Due to the large size of the Kennebec River, the primary water quality concern was bacteria.

Figure 5-2 illustrates maximum *E. Coli* concentrations in the Kennebec River at a minimal flow of 1,000 cubic feet per second (cfs) for different recurrence interval storms. As shown, the 1-year recurrence interval represents the knee of the curve. Consequently, a series of abatement alternatives were evaluated for the 1-year storm. Present-worth costs for several prime alternatives are illustrated in Figure 5-3. The least costly alternative included the construction of two satellite vortex facilities; however the second least costly alternative, which included a single vortex facility at the WWTP, was selected due to nonmonetary factors such as facility siting, the desire to avoid satellite facilities, and flexibility for future expansion or upgrades.

Table 5.4 Issues Driving CSO Technical Considerations

City	Astoria, OR	Atlanta, GA	Auburn, NY	Augusta, ME	Buffalo, NY	Chicago, IL	Cincinnati, OH	Cleveland, OH	Columbus, GA	Decatur, IL	Detroit, MI (Detroit R.)	Detroit, MI (Rouge R.)	Gardiner, ME	Hartford, CT	Louisville, KY	Mt. Clemens, MI	Newport, RI	New York City, NY	Portland, OR	Rochester, NY	Rockland, ME	San Francisco, CA	Seattle, WA	Syracuse, NY	Washington, D.C.	Winnipeg, Manitoba
Facility Plan																										
Completed			♦	♦		♦	♦	♦	♦	♦	♦	♦	♦			♦		♦	♦	♦	♦	♦	♦	♦	♦	
In Progress	♦	♦			♦			♦						♦	♦		♦						♦			♦
Reason for CSO Abatement																										
Planned Sewer Improvements				♦	♦		♦	♦		♦		♦	♦	♦	♦				♦	♦	♦		♦	♦	♦	
Regulatory Requirements	♦	♦	♦	♦	♦		♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Litigation / Lawsuit		♦	♦							♦	♦	♦						♦	♦					♦		
Significant Pollution Event						♦								♦		♦	♦					♦				
Regulatory Requirements																										
Demonstrative		♦		♦			♦	♦	♦	♦	♦	♦	♦	♦				♦			♦			♦		
Presumptive	♦	♦	♦			♦	♦	♦										♦	♦	♦		♦	♦	♦	♦	
Not Answered					♦										♦	♦	♦									♦
Receiving H2O Criteria																										
BOD		♦				♦				♦		♦		♦			♦						♦		♦	
Bacteria	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦	♦
Dissolved Oxygen		♦				♦		♦				♦			♦			♦					♦		♦	♦
Fish Kills																									♦	
Floatables	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦	♦	♦	♦		♦	♦	
Flow						♦																				
Metals		♦				♦			♦										♦							
Nutrients		♦				♦			♦														♦		♦	
pH																										
Solids		♦				♦			♦	♦		♦		♦	♦		♦	♦		♦			♦	♦	♦	
Abatement Tech Selection																										
Benefit-Cost Analysis	♦	♦	♦	♦			♦	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦	♦	♦	♦	♦	♦	♦
Regulatory Requirement		♦			♦	♦	♦	♦	♦		♦	♦					♦	♦	♦				♦			
Specified Storm																										
Selected Technologies																										
BMP's	♦	♦	♦	♦	♦		♦	♦	♦	♦	♦	♦	♦	♦	♦			♦	♦	♦	♦		♦	♦	♦	
Disinfection		♦	♦	♦	♦		♦	♦			♦	♦		♦	♦	♦			♦	♦	♦			♦	♦	
Flow Balance Method										♦														♦		
Flowslipping	♦			♦										♦												
Maximize Existing Treatment	♦			♦		♦		♦	♦				♦	♦								♦				
Netting								♦						♦	♦			♦						♦		
Rainleader Disconnection	♦		♦											♦												
Retrofitted WWTP			♦	♦				♦						♦								♦				
Screening		♦					♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦	♦					♦	
Separation	♦		♦	♦	♦				♦				♦	♦							♦		♦	♦		
Settling Tanks							♦	♦																		
System Storage (in)	♦			♦	♦	♦		♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦		
System Storage (out)		♦				♦	♦	♦		♦				♦	♦		♦	♦		♦		♦	♦	♦		
Vortex	♦		♦	♦			♦		♦	♦				♦	♦			♦			♦			♦	♦	
Selection In Progress		♦						♦																		♦

The selected alternative involves retrofitting the existing WWTP to include a CSO-related bypass to treat 44% of Augusta's current annual CSO volume. Other improvements involve constructing consolidation conduits, two CSO pumping stations, and a vortex treatment facility at the site of the WWTP. This solution has been approved by U.S. EPA and the State of Maine Department of Environmental Protection.

The retrofits to the existing WWTP include new headworks that contain mechanical screens and an aerated grit chamber; new distribution structures; and new high-rate disinfection technology. Currently, when peak flow at the WWTP approaches 9 million gallons per day (MGD), excess flow is bypassed to the chlorine contact tank after physical degritting. The retrofit improvements will allow the full 29 MGD of connected interceptor capacity to receive preliminary treatment. Daily maximum flows of 12 MGD will receive secondary treatment, and 17 MGD will receive primary treatment followed by high-rate disinfection.

Later phases of the CSO abatement program will include a consolidation conduit to intercept CSO discharges throughout the system and convey the flow to the WWTP; three new vortex separators at the WWTP; and additional high-rate disinfection volume at the WWTP. After all phases are completed, the total influent peak flow capacity to the WWTP will be increased from 29 MGD to 107 MGD. Up to 78 MGD will be treated in the vortex separators. The phases of the CSO abatement program are scheduled to be completed by 2009.

Table 5-5. CSO Financial Considerations

City	Astoria, OR	Atlanta, GA	Auburn, NY	Augusta, ME	Buffalo, NY	Chicago, IL	Cincinnati, OH	Cleveland, OH	Columbus, GA	Decatur, IL	Detroit, MI (Detroit R.)	Detroit, MI (Rouge R.)	Gardiner, ME	Hartford, CT	Louisville, KY	Mt. Clemens, MI	Newport, RI	New York City, NY	Portland, OR	Rochester, NY	Rockland, ME	San Francisco, CA	Seattle, WA	Syracuse, NY	Washington, D.C.	Winnipeg, Manitoba
CSO Area																										
<1,000 Ac			◆	◆									◆								◆					
1,000-10,000 Ac	◆								◆							◆	◆			◆				◆		
>10,000 Ac		◆			◆	◆	◆	◆		◆	◆	◆		◆	◆			◆	◆			◆	◆		◆	◆
# of Wet-Weather Facilities Built																										
Zero	◆			◆	◆		◆				◆				◆								◆	◆		◆
1-10		◆	◆					◆	◆	◆		◆	◆	◆		◆	◆	◆	◆	◆	◆				◆	
10-50						◆																◆				
50-100																										
>100																										
Estimated Past Cost																										
<10 Million	◆			◆									◆						◆		◆					◆
10-50 Million			◆							◆						◆								◆	◆	
50-100 Million									◆					◆				◆								
100-500 Million		◆					◆	◆			◆	◆			◆								◆			
>500 Million						◆														◆		◆				
Not Answered					◆												◆									
Estimated Future Cost																										
Abatement Complete. O&M Only			◆							◆			◆							◆		◆				
<10 Million																					◆					
10-50 Million	◆			◆												◆									◆	
50-100 Million																							◆			
100-500 Million							◆				◆			◆										◆		◆
>500 Million		◆				◆		◆				◆						◆	◆							
Not Answered					◆				◆						◆		◆									
Funding Source																										
City Funding									◆									◆								
Federal Grant Money		◆				◆		◆	◆	◆	◆	◆								◆		◆		◆	◆	
Increase Sewer Rates	◆	◆	◆	◆				◆	◆	◆	◆	◆	◆	◆		◆			◆	◆		◆	◆	◆	◆	◆
Increase Taxes						◆	◆		◆					◆				◆			◆	◆				
Innovative Technology Grant																									◆	
Investment Income form Bonds						◆																				
Revolving Loan	◆		◆	◆		◆		◆			◆	◆	◆	◆		◆				◆	◆	◆		◆		
State Grant Money			◆			◆				◆				◆						◆			◆	◆		
Currently Seeking Funds															◆											
Not Answered					◆												◆									

Cost Estimates ENR: 5921 July 1998
Questionnaire Date: July 1998.

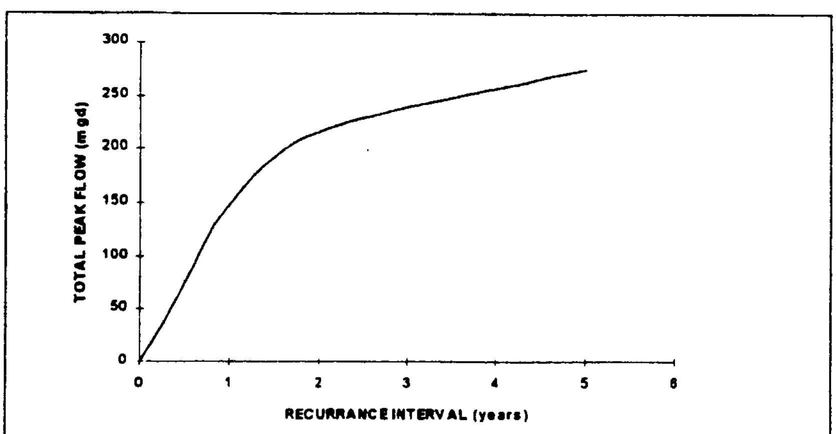
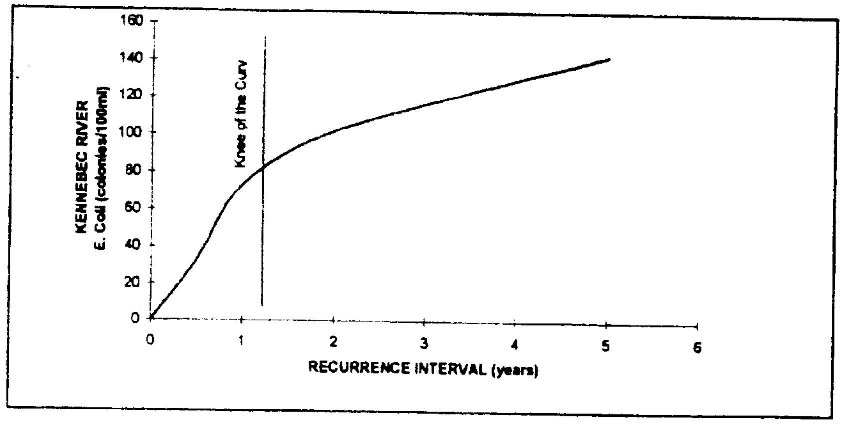


Figure 5-1. Recurrence Intervals vs. Total Peak Flow, Augusta, Maine



1. Assumes complete mixing of untreated CSO discharges
2. Using average CSO discharge concentration of 800,000 colonies/ 100 ml
3. Kennebec River flow at 1,000 cfs

Figure 5-2. Recurrence Interval vs. E. Coli Count, Augusta, Maine

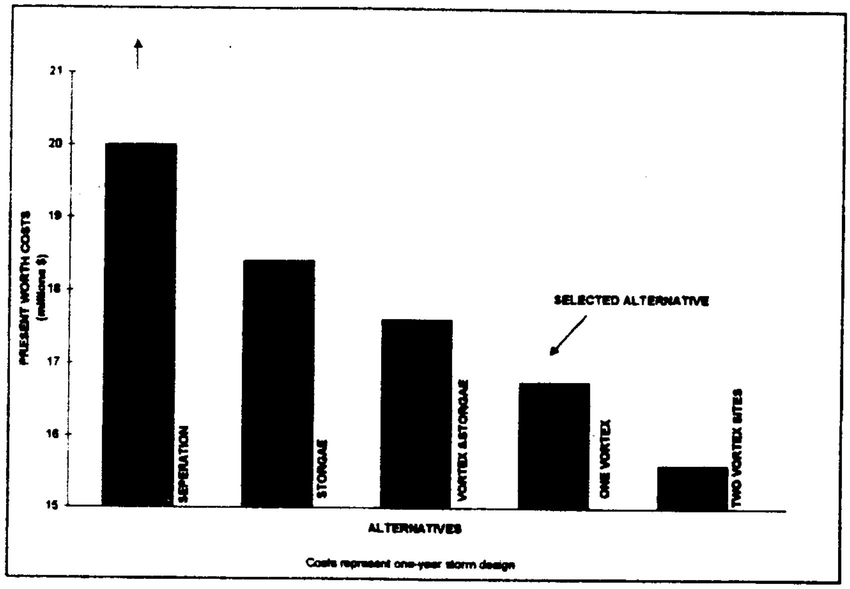


Figure 5-3. Present Worth Costs for CSO Abatement Alternatives, Augusta, Maine

Table 5-6. Watershed Initiative Diffucluties	
• Judicial interpretation of regulations	• Funding
• Litigation hampers open process	• Communication among organizations
• Many ancillary projects	

R0018445

References and Contacts:

Moffa, Peter E. (1997) *Control and Treatment of Combined Sewer Overflows*, Van Nostrand Reinhold, New York, N.Y.

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5.2.3 Decatur, Ill.

CSO Community Characteristics

♦ Population	95,000
♦ CSO Area	7,000 Ac
♦ Annual Rainfall	40"
♦ # of Discharge Points	4

Distinctive CSO Community Attributes

- CSO abatement program cmpleted in 1992
- Operation of full-scale CSO treatment facilities including one EPA swirl concentrator and six Fluidsep units

Decatur, Ill. is located in the center of Illinois along the Sangamon River. A dam on the river forms Lake Decatur, which serves as a recreational resource and public water supply. The area has a population of approximately 95,000 and has a heavily industrial economic base. The combined sewer area is surrounded on three sides by newer sanitary sewers and on the fourth side by Lake Decatur.

Prior to 1992, the CSO outfalls discharged directly downstream of the Lake Decatur dam. During the summer, brief rains caused the combined sewers to overflow; however, the rains did not produce enough runoff to cause the lake to spill over the dam. Therefore, the sewer overflows resulted in stagnant pools and subsequent fish kills.

The city and sanitary district began facilities planning in 1976. At that time the WWTP was frequently overloaded, standards violations were common, and there was no CSO treatment. Between 1976 and 1980 planning concentrated on the main WWTP. Beginning in 1980 CSO control and treatment became a topic of interest when the Illinois Environmental Protection Agency (EPA) documented that the CSOs were polluting the river and control was required.

In 1982 the Sanitary District of Decatur signed a federal consent decree which ordered the upgrading of the main WWTP, implementation of an industrial pretreatment program, and compliance with Illinois rules and regulations pertaining to CSOs. The consent decree set time limits for completing work in each area. The CSO control measures were to be completed by 1986, later extended to 1992. The extension helped the cash flow of both the Illinois EPA Grants Section and local government. The schedule also allowed for a step-by-step approach to the CSO improvements

The consent decree helped both parties. The sanitary district gained assurance of grant funding for the necessary work, avoided enforcement actions until the completion date, and obtained authority to issue bonds for local funding. The Illinois EPA benefited by having a federal court order to ensure compliance by a specific date and gained the cooperation of the Sanitary District.

The overall CSO control plan included four satellite treatment facilities: the McKinley Ave., Oakland Ave., Seventh Ward, and Lincoln Park CSO Treatment Facilities. The McKinley Ave. Facility was completed in 1986 and includes a 500,000-gallon first flush storage tank and a 40 MGD U.S. EPA vortex unit. The storage tank collects the first 500,000 gallons of CSO, which is later pumped to the WWTP. CSO beyond the first 500,000 gallons is diverted to the vortex unit. The Lincoln Park CSO facility was completed in 1992 and was the final and largest treatment facility. The Lincoln Park and McKinley Ave. facilities are similar in concept; however, Lincoln Park utilizes a 1.33 million-gallon storage tank and four Fluidsep vortex units capable of treating 416 MGD (see Figure 5-4). The total CSO control plan improvements cost $34.4 million, $20.5 million coming from state and federal grants and the balance coming from the local community.

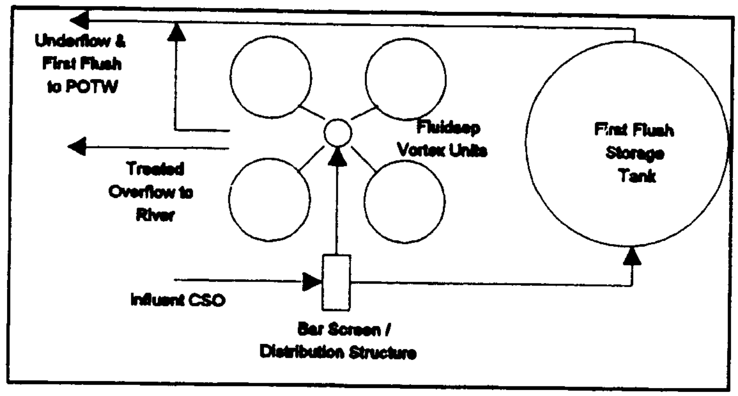

Figure 5-4. Lincoln Park CSO Treatment Facility

References and Contacts:

Bainbridge, Gee, Milanski & Associates Inc. and Crawford, Murphy & Tilly Inc. (1987) *Sanitary District of Decatur Combined Sewer Overflow Operational Study.*

Bainbridge, Gee, Milanski & Associates Inc. and Crawford, Murphy & Tilly Inc. (1995) *Lincoln Park Combined Sewer Overflow Treatment Facility Operational Study.*

Mr. Gary Hornickel, Technical Director
Sanitary District of Decatur
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Decatur, IL 62522

5.2.4 San Francisco, Calif.

CSO Community Characteristics

♦ Population	727,000
♦ CSO Area	25,000 Ac
♦ Annual Rainfall	21"
♦ # of Discharge Points	36

Distinctive CSO Community Attributes

- CSO abatement program cmpleted in 1997
- Diverse funding source
- Conversion of WWTP into wet weather pollution treatment facility

San Francisco is a city of 727,000 people located on a peninsula surrounded by the San Francisco Bay and the Pacific Ocean. Almost 100% of the city's 25,000 acres are served by a combined sewer system. Each of the 36 CSOs discharge into the San Francisco Bay or the Pacific Ocean. The city is highly urbanized, with a large central business district. Very little space is available for the construction of treatment facilities or large storage and conveyance systems needed to handle CSO.

R0018447

March, 1997 marked the completion of the major components of the city's wastewater facility improvement program. This construction program cost more than $1.4 billion dollars over a 20-year period. The earliest projects were funded by federal (68%), state (12%) and sewer service (20%) monies. Subsequent projects used state revolving funds and sewer service charges. One project used U.S. EPA marine CSO funds.

At the time of the 1972 Federal Clean Water Act Amendments, the City of San Francisco was planning improvements to its wastewater facilities. The State of California directed the city to undertake measures to reduce impacts from WWTPs and CSOs in the early 1960s. The city's first study of water quality impacts from CSOs was completed in 1967.

Motivated by federal and state policy and the need to improve its wastewater facilities, the city committed to upgrade secondary WWTPs and eliminate SW discharges along the shoreline within reasonable costs, times, and with minimal public disruption. To meet this challenge, the city developed a "Wastewater Master Plan" (1971) and an "Environmental Impact Statement and Report" (1974). The original plan was based on cost-benefit considerations; the resulting requirements closely matched those of the federal presumption approach.

San Francisco used a combination of in-line storage, off-line storage, and wet weather treatment. Wet weather treatment included primary treatment at the city's two WWTPs and conversion of a third WWTP to a wet weather facility. In addition the CSO storage boxes were designed to capture large settleable and floatable solids (see Figure 5-5).

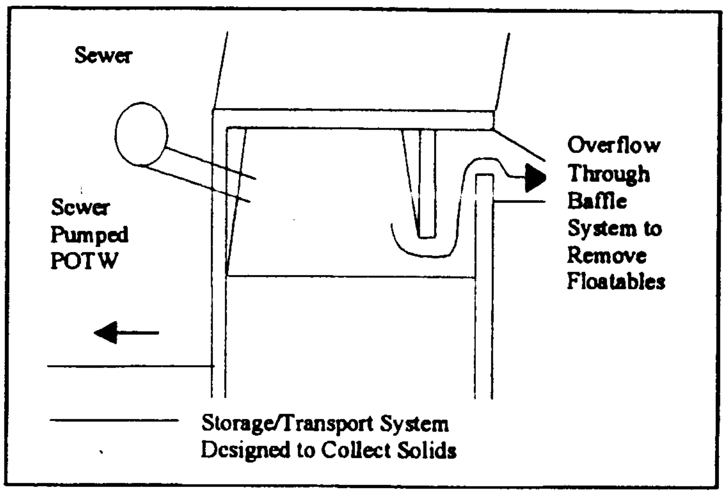

Figure 5-5. Typical Storage Boxes for San Francisco

San Francisco appears to be meeting the CSO frequency requirements (see Table 5-7). The number of days with elevated coliform levels dropped between 78% and 98%. An evaluation of a large CSO storage basin found a 33% reduction in total suspended solids and BOD through the storage and decanting of captured flows.

Table 5-7. San Francisco CSO Frequency Requirements

Waterbody	Frequency
Estuarine Shellfish Area	1/year
North Shore Area	4/year
Ocean Discharges	8/year
Maritime Area	10/year

References and Contacts:

San Francisco Public Utilities Commission (June 1997) *The Clean Water Act: 25 Years of Progress in San Francisco.*

Ms. Michelle Pla, Manager
San Francisco Public Utilities Commission
1212 Market Street, 2nd Floor
San Francisco, CA 94102

5.2.5 Syracuse, N.Y.

CSO Community Characteristics

- Population 475,000
- CSO Area 67,000 Ac
- Annual Rainfall 37"
- # of Discharge Points 66

Distinctive CSO Community Attributes

- Cost-benefit Analysis
- Staged construction that meets the presumption and demonstration approaches

The Syracuse is located in Onondaga County, N.Y. and has a population of 475,000. Approximately 40% of the city of Syracuse's 16,600 acres are served by a combined sewer system. Each of the 66 combined sewer overflows discharge into one of three receiving streams that are tributary to Onondaga Lake. Onondaga Lake has become a matter of national interest as one of the most polluted lakes in the country. This urban lake and its drainage area lie wholly within Onondaga County and serve as a good opportunity to assess CSO impacts within the context of an entire watershed.

After a period of more than 25 years of evaluating the CSO problem involving demonstrating various abatement technologies, characterizing the sewer system and receiving waters, implementing a BMP program and performing extensive cost-benefit analyses, a comprehensive CSO abatement program for the city of Syracuse, estimated at over $140 million, is underway. The final phase of this process began in 1988, when the county entered into a consent order, and was completed in 1996 upon its signing.

Between 1982 and 1984, the county instituted a successful BMP program. The results showed more than an 85% reduction in annual pollutants to the receiving waters. The major elements of the BMP program were: sewer cleaning, overflow-structure modifications, and sewer replacement to assure maximum system storage and conveyance to the Syracuse Metropolitan WWTP. Table 5-8 illustrates the improvements as a result of this $10 million BMP program.

Table 5-8. Pre & Post-BMP CSO Discharge Statistics, Syracuse, N.Y.

CSO Discharge Characterization	Pre-BMP	Post-BMP
Number of Events/Year	165	56
Annual CSO Volume (million gallons)	11,000	1,654
1-year Storm Volume (million gallons)	72	59
90 Percentile Storm Volume (million gallons)	54	40

Water quality concerns were investigated during the middle 1970s and verified in the early 1990s. These investigations utilized sewer modeling and flow monitoring combined with water quality sampling and analyses to estimate CSO loadings to receiving waters. Floatables and bacteria were the parameters of most concern. A bacteria model was also used to estimate the number of violations, defined as exceeding 200 fecal coliform per 100 ml, within the Onondaga Lake.

A limited watershed effort became necessary to put the CSO component of solids and nutrients in proper perspective. Agriculture comprises the major land actively outside of the city of Syracuse and the urban areas. Using a watershed model, solids and nutrient loadings were calculated for an average rainfall year (1991). Table 5-9 illustrates the loadings relative to the WWTP. The net result was that phosphorus, nitrogen, and solids were found to be of less significance than was thought before the watershed estimates were made.

Table 5-9. Pollutant Loading Summary to Onondaga Lake, Syracuse, N.Y.

Pollutant Source	Total Phosphorous (lbs)	Total Phosphorous % of Total	Total Nitrogen (lbs)	Total Nitrogen % of Total	Total Suspended Solids (lbs)	Total Suspended Solids % of Total
WWTP	134,320	31	5,752,620	80	1,167	7
CSO	16,800	4	25,432	2	3,739	22
Nonpoint	275,349	65	1,313,434	18	12,107	71
Total	426,469		7,201,486		17,013	

Several abatement alternatives were evaluated based on costs and benefits. The county chose regional treatment with vortex units and high-rate disinfection because it was the least costly alternative that met water quality standards. In addition, the plan includes netting devices for capturing floatables and restoration of an existing 5 MG storage facility.

High cost/benefit projects and projects designed to demonstrate effectiveness were scheduled in the initial phase. The scheduling of the projects became decisive in that the proposed regional facilities would ultimately meet both the presumption and demonstration clauses of the federal CSO policy. The next step in the process was to phase the construction of the facilities over a 15-year, build-out period to provide both a reasonable compliance schedule and an affordable cash flow. Figure 5-6 illustrates the compliance schedule.

References and Contacts:

Moffa, Peter E. (1997). *Control and Treatment of Combined Sewer Overflows.* Van Nostrand Reinhold, New York, N.Y.

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5.3 CSO Case Histories and Benchmark Data Discussion

5.3.1 General CSO Discussion

CSOs generally were recognized as a significant source of pollution in the late 1960s and specifically identified at the federal level through the landmark 1972 Amendments to the Federal Water Pollution Control Act. Much of the CSO work was started through federal R & D programs initiated in the early 1970s.

The activity directed toward CSOs has been greater than SSOs and SW owing to the earlier awareness and recognition of this type of pollution and, perhaps more importantly, the urgency associated with the health risks stemming from the sewage component. The intensity of regulatory and municipal activities sharply increased in 1989 when U.S. EPA published the draft National CSO Control Strategy. Until then, in the absence of clear guidelines, most municipalities were unwilling to forge ahead. Upon the release of the National CSO Control Policy in

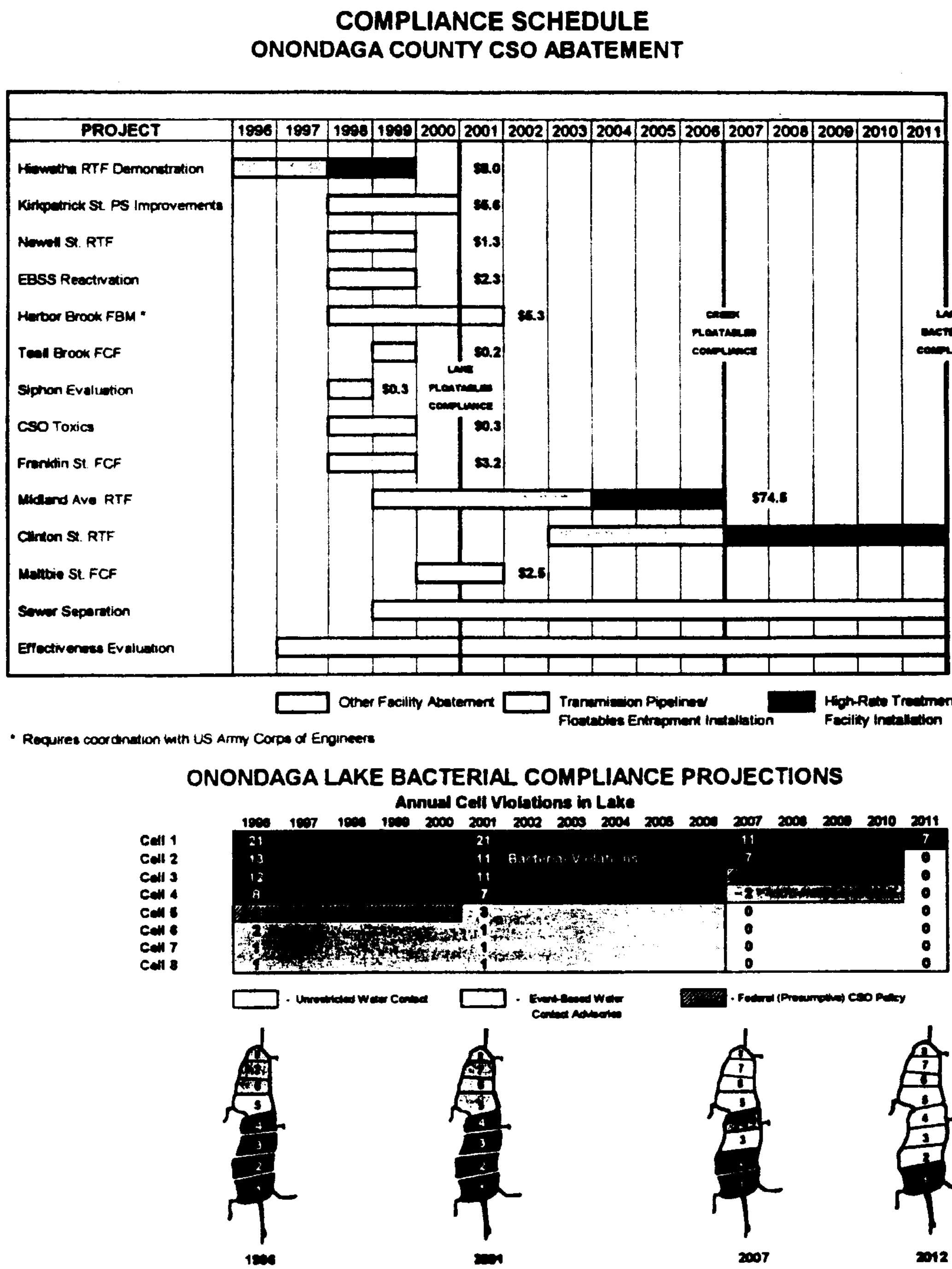

Figure 5-6. CSO Abatement Compliance Schedule, Onondaga County, N.Y.

1994, many CSO facility plans were revisited to determine compliance with either the presumption or demonstration provisions and to develop the required LTCP.

The most prevalent form of implementation has been BMPs due to the "housekeeping" nature of such steps and the low cost to benefit relationship. Reductions of annual CSO volume from BMP steps were reported as high as 90%.

Abatement beyond BMPs was implemented by only a limited number of communities prior to the national policy. In some cases, communities with high enough state priorities were able to take advantage of federally available grant funds. However, for the most part, abatement has taken place after 1989 and has not included federal grants. State revolving funds have become available in place of the previous U.S. EPA construction grants program.

As a consequence of little or no federal or state funding currently available for design and construction, financial considerations have become that much more important, resulting in a greater emphasis on cost/benefit evaluations and reviewing the affordability guidelines within the policy.

Most communities acted to abate their CSOs due to regulatory requirements which can take the form of permit renewals, administrative orders, or consent orders. Generally communities acted upon requirements more or less in that order.

There is a noticeable lack of consistency from case to case in setting permit parameters, which is understandable in consideration of their site-specific nature and related health risks. States should await site-specific information before setting permit limits.

5.3.2 CSO Questionnaire Findings

5.3.2.1 CSO Community Statistics

The communities included in these benchmark matrices represent a range of geographic locations, demographics, abatement strategies and schedules. The differences found between these communities stress the site-specific nature of CSO control and abatement.

Combined sewer systems serve roughly 950 communities with about 40 million people. Most communities with CSOs are located in the Northeast and Great Lakes regions, particularly in New England, Ohio, Illinois, Michigan, and New York. Although large cities like New York, Philadelphia, and Atlanta, have combined sewer systems, most communities with CSO problems have fewer than 10,000 people (EPA, 1998). Most sewer systems have evolved with the community, and therefore no two systems are identical. For example, some communities such as San Francisco are served entirely by combined sewer, while others, such as Atlanta, have a relatively old combined sewer system surrounded by a newer separated system. The wastewater/CSO characteristic for each community is different and is largely related to the economic base of the community. Some communities such as Detroit have an industrial economic base, while others like Auburn are residential and commercial in nature. The locations of CSO communities across the county are illustrated in Figure 5-7.

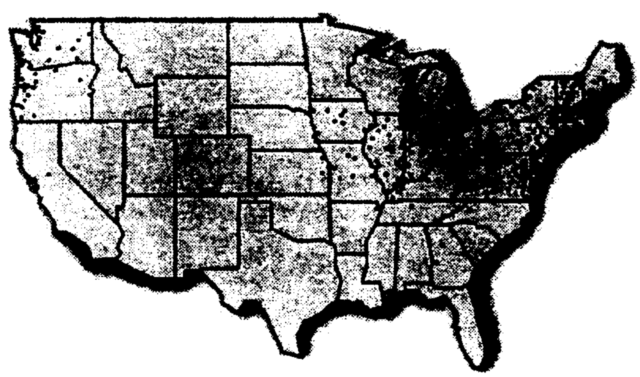

Figure 5-7. CSO Communities in the US. (EPA, 1998)

5.3.2.2 CSO Public Participation

Based on questionnaire responses, active public participation programs tend to be integrated with a watershed approach. For example, communities such as Atlanta and Detroit (Rouge River) have active public participation and watershed programs. Other communities that have public participation programs are: Astoria, Augusta, Chicago, Cincinnati, Cleveland, Hartford, Louisville, San Francisco and Winnipeg.

Public participation approaches for CSO abatement programs throughout the country appear to follow similar trends. The information provided by each municipality suggests that the public participation philosophy was established at or before the initiation of the formal CSO abatement program. At the beginning of the abatement process, a municipality either decided to actively include the public in the decision-making process or to include the public only as mandated by law. It is likely that the municipalities that identified themselves as "reactive" were including the public as required by law but increased public involvement as public demand grew. The most popular forms of public participation are newsletters, public hearings/meetings, and newspaper articles. The majority of the public was concerned about the effectiveness of the abatement strategy to meet water quality and associated aesthetics and recreational expectations. Construction impacts during implementation of abatement infrastructure were also a notable public concern.

From the viewpoint of the municipal agency, public participation programs can provide assistance but can also create obstacles. The clear advantage of engaging the public is recognizing and addressing public concerns early in the process, thus making the public a stakeholder. This process is best for the community in the long term; however, as in Atlanta, it may create ancillary work in the short term. Atlanta also noted that open public participation is difficult when litigation is brought by public stakeholders.

5.3.2.3 *CSO Systems Characterization*

Nearly all communities used a mathematical model to describe their sewer system. The U.S. EPA Storm Water Management Model tended to be the most preferred model. Communities have found that replicating the sewer system with a model can answer questions that would be impractical to answer through field measurements and observation.

Currently, however, most communities are focusing on abating only municipal and industrial point sources and not embodying the entire watershed and other pollution sources. Such action is driven by federal CSO policy and lack of policy for other types of pollution (e.g., agricultural runoff). The municipal and industrial point sources of pollution tend to be more easily controlled and managed at the source, whether it is at the end of a pipe in the case of a CSO, or a pretreatment program at an industrial site.

Many CSO communities are looking to the future and realizing the need to address nonpoint sources such as urban and agricultural runoff. As a result, these communities have used a watershed approach to prioritize pollutant sources and plan for the future but have not begun to use the watershed approach to abate pollution.

Some communities have initiated a watershed approach, including Atlanta, Chicago, Cleveland, Detroit and Syracuse. The watershed approach in Detroit has come to national attention. Wayne County is spearheading the watershed approach via the Rouge River National Wet weather Demonstration Project (Rouge Project) with funding from U.S. EPA and local communities. The Rouge Project oversees the 17 combined sewer overflow abatement projects (11 retention treatment basins and 6 sewer separation projects). These control technologies are currently being evaluated to help quantify their effect on the quality of the river and thereby suggest the most appropriate CSO method. The following are some findings from the Rouge Project (Rouge River National Wet Weather Demonstration Project, March 1998):

- *E. coli* concentrations discharged from the CSO treatment basins are small compared to the instream *E. coli* concentrations. Instream *E. coli* concentrations during wet weather are frequently above body contact standards due to non-CSO pollution sources.
- Dissolved oxygen sags are attributed to CSO treatment basin effluent and other non-CSO pollution sources
- Dissolved oxygen impairment during dry weather is attributed to a combination of high sediment oxygen demand and low re-aeration due to naturally flat river slope.
- CSO treatment basin effluent contributes 15% of instream BOD at points of discharge.

Because CSO control will not eliminate all pollution to the river, the Rouge Project is assessing and implementing nonpoint source controls as well and pollution prevention programs for watershed residents and businesses. Findings from this study will be shared with other urban watersheds.

Syracuse exemplifies a community that assessed pollution sources from throughout the watershed before developing abatement alternatives for CSOs. This evaluation included the use of a watershed model, sewer system model, and geographic information system to calculate solids and nutrient loadings. The major finding suggested that phosphorous loading from CSOs was less significant than loadings from the WWTP and agricultural runoff. Identifying that significant phosphorous loadings came from sources other than CSOs allowed the municipality to proceed with physical treatment and disinfection rather than storage for CSOs, representing a huge savings to the city.

5.3.2.4 *Issues Driving CSO Technical Considerations*

Most CSO communities have completed or are in the process of completing a long term control plan. However, some variability exists in the initiation of the plan. As documented in the 1994 federal CSO policy, the LCTP is to be submitted within two years of an enforcement action, which can take the form of a state permit (generally the most preferred) or a specific administrative or consent order. Many large communities, such as Boston and New York City, were targeted as high priorities by regulatory agencies. As such, enforcement actions were served even before the federal CSO policy was finalized. On the other hand, medium-sized communities, such as Gardiner, Me., were a lower priority to regulatory agencies and therefore were not served an enforcement action as early. In this same manner, small CSO communities may not have to complete a LCTP in the near future because of their low priority status. The CSO policy states, at the discretion of the NPDES authority, that communities with populations less then 75,000 may need to comply with only the nine minimum controls. Yet, still other communities, such as Rochester, N.Y., moved ahead with a LCTP before the CSO policy was developed. The motivation for such a progressive stance was the availability of federal and state grant money.

Most communities acted to abate their CSOs due to regulatory requirements. These regulations may be enforced by either the state government (delegated state) or by the U.S. EPA. Communities who have not completed a LTCP are generally required to complete the plan. Communities who have an approved LTCP are required to follow either the presumption or demonstration approach. If a community follows the demonstration approach, the critical permit requirements generally relate to an effluent standard. If a community follows the presumption approach, the critical permit requirements tend to specify some level of capture/treatment. Regardless of the approach bacteria and floatables tend to be the pollutants of most concern.

Some communities were motivated to abate their CSOs because of litigation. In the case Decatur, the litigation and resulting consent decree helped both parties. The Sanitary District gained assurance of grant funding for the necessary work, avoided enforcement actions until the completion date, and obtained authority to issue bonds for local funding. The Illinois EPA benefited by having a federal court order to ensure compliance by a specific date and gained the cooperation of the Sanitary District.

Almost the same number of communities followed the presumption approach as followed the demonstration approach; however, the majority of smaller communities followed the Presumption approach. The major advantage of the presumption approach is that it allows smaller communities that cannot afford extensive water quality monitoring and impact studies to proceed with abatement planning. Some larger communities proceed with presumption approach because it provides an opportunity to avoid any stalemate until a consensus is reached over water quality impacts. And yet some communities, with diverse combined sewer systems, used both approaches where appropriate.

The major receiving water criteria were floatables and bacteria. Solids and BOD follow, with nutrients and dissolved oxygen being the parameters of least concern. These criteria originate from public interest; however, they are enforced through the CSO policy and ultimately the Clean Water Act. It is clear that the public desires aesthetically pleasing waters (i.e., no floatables) that are safe for recreation (i.e., no harmful bacteria). These criteria are addressed in the CSO policy as part of the presumption and demonstration approaches. The presumption approach requires a community to meet any one of three predefined conditions, thereby presuming that water quality requirements are being met. The demonstration approach requires that water quality standards and designated uses be met on a case-by-case basis consistent with a LTCP, unless uses cannot be met as a result of other pollution sources (e.g., natural background conditions). Regardless of the approach, the obligation is to meet the requirements of the Clean Water Act, the protection of designated uses.

Generally the technology chosen by a community should and did reflect the site-specific nature/characteristics of CSOs within that community. The majority of the communities are planning to implement many different abatement technologies to most effectively meet water quality criteria. BMPs as prescribed by the nine minimal controls are currently the most popular form of CSO control. Implementation of BMPs has made a positive impact on water quality. For example, in Syracuse, BMP improvements such as sewer cleaning and raising weirs were implemented in the early 1980s to optimize flows to the WWTP. Comparisons of pre-BMP to post-BMP rainfall versus CSO overflow volume relationships showed a reduction in annual overflow pollutants of 85% to 90%. Many communities are in the process of planning for the implementation of structurally intensive solutions. In-system and offline storage, screening, disinfection, and vortex solid separators are the most popular control approaches among the communities responding.

5.3.2.5 *CSO Financial Considerations*

In the last 25 years, the federal government has spent more than $60 billion through grants and low-interest loans for the construction of WWTPs and sewer lines. States and municipalities have spent additional billions in matching funds for these improvements. A large percentage of the federally available funds was spent throughout the '70s and early '80s making improvements to WWTPs.

Some CSO communities took advantage of the federally available funds to abate CSOs while making improvements to WWTPs. In some respects this approach was uncertain because the federal CSO policy was in its infancy and no clear CSO related standards were available as guidance. A good example of this type of community is Rochester, N.Y., which moved to abate CSOs by separating the sewer system during WWTP improvements. The federal government funded almost the entire CSO abatement project. A small portion of Rochester's CSO abatement was completed without federal funds. The remaining CSO abatement included in-line and off-line storage, a more cost-effective approach reflecting the local funding source.

San Francisco started its CSO abatement program while federal funds were available and before the federal CSO policy was promulgated. However, San Francisco, being much larger than Rochester, could not implement a CSO abatement program as quickly. San Francisco started its program in 1978 and completed the major parts by 1997. As a result, San Francisco accepted funding from the entire range of available sources. The earliest projects were funded from approximately 68% federal, 12% state and 20% local sources. Subsequent projects used state revolving funds and local funds. One project used a special U.S. EPA marine CSO fund.

Many smaller communities such as Astoria and Augusta did not start their CSO abatement programs until the '90s. Their size and low priority, as discussed in the Issues Driving CSO Technical Considerations section, can explain this timing. Nonetheless, communities that began their CSO abatement programs in the '90s with the dawn of the federal CSO policy were too late to take advantage of federal grant money. These communities tended to rely on state revolving loans and local funding. As a result the local authorities required more information on the returns of these major investments to improve water quality before being willing to proceed. Also, these local authorities were more apt to challenge the legality of water quality standards. Owing to the greater sensitivity to costs, communities became more interested in satellite treatment as opposed to centralized treatment.

Selected abatement controls tend to reflect the source of funding. This may be illustrated by comparing the cost of sewer separation to satellite treatment such as vortex facilities. Sewer separation costs, including the cost for new SW treatment, for 6,813 acres in the City of Syracuse were estimated to be $612 million. Satellite treatment costs, including vortex units, netting devices and disinfection for the same area were estimated to be $144 million (Moffa & Associates, 1996). Obviously the cash flow for these approaches is very different. Sewer separation projects tend to be large up-front capital expenditures with smaller future operation and maintenance (O&M) costs, while satellite treatment tends to have smaller up-front capital expenditures with larger future O&M costs. Separate sewers also produce SW issues that need to be addressed.

CHAPTER 6.0

SSO Benchmark Data and Case Histories

6.1 Benchmark Data for SSO Communities

The following section includes a benchmark matrix for general SSO community statistics (Table 6-1), SSO public participation (Table 6-2), SSO systems characterization (Table 6-3), issues driving SSO technical considerations (Table 6-4), and SSO financial considerations (Table 6-5).

Table 6-1. SSO Community Charcteristics

City	Bloomington, IN	Flagstaff, AZ	Greenwood, SC	Hillsboro, OR	Houston, TX	Johnson County, KS	Kennebunk, ME	Laughlin, NV	Martinez, CA	New Orleans, LA	Oakland, CA	Oklahoma City, OK	Orange County, CA	San Diego, CA	Tulsa, OK	Wayne County, MI
Receiving H2O Type																
Estuary					◆		◆		◆		◆					
Harbor																
Lake			◆					◆		◆						
Ocean / Bay					◆		◆		◆				◆	◆		
River		◆	◆	◆		◆	◆	◆		◆		◆	◆		◆	◆
Stream	◆		◆	◆	◆	◆						◆				
Population																
<500,000	◆	◆	◆	◆		◆	◆	◆	◆			◆			◆	◆
500,000 - 1,000,000										◆	◆					
>1,000,000					◆								◆	◆		
SSO Area																
<10,000 Ac		◆						◆								
10,000- 100,000 Ac	◆		◆	◆		◆	◆			◆	◆					
100,000 -500,000 Ac					◆				◆			◆	◆	◆	◆	◆
Annual Rainfall																
0-20"		◆						◆	◆				◆	◆		
20-30"											◆					
30-40"				◆		◆						◆				◆
40-50"					◆		◆								◆	
>50"	◆		◆							◆						
# of Discharges to Public Waters																
Zero		◆		◆									◆			
<10			◆				◆	◆			◆				◆	
10-50	◆				◆	◆			◆	◆		◆		◆		◆
50-100																
>100																
Annual Wet-Weather Discharge Qty.																
<10 MG								◆					◆			
10-100 MG							◆								◆	
100-1,000 MG						◆			◆		◆					◆
>1,000 MG					◆									◆		
Unknown	◆	◆	◆	◆						◆		◆	◆			

Questionnaire Date: July 1998.

Table 6-2. SSO Public Participation

City	Bloomington, IN	Flagstaff, AZ	Greenwood, SC	Hillsboro, OR	Houston, TX	Johnson County, KS	Kennebunk, ME	Laughlin, NV	Martinez, CA	New Orleans, LA	Oakland, CA	Oklahoma City, OK	Orange County, CA	San Diego, CA	Tulsa, OK	Wayne County, MI
Mathematical Model for Flow Estimates																
Yes	◆	◆	◆	◆	◆	◆			◆	◆	◆		◆	◆	◆	
No							◆	◆				◆				◆
Watershed Approach to Consider Other Wet-Weather Impacts																
Yes	◆		◆	◆	◆	◆			◆		◆		◆		◆	◆
No		◆					◆	◆		◆		◆		◆		
Current Abated Wet-Weather Pollution																
Municipal Point Source		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Industrial Point Source		◆	◆	◆					◆				◆			
Urban Runoff				◆				◆	◆	◆	◆		◆		◆	
Agricultural Runoff				◆									◆		◆	
None	◆															
Future Abated Wet-Weather Pollution																
Municipal Point Source	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Industrial Point Source		◆	◆	◆					◆				◆			
Urban Runoff	◆		◆	◆				◆	◆	◆	◆		◆		◆	
Agricultural Runoff			◆	◆									◆		◆	

Questionnaire Date: July 1998

Table 6-3. SSO Systems Characterization

City	Bloomington, IN	Flagstaff, AZ	Greenwood, SC	Hillsboro, OR	Houston, TX	Johnson County, KS	Kennebunk, ME	Laughlin, NV	Martinez, CA	New Orleans, LA	Oakland, CA	Oklahoma City, OK	Orange County, CA	San Diego, CA	Tulsa, OK	Wayne County, MI
Level of Participation																
Proactive	◆			◆	◆			◆		◆	◆	◆			◆	
Reactive																
Minimum required by Law		◆	◆			◆	◆		◆				◆	◆		◆
Type of Participation																
Brochures / Pamphlets												◆				
Newsletters						◆										
Public Addresses thru Media						◆									◆	
Public Hearings/Meetings	◆			◆						◆	◆					
Educational & Awareness	◆			◆				◆				◆				
Special Committees	◆				◆						◆					◆
Not Answered		◆	◆				◆		◆				◆	◆		
Public Concerns																
Recreation										◆	◆		◆	◆		
Aesthetics													◆	◆		
Facility Construction																◆
Cost for Abatement								◆								
Flooding / Sewer Backups	◆	◆	◆	◆	◆							◆			◆	◆
Public Health																
Water Quality	◆	◆		◆	◆	◆		◆		◆	◆		◆	◆		◆
Minimal			◆				◆	◆	◆							
Uninterrupted Service		◆			◆							◆				

Questionnaire Date: July 1998.

Table 6-4. Issues Driving SSO Technical Considerations

City	Bloomington, IN	Flagstaff, AZ	Greenwood, SC	Hillsboro, OR	Houston, TX	Johnson County, KS	Kennebunk, ME	Laughlin, NV	Martinez, CA	New Orleans, LA	Oakland, CA	Oklahoma City, OK	Orange County, CA	San Diego, CA	Tulsa, OK	Wayne County, MI
Facility Plan																
Completed				◆	◆	◆	◆	◆			◆				◆	◆
In Progress	◆		◆						◆	◆			◆	◆		
Not Started / None		◆										◆				
Reason for SSO Abatement																
Planned Sewer Improvements	◆	◆	◆	◆		◆	◆		◆		◆	◆	◆	◆	◆	◆
Regulatory Requirements			◆	◆		◆	◆		◆		◆		◆	◆	◆	◆
Litigation / Lawsuit				◆	◆					◆						◆
Significant Pollution Event								◆								
Receiving H2O Criteria																
Bacteria	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆	◆
BOD	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆			◆			◆
Dissolved Oxygen		◆	◆	◆		◆	◆	◆	◆	◆	◆		◆			
Fish Kills													◆			
Floatables		◆	◆						◆				◆			
Nutrients		◆	◆	◆												◆
pH											◆					
Solids		◆	◆	◆				◆	◆				◆			
Toxins			◆										◆			
None												◆				
Abatement Tech Selection																
Benefit-Cost Analysis	◆		◆	◆	◆	◆		◆	◆		◆	◆	◆	◆		◆
Regulatory Requirement		◆		◆		◆	◆	◆			◆		◆		◆	◆
Specified Storm													◆			
Tech Not Selected										◆						
Selected Technologies																
I / I Reduction	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆
Increased Capacity at WWTP					◆	◆										◆
Preventive Maintenance			◆					◆	◆			◆				
System Storage (In)					◆								◆			
System Storage (Out)											◆				◆	
Wet-Weather Treatment Plant					◆	◆										◆
Tech Not Selected										◆						

Questionnaire Date July 1998

Table 6-5. SSO Financial Considerations

City	Bloomington, IN	Flagstaff, AZ	Greenwood, SC	Hillsboro, OR	Houston, TX	Johnson County, KS	Kennebunk, ME	Laughlin, NV	Martinez, CA	New Orleans, LA	Oakland, CA	Oklahoma City, OK	Orange County, CA	San Diego, CA	Tulsa, OK	Wayne County, MI
SSO Area																
<10,000 Ac		◆						◆								
10,000- 100,000 Ac	◆		◆	◆		◆	◆			◆	◆					
100,000 -500,000 Ac					◆				◆			◆	◆	◆	◆	◆
Estimated Past Cost																
<10 Million	◆		◆	◆			◆	◆	◆	◆		◆				◆
10-50 Million																
50-100 Million						◆										
100-500 Million											◆					
>500 Million					◆										◆	
Not Answered		◆											◆	◆		
Estimated Future Cost																
Abatement Complete. O&M Only					◆		◆	◆			◆	◆				
<10 Million			◆	◆												
10-50 Million	◆															
50-100 Million																
100-500 Million									◆	◆					◆	◆
>500 Million																
Not Answered		◆				◆							◆	◆		
Funding Source																
Municipal Funding									◆					◆		
Federal Grant Money										◆	◆					
Increase Sewer / Users Rates	◆	◆	◆	◆	◆		◆		◆	◆		◆			◆	
Increase Taxes															◆	
Innovative Technology Grant																
Investment Income form Bonds		◆	◆													
Revolving Loan	◆		◆			◆					◆				◆	◆
State Grant Money						◆										
Not Applicable Not Answered								◆					◆			

Cost Estimates ENR: 5821 July 1998
Questionnaire Date. July 1998

R0018459

6.2 Case Histories for SSO Communities

6.2.1 Bloomington, Ind.

SSO Community Characteristics

◆ Population	110,000
◆ Sewer Area	77,000 Ac
◆ Annual Rainfall	60"
◆ # of SSO Discharge Points	15

Distinctive SSO Community Attributes

- Formation of utulity specifically for wet weather flows
- Retrofitting decommissioned WWTP as for off-line storage of wet weather flows

Bloomington's 250 miles of sanitary sewer are separate from the storm sewer system. However, during wet weather, the "separate" sewer system overflows at a number of points in the collection system, backs up into basements, and violates the NPDES permit for WWTPs. Bloomington's wet weather problem has been ongoing since the formation of the utility in the early 1970s. A sanitary sewer evaluation survey performed in conjunction with U.S. EPA's construction grants program identified a number of pipe replacement projects. The most recent project increased the capacity of two large pump stations in the collection system where SSOs frequently occurred. Unfortunately, these pipe replacement projects have done little to reduce the impact of wet weather discharges. These impacts have, for the most part, merely been transferred downstream.

In 1996, Bloomington experienced significantly higher than normal rainfall and the resulting wet weather impacts for that year were excessive. Also, the South WWTP consistently exceeded its design flow, and preliminary planning efforts began to either expand or replace the existing plant. At this point, Bloomington recognized the need to better manage wet weather flows and establish a wet weather management program. The focus of the $26 million dollar program was to reduce infiltration/inflow (I/I). Sewer system rehabilitation and replacement, off-line storage, and WWTP expansion are some of the strategies being investigated to reduce wet weather impacts.

A wet weather focus group consisting of a cross section of interested citizens was formed in 1997 and assisted in the selection of an engineering consultant to manage the wet weather program. The focus group meets on a regular basis and advises the wet weather management team in pursuing wet weather reduction strategies.

Currently, Bloomington is evaluating a number of cost-effective strategies. The South WWTP will add capacity through a combination of physical and process improvements. The lagoons at the decommissioned WWTP near the center of the collection system will be converted for off-line storage of peak flows during wet weather. Rehabilitation and replacement of the sewer pipe and manholes will be more aggressive, particularly in three problem areas of the city where SSOs and basement flooding have been concentrated. A number of direct SW connections to the sanitary sewer system have already been identified and eliminated. Bloomington has also formed a local SW utility in an effort to comprehensively manage wet weather impacts. Formerly operated and maintained at a minimum level under the city's public works department, the new utility dedicates funds especially for the operation and maintenance of the SW system in addition to capital repair of the long neglected infrastructure.

References and Contacts:
Mr. Douglas T. Jones
City of Bloomington Utilities
1969 S. Henderson Street
Bloomington, IN 47404

6.2.2 Houston, Texas

SSO Community Characteristics

♦ Population	1,800,00
♦ Sewer Area	385,000 Ac
♦ Annual Rainfall	46"
♦ # of SSO Discharge Points	20

Distinctive SSO Community Attributes

- Selection of SSO controls based on flow and water quality monitoring
- Use of wet weather treatment facilities for SSO
- Stakeholder involvement created wide support

Located 40 miles inland of the Gulf of Mexico, Houston is the fourth largest metropolitan area in the United States. Houston experienced a period of rapid growth early in the 20th century after a shipping channel connected the city to Galveston Bay and the gulf, making it a deepwater port. Other than the channel, most of the surface waters in and around Houston are classified as bayous. However, as Houston's bayous approach Galveston Bay they become wider and more closely approximate shallow tidal wetlands. During periods of wet weather, the bayous fill rapidly and carry SW away from the city to Galveston Bay.

The city's wastewater system is one of the country's largest. Currently, the average daily wastewater treatment demand is 250 MGD. With a service area of 600 square miles, it incorporates 46 WWTPs, 377 lift stations, 5,700 miles of separate sanitary sewers, and 100,000 manholes. The city provides water and wastewater service to approximately 378,000 customers and a total population of nearly 1.8 million. Much of Houston's growth in the last 25 years occurred as the city annexed previously unincorporated county areas. This rapid growth exceeded WWTP capacity. By the late 1980s, moratoriums on new construction existed in 90% of the metropolitan area.

Houston received administrative orders from the Texas Natural Resources Conservation Commission (TNRCC) and EPA Region 6 in 1987 requiring the city to control SSOs and upgrade the collection system by December, 1997. The administrative orders resulted in an investment of $1.2 billion by the city of Houston in SSO control.

Houston invested $65 million between 1988 and 1991 to evaluate its collection system and conduct extensive flow monitoring. The physical analysis identified infiltration due to leaking joints, cracks, and breaks in the city's sewers and laterals on private property as the primary sources of the increased wet weather flows. In 1992, the Greater Houston Wastewater Program (GHWP) was formed as an integrated organization of city employees and consultant staff, developed specifically for complying with the mandates of state and federal regulatory agencies. In the absence of a national SSO policy, the GHWP, TNRCC, and EPA Region 6 had to consider two principal issues regarding control of wet weather SSOs. These were: (1) the level of design storm protection that the collection system would provide for customers; and (2) the level of treatment required for overflows in excess of the design storm flow, based on impact to receiving water quality.

In 1994, Houston completed a water quality study of local receiving waters (bayous) for the purpose of quantifying the surface water quality benefits associated with SSO control alternatives. Monitoring confirmed that the quality of wet weather discharges from the constructed overflows was roughly equivalent to wet weather bayou water quality, so the city concluded that selection of a design storm for development of the capital improvements program was an issue of customer service, not water quality.

The capital improvements program, completed in December 1997, consisted of approximately 400 projects made up of relief sewers, sewer rehabilitation, new or upgraded pump stations, WWTP expansions, and wet weather facilities at a cost of nearly $1.2 billion. All engineering was performed by more than 70 local design firms, and most construction contracts were awarded to local firms, using local labor, equipment, and materials. The capital improvements program provided a significant boost to the local economy.

The GHWP was one of the most ambitious collection system improvement efforts ever undertaken in the country. Now complete, this comprehensive response to regulatory mandates and customer needs encompassed more than 400 projects. Both EPA Region 6 and TNRCC officials have given the city high marks for its progress and meeting the December 1997 deadline.

In November, 1997 TNRCC lifted the final set of administrative orders against Houston. This marked the first time in 24 years that the city was not under any administrative orders. The GHWP not only improved the reliability of the collection system, but also fostered local economic growth. New development boomed following completion of the SSO abatement program. In 1997 Houston issued building permits for $2 billion of new construction. This would not have been possible without the city's capital investment in its wastewater infrastructure.

References and Contacts:

Limno-Tech Inc. (as sub-contractor to Parsons Engineering Science) (1999) *Developing Case Studies on Sanitary Sewer Overflow Abatement Programs.* U.S. Environmental Protection Agency, Office of Water.

Mr. Joesph Basista
(713) 659-4644

6.2.3 Johnson County, Kan.

SSO Community Characteristics

♦ Population	400,000
♦ Sewer Area	120,000 Ac
♦ Annual Rainfall	37"
♦ # of SSO Discharge Points	20

Distinctive SSO Community Attributes

- Successful private property I/I reduction program
- Use of wet weather treatment facilities for SSO

Johnson County is located in eastern Kansas, on the southwest edge of the Kansas City, Mo., metropolitan area. The county includes 22 separate city governments. Johnson County Wastewater (JCW) operates three WWTPs throughout the county, treating a combined average dry weather flow of slightly more than 38 MGD. JCW also operates six wet weather treatment facilities that provide primary treatment to excess wet weather flows. These facilities were developed in the 1960s. JCW cleans and maintains more than 1,500 miles of sewer line and 32,000 manholes.

In the early 1980s, the sanitary sewer system was experiencing both excessive groundwater infiltration and SW inflow. In the districts, the considerable amount of I/I caused the wet weather facilities to activate frequently. Moderate amounts of rainfall often resulted in surcharging manholes, bypassing of raw wastewater to receiving streams, and backups of sewage into basements. The bypasses and backups of raw wastewater were a potential health hazard and resulted in considerable financial loss each year. During heavy rainfall events, JCW would receive hundreds of telephone calls from residents concerning basement flooding and sewage backups. In 1983, the Board of County Commissioners of Johnson County recognized the need for an aggressive public and private property I/I reduction program.

JCW's effort to control SSOs has two primary components: (1) an aggressive I/I reduction program; and (2) the operation of satellite wet weather treatment facilities. Numerous complaints by residents of sewers backing up into homes motivated JCW in 1985 to begin the extensive I/I reduction program. The program included a comprehensive sanitary sewer evaluation study to inspect all structures, including more than 55,000 private connections to residential and commercial properties.

The initial efforts of the I/I reduction program included inspection of numerous commercial and residential properties and public sector projects (manhole inspections, sewer line smoke testing, and television inspections) to ascertain the structural condition of the collection system. The goal was to determine the total number of I/I sources in the districts. Public notices were placed in local newsletters and area newspapers, explaining that inspectors would visit each property to obtain information from residents and owners concerning past problems with the collection system. While on site, the inspectors also located rainwater downspouts, area drains, and sump pump connections. As the information was collected, it was entered into a database, which allowed JCW to identify direct and suspect connections that were contributing inflow to the collection system. The inspection program covered more than 55,000 homes and businesses, eventually identifying approximately 15,600 sources on private property. The five most common private property sources of I/I were foundation drains, basement entry drains, sump pumps, cleanouts and downspouts, and driveway and other area drains. Additionally, the program inspected more than 17,000 manholes and found that nearly all had some defect that allowed for inflow.

Following source identification and hydraulic modeling, the I/I reduction program focused on the elimination of as many of the known sources as possible in a prompt, orderly, and cost-effective manner. It was determined that a phased implementation would result in the lowest possible construction and administrative costs. The phased approach was based on a combination of watershed location, unit inflow rate, and the local history of sewer backups. The phasing tended to concentrate survey and construction activities in the same geographic area, thereby producing measurable improvements early in the program.

The I/I reduction program work was completed in 1994. The public and private property I/I reduction programs together resulted in a net reduction of nearly 280 MGD during the 10-year, 1-hour storm. The removal of 15,632 private property sources is estimated to have eliminated more than 110 MGD of the 280 MGD. Out of the 55,000 buildings in the districts, only nine remain to either be inspected (refused entry) or to have a source disconnected, and these are being addressed through the appropriate legal channels.

The total cost for the overall I/I reduction program was approximately $60 million. The private property work cost nearly $10.3 million, the public sector work (I/I reduction and relief sewers) almost $30 million and the remainder consisted of engineering and administrative expenses. JCW received almost $12 million in grant funds and nearly $18 million in state revolving fund low interest loans. However, the private property I/I reduction program expenditures were not grant or loan eligible and were funded with obligation bonds.

JCW's SSO control plan also includes the use of six satellite wet weather treatment facilities to provide primary treatment and disinfection to excess flows during wet weather. Although these facilities are somewhat controversial in that they are discharging partially treated sewage, JCW believes that they are a viable component of its effort to reduce direct human exposure to raw sewage. JCW has performed water quality monitoring during wet weather events and determined that the facilities have a minimal impact on the small urban creeks into which they discharge. JCW has also looked at the cost of eliminating the wet weather facilities while maintaining the same level of storm protection, and found costs prohibitive.

JCW believes that the I/I reduction program has significantly reduced I/I. The I/I work has met or exceeded the expected reductions in wet weather flows throughout the system. The focus on private property I/I was a proactive approach to reducing peak flows. EPA Region 7 and Kansas state officials agree that the allocation of local public funds to address private property I/I sources is an effective approach to solving I/I problems.

Through what is believed to be the largest private property I/I reduction program in the country, JCW has eliminated all capacity-related uncontrolled SSOs during events up to the 10-year, 1-hour (2.5 inches) storm.

References and Contacts:

Limno-Tech, Inc. (as sub-contractor to Parsons Engineering Science) (1999) *Developing Case Studies on Sanitary Sewer Overflow Abatement Programs.* U.S. Environmental Protection Agency, Office of Water.

Mr. Chris Burns
Johnson County Wastewater
Johnson County, Kansas
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6.2.4 Oklahoma City, Okla.

SSO Community Characteristics

♦ Population	470,000
♦ Sewer Area	400,000 Ac
♦ Annual Rainfall	40"
♦ # of SSO Discharge Points	20

Distinctive SSO Community Attributes

- Successful sewer rehabilitation and replacement program
- "Business" approach has markedly improved funding base and customer service

Oklahoma City is located in central Oklahoma, approximately 200 miles north of Dallas, Texas, spanning more than 620 square miles. Oklahoma City's central business district contains large numbers of commercial and single family residential properties, while the outskirts are primarily agricultural. Oklahoma City Water and Wastewater Department (OCW) provides water and wastewater services to more than 470,000 people spread across 320 square miles — nearly 96% of the city's total population. OCW maintains more than 2,400 miles of sewer line, including 63 lift stations and 4 WWTPs with a combined capacity of 101 MGD. The average dry weather flow to these plants is 75 MGD.

In the mid-1980s, SSOs in Oklahoma City sewers were a daily occurrence. The OCW, now part of the Oklahoma City Utility Trust, had a substantial backlog of complaints of sewer stoppages and overflows. Basement flooding occurred regularly in parts of the city. In 1986, OCW adopted an "enterprise system" under which all revenues derived from the water and wastewater utilities were put back into the system, instead of the city's general fund. With the inception of the enterprise system, OCW became committed to implementing efficient business practices and delivering quality water and sewer services. This effort, which continues today, included a dedication to sewer rehabilitation and repair which has virtually eliminated capacity constraints within the system and vastly improved customer service.

OCW does not have a specific SSO control plan. The progress it has made in controlling SSOs was not driven by water quality concerns. Rather, OCW established a goal of eliminating sewer back-ups in homes and has dedicated much of the work of the capital improvements program (CIP) to this end. At an annual cost of $6 million, or slightly less than $13 per capita, OCW replaces approximately 1%, or 120,000 linear feet of sewer line each year. The focus on sewer line replacement has been a continuous and sustained element of the CIP since 1986. The CIP has also included a number of improvements in the city's WWTP capabilities.

OCW tracks sewer system complaints and uses this information to gauge the success of the CIP investment in line replacement. Each complaint is entered into a database that helps identify persistent problem areas. By systematically replacing the weakest portions of the sewer system, OCW has dramatically improved wastewater service in Oklahoma City.

Fully 95% of OCW's maintenance activities are preventative, rather than reactive. Increased levels of routine maintenance have proved valuable in eliminating line blockages and in identifying the need for repairs before problems are elevated to emergencies.

The OCW management believes that there are three primary components to a well functioning utility: adequate financing, control over planning, and dedicated personnel. In Oklahoma City, the enterprise system has given OCW control over financing and planning for the water and wastewater utilities. The city's conversion to the enterprise system has resulted in excellent water and wastewater improvements. The revenues generated by the utility are controlled by the utility and put back into projects to improve utility services.

The CIP focus on line replacement and I/I control has allowed Oklahoma City to decrease total flows to the WWTPs, while the population has grown, and virtually eliminate capacity related overflows within the system. Sewer rehabilitation programs have had numerous benefits, including: reduced frequency of emergency maintenance; lower incidence of damage to public and private property; extended infrastructure life; and decreased overflows and stoppages. All these contribute to the ultimate goal of improved customer service. Both the Oklahoma Department of Environmental Quality and EPA Region 6 officials believe that OCW has found an effective, proactive means of controlling SSOs and would like to see their efforts emulated by other jurisdictions.

References and Contacts:

Limno-Tech, Inc. (as sub-contractor to Parsons Engineering Science) (1999) *Developing Case Studies on Sanitary Sewer Overflow Abatement Programs.* U.S. Environmental Protection Agency, Office of Water.

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6.2.5 Wayne County (Downriver Communities), Mich.

SSO Community Characteristics

◆ Population	320,000
◆ Sewer Area	100,000 Ac
◆ Annual Rainfall	34"
◆ # of SSO Discharge Points	20

Distinctive SSO Community Attributes

- Michigan state rigorous SSO abatement criteria
- Construction of a regional storage-transport system as SSO control

The Downriver Collection System (DCS) in Wayne County, Mich., serves more than 320,000 people in 13 communities. These communities are located southwest of Detroit and are known as the Downriver Communities.

Administered by the Michigan Department of Environmental Quality (MDEQ), Michigan has one of the most rigorous state-mandated abatement criteria for controlling SSOs. In deriving the criteria for controlling SSOs, MDEQ started by assuming wet sanitary sewers closely approximate storm sewers. Therefore, the design criteria is based loosely on standard storm sewer requirements. Storm sewers are normally designed to transport the 10-year, 1-hour storm in residential areas, and the 25-year, 1-hour storm in commercial areas. To be conservative, MDEQ initially considered using the 25-year, 1-hour storm event as a uniform standard for all areas. However, a storm of such short duration did not provide enough information about the volume required to contain a longer, equally intense storm. Hence, MDEQ adopted the 25-year, 24-hour design storm. With such rigorous design criteria, MDEQ expects very few overflow events. Most will be attributable to extreme conditions such as large back-to-back events; storms having intensities greater than the design storm; or theoretical system capacities reduced by high groundwater, snowmelt, or late winter rains on frozen ground. Therefore, each overflow event is reviewed on a case-by-case basis, with MDEQ giving careful consideration to extenuating circumstances before levying fines.

When MDEQ initiated legal action against the DCS in 1987, the collection system was experiencing 25 to 35 SSO events annually with an estimated total volume of 366 MG per year. Basement flooding due to sewer backups was also widespread within the DCS service area.

During the fall of 1990, as part of the Downriver Improvements Program, system-wide flow, rainfall, and groundwater information was collected. The flow monitoring revealed a number of system deficiencies and evidence that many of the tributary communities routinely exceeded their contractual peak flow, which in turn caused the hydraulic capacity of the system to be exceeded. Excess flows were determined to be attributable to high I/I in many communities, excessive pumping from the city of River Rouge, and a non-operational regulator in the city of Ecorse. It was also determined that the WWTP did not have sufficient capacity to handle the resultant flow if all communities were to simultaneously discharge at their contractual peaks.

Flow monitors in the thirteen communities were used to evaluate the relative contribution of each to the wet weather flow problem. The measured flows were also used in negotiations between the communities when determining an equitable distribution of the Downriver Improvement Program costs. In order to direct local rehabilitation efforts, most of the communities also undertook a concurrent flow-monitoring program to identify areas subject to the greatest wet weather inflows. In general, the older communities had higher levels of I/I, often two to three times those of newer areas. These high rates were mainly attributable to SW connections, footing drains, the relatively large older sewers, deteriorating pipes, and leaks in manholes.

The Downriver Communities entered into a consent agreement with MDEQ in 1994 after numerous violations of both the Federal Clean Water Act, the Mich. Water Resource Commission Act, and the terms and conditions of the county's NPDES permit. The objectives of the improvements program, mandated by the consent decree were:

- reducing discharges of untreated sanitary sewage,
- reducing basement flooding related to the DCS capacity or WWTP constraints, and
- reducing wet weather inflows into the collection system.

In order to meet these objectives, the collection system and the WWTP must have the capacity to transport and treat all flows (blend of primary and secondary treatment) up to the 25-year, 24-hour storm (roughly equivalent to 3 inches). The collection system must also have the capacity to transport all flows up to the 100-year, 24-hour storm (roughly equivalent to 4-5 inches) to the WWTP. The WWTP must provide secondary treatment for flow up to 125 MGD and a blend of primary and secondary for an additional 25 MGD. Flow that exceeds 150 MGD up to 225 MGD must receive preliminary treatment (screening, grit removal, and disinfection). Flows greater than those generated by the 100-year, 24-hour storm can be routed to "inactive" emergency bypass structures spread throughout the system.

The consent agreement put the DCS on a compliance schedule to reduce the occurrence and volume of SSOs. A number of alternatives, representing both "local" and "regional" approaches, were considered for meeting the requirements of the consent decree. These included: WWTP relief capacity for peak flows; off-line storage basins; on-line storage basins; and a regional storage-transport system including relief sewers and a large diameter tunnel. The regional storage-transport system was selected because it was the most cost effective on an annualized basis. This alternative was also particularly attractive because all flows would receive some treatment; all emergency discharges would, for the most part, go to the Detroit River (rather than smaller tributary streams); a minimum amount of site acquisition was required; and because of the lower O&M requirements associated with the operation of a regional facility compared to a series of satellite storage basins. In addition to the regional storage-transport system, the mandated SSO abatement plan includes the expansion of the WWTP, implementation of localized sewer rehabilitation programs, and construction of an off-line basin facility and an emergency discharge outfall.

Implementation of various aspects of the mandated improvements began in 1994. The rehabilitation of county interceptors and community sewers was completed in the fall of 1995, with significant state revolving fund loan assistance. Subsequently, system flows have been monitored to track the effectiveness of improvements and to provide data for sizing the regional storage-transport system. Work on the WWTP upgrades began in 1994, including the construction of dechlorination facilities, the installation of a new solids handling facility, and construction of a new maintenance facility. The WWTP is currently being expanded to provide reliable primary/secondary treatment for flows up to 150 MGD and preliminary treatment for emergency flows up to 225 MGD. The WWTP improvements also include expansion of the disinfection and outfall facilities, which will bring the capacity of these facilities in line with the increased capacity of the rest of the plant. The final component of the mandated improvements is the construction of community relief sewers and a large diameter tunnel. Construction of the upper portion of the tunnel and a county relief sewer began late in 1996. Local relief sewer projects commenced in 1997. Construction of the main portion of the tunnel began in 1998 and should be completed in 2001.

In general, water quality is a primary concern for local governments, and Wayne County officials do not believe that the SSOs within the DCS service area represented a $270 million water quality problem. Wayne County's Director of Public Works, James Murray, stated that: "SSO water quality objectives need to be integrated with CSO and SW quality objectives. Substantial costs are being incurred by the DCS to eliminate SSO discharges, while at the same time current SW and CSO programs provide for discharges into the same watercourse with effluent quality far less stringent."

Wayne County officials advocate a watershed-based approach, which would integrate the control of all sources of wet weather pollutants and yield a more cost effective solution with maximum water quality benefits. They also indicated that:

- it is not practical to assume that SSO events will never occur;
- it would be more appropriate to clearly define emergency conditions, identifying specific circumstances when a system bypass would be acceptable; and
- emergency conditions should not necessarily be based on a design storm, but rather on the frequency of occurrence of overflow events.

References and Contacts:

Limno-Tech, Inc. (as a sub-contractor to Parsons Engineering Science) (1999) *Developing Case Studies on Sanitary Sewer Overflow Abatement Programs.* U.S. Environmental Protection Agency, Office of Water.

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6.3 SSO Case Histories and Benchmark Data Discussion

6.3.1 General SSO Discussion

Although surveys and studies have collected information on sanitary sewer collection systems and SSOs, information on the status of the collection systems and extent of SSO problems remain limited. However, these surveys and studies have identified SSOs as a common characteristic of most sanitary sewer collection systems.

Because many municipalities have not quantified their SSOs, very few have moved to correct or abate this pollution source. The lack of a national SSO policy, and the rarely enforced NPDES requirements also make SSO abatement a low priority for most municipalities.

SSOs during dry weather conditions are less common today then they were in the past due to efforts to increase WWTP and collection system capacities. However, SSOs during wet weather conditions continue to be a common occurrence around the nation. Although many communities have not moved forward in abating wet weather SSO related concerns, some generalizations can be made about the condition of sanitary sewer collection systems and SSOs, and permitting inconsistencies around the nation.

There are many potential strategies that municipalities may adopt to abate SSOs. Most involve some combination of upgrading the WWTP, removing sources of I/I, and increasing the storage capacity of the collection systems. Some strategies involve technology used for CSO control, such as off-line storage and satellite treatment facilities. However, currently this approach is atypical. Reasons for abating SSOs come from customer complaints regarding sewer backups as much as from water quality concerns.

6.3.1.1 Sanitary Sewer Failures and Resulting Overflows

The Urban Institute (1984) estimated that as an annual average there are 825 sewer backups and 140 sewer breaks every year for every 1,000 miles of sewer. A system of 1,000 miles of sewer serves about 250,000 people. The Urban Institute also proposed that sewer backup rates were highest in the northeast and economically distressed cities and were generally higher in communities with the oldest sewer systems. High sewer break rates in the south and west are particularly associated with large, growing cities. The Urban Institute survey attributed backups to a variety of factors: the location of pipe in trouble-prone areas, the pipe material, the size of pipes, the material, construction methods, local soils, and maintenance practices.

In 1994, the Civil Engineering Research Foundation found that three quarters of the sanitary sewer systems function at 50% of capacity or less. Root penetration, corrosion, soil movement, and inadequate construction are the cause of most structural failures.

As a result of reduced sewer capacity and failures, SSOs during wet and dry weather are a reality. The Association of State and Interstate Water pollution Control Administrators (ASIWPCA) found that 31% of municipal systems have at least an occasional dry weather SSO. The estimated annual number of dry weather SSOs was 1,962 for the 25 states providing information. The ASIWPA study also found that 29% of the municipal sanitary sewer systems experience wet weather SSOs and 25% of the WWTPs experience some problems during wet weather.

In a Water Pollution Control Federation study (1989), 1,003 WWTPs identified facility performance problems. I/I was the most frequently cited problem.

6.3.1.2 *NPDES Inconsistencies*

Different NPDES authorities have historically provided different emphasis on oversight of sanitary sewer collection systems. In addition, some of the NPDES regulatory provisions addressing sanitary sewer collection systems are unclear, and different NPDES authorities have provided different interpretations regarding SSOs. For example, the ASIWPCA study (1996) found that only two states issue permits to municipalities that discharge from their sanitary sewer system to another municipal sewer collection system, five states issue permits for some of these types of system, and 26 states do not issue permits for these systems. The ASIWPCA study also found that 13 states authorize wet weather control facilities that provide some level of treatment or flow control. EPA Region 6 and states in at least four other EPA regions (2, 3, 5 and 9) have issued permits for controlled discharges from wet weather facilities. Other states and EPA regions have not currently decided whether or not to allow wet weather facilities.

6.3.2 SSO Questionnaire Findings

6.3.2.1 *SSO Community Statistics*

The SSO benchmark questionnaires returned cover a wide range of conditions and receiving waters. Most SSOs discharge into rivers, but lakes, the ocean, estuaries, and streams are also represented, and most communities discharge into several different types of receiving waters. The surveyed SSO communities also represent a wide range of populations and service areas. Annual rainfall for these communities varies significantly. Many communities had not determined the quantity of annual SSO discharge, in part because many SSOs occur as basement and street flooding which is difficult to quantify.

In contrast to CSO and SW, most communities have not defined their SSO annual discharge quantity; Wayne County, Mich. was one of the few exceptions. Flow monitoring in 13 Wayne County communities was used to evaluate the relative contribution of each to the wet weather pollution.

6.3.2.2 *SSO Public Participation*

Public participation for SSO tends to be different as compared to CSO and SW. SSO public participation efforts tend to originate from sewer backup-related occurrences rather than environmental issues or water quality. Therefore SSO public participation tends to be more of a pragmatic approach rather than environmental education approach. For example, Houston, Texas needed to move ahead simultaneously with initial planning, design, and construction activities in order to meet a consent agreement deadline. The local engineers and construction community, along with the municipality staff, organized together during the initial phase of planning and program development. This relationship helped the stakeholders to become fully committed to the process well ahead of actual design and construction contracts.

General water quality, along with basement flooding and other sewer backup related occurrences, were the most commonly listed public concerns. The major water quality parameters of concern were bacteria, BOD, and dissolved oxygen.

6.3.2.3 *SSO Systems Characteristics*

The majority of the communities responding had used a mathematical model to estimate flow in their sanitary sewer collection systems. Houston invested $65 million between 1988 and 1991 to evaluate its collection system and conduct extensive flow monitoring. The physical analysis identified infiltration due to leaking joints, cracks, and breaks in city sewers and private property laterals as the primary source of increased wet weather flows. The collection system modeling helped Houston better define the size of the satellite treatment facilities.

Although many communities say they use a watershed approach, some interpret this approach as encompassing all the sewers and laterals in the sewershed when planning for rehabilitation or abatement. Houston and the Downriver Communities, however, pursued a more ideal watershed approach. The city completed a water quality study of local receiving waters for the purposes of evaluating surface water quality benefits associated with SSO control. Monitoring and modeling confirmed that the water quality of wet weather pollution from constructed overflows was roughly equivalent to wet weather receiving water quality. As a result, the goals of the SSO control program were more concerned about customer service (i.e., sewer backups) than receiving water quality. The Downriver Communities in Wayne County also pursued a watershed approach, but the results were not as successful as Houston. The Downriver Communities identified other pollution sources in the watershed such as CSOs and SW. However, the regulatory agency viewed each pollution source separately and held the Downriver Communities to rigid SSO effluent standards regardless of water quality impacts of other pollution sources.

Current pollutant abatement included municipal and industrial point sources, plus urban runoff, from practically all cities. Control efforts for the same targeted pollutant sources were generally expected to remain in the future.

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6.3.2.4 *Issues Driving SSO Technical Considerations*

Two cities, Flagstaff and Oklahoma City, indicated that an SSO facility plan has not been initiated. The remaining communities were equally split between developing a plan and completion of a facility plan. Of the many potential strategies municipalities may adopt to abate SSOs, most involve some combination of upgrading the WWTP, removing sources of I/I, and increasing the storage capacity of the collection systems. Some abatement strategies involve technology used for CSO control, such as off-line storage and satellite treatment facilities. However, currently this approach is atypical. Bacteria, BOD, and dissolved oxygen were the most prevalent water quality criteria for local receiving waters. Floatables, sediments, and nutrients were also notable water quality concerns.

Planned sewer improvements and regulatory requirements were listed as the most common reason for SSO abatement. A few communities, such as Downriver Communities, Hillsboro, Houston, and New Orleans, responded to litigation.

SSO abatement is almost exclusively accomplished by I/I reduction. However, upgrading the WWTP and increasing the storage capacity of the collection systems are also common. In a few select cases, such as Johnson County and Houston, satellite treatment of SSOs have been approved. Satellite treatment technology included screening, settling tanks or ponds, and disinfection. Such an approach provided a cost-effective means of complying with water quality requirements.

6.3.2.5 *SSO Financial Considerations*

Most communities spent less than $10 million for past SSO costs, indicating that the communities have not started major infrastructure-type abatement. Most communities have acquired or plan to acquire funding for SSO abatement through increased sewer rates. Another common funding source was revolving loans.

CHAPTER 7.0

SW Benchmark Data and Case Histories

7.1 Benchmark Data for SW Communities

The following section includes a benchmark matrix for general SW community statistics (Table 7-1), SW public participation (Table 7-2), SW systems characterization (Table 7-3), issues driving SW technical considerations (Table 7-4), and SW financial considerations (Table 7-5).

7.2 Case Histories for SW Communities

Stormwater case histories are useful in documenting the successes and disappointments of SW management in areas having up to several decades of experience. Most U.S. cities are just beginning to consider local SW controls as a result of federal regulations. However, the literature (especially technical conference publications) shows that many cities throughout the country have been involved to a certain extent in some SW control. The following case histories present five municipalities that have been involved in local SW management longer than many in the nation: Bellevue, Wash., Denver, Colo., Austin, Texas, Milwaukee, Wis., and Orlando, Fla. These mature SW management programs have all progressed through many phases of operation and are renowned for developing or making major advances in certain specific aspects of SW management, such as utility district financing, integrating drainage and water quality issues, addressing groundwater problems, and dealing with watershed-scale problems.

7.2.1 Austin, Texas

Austin has been long known as an innovator for SW controls, especially the sand filter. It was also one of the earliest cities to enact comprehensive SW management regulations specifically to protect both surface and groundwater receiving water quality.

Austin was incorporated in 1839 and is a rapidly growing city, with a population of about 460,000 (1990 census). It is the capital of Texas, home to the University of Texas, and an important high-technology center. The city covers an area of 116 square miles and the land elevation ranges from about 400 to over 1,000 ft. The area receives about 32 inches of rain a year, but can have prolonged dry periods with large amounts of evapotranspiration, resulting in arid characteristics. The separate storm drainage system discharges into several heavily urbanized streams which drain to the Colorado River. The river is dammed in Austin into a chain of three large lakes (Lake Travis, Lake Austin, and Town Lake) that comprise the local water supply. The Edwards Aquifer recharge zone underlies parts of Austin, making groundwater protection an additional important component of local SW management efforts.

Table 7-1. SW Community Statistics

City	Austin, TX	Bellevue, WA	Birmingham, AL	Boston, MA	Burbank, CA	Denver, CO	Detroit, MI	Frederick, MD	Fridley, MN	Hillsboro, OR	Orem, UT	Orlando, FL	River Falls, WI	Struthers, OH
Receiving H2O Type														
Estuary				◆										
Lake	◆	◆	◆			◆	◆		◆		◆	◆		
Ocean				◆										
River	◆			◆		◆	◆		◆	◆	◆		◆	◆
Stream	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆			◆	
Groundwater											◆			
Population														
<500,000	◆	◆	◆		◆			◆	◆	◆	◆	◆	◆	◆
500,000 - 1,000,000														
>1,000,000				◆		◆	◆							
SW Area														
<10,000 Ac				◆	◆			◆	◆		◆		◆	
10,000- 100,000 Ac	◆	◆	◆							◆				◆
100,000 -500,000 Ac	◆					◆	◆					◆		
Annual Rainfall														
0-20"					◆	◆					◆			
20-30"									◆					
30-40"	◆	◆					◆			◆			◆	◆
40-50"				◆				◆				◆		
>50"			◆											
# of Discharges to Public Waters														
<10											◆			
10-50														
50-100									◆				◆	
>100	◆	◆		◆		◆	◆					◆		
Not Answered			◆		◆			◆		◆				◆
Annual Wet-Weather Discharge Qty.														
<10 MG														
10-100 MG														
100-1,000 MG														
>1,000 MG	◆						◆							
Not Answered		◆	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆	◆

Questionnaire Date: July 1998.

Austin's peak discharge control regulations were implemented in the mid-1970s in response to the city's rapid growth and associated increased flooding and erosion. SW quality regulations were first implemented in the early 1980s to protect the city's water supply. A drainage fee was established in 1982 and the Drainage Utility was established in 1991.

SW Community Characteristics

◆ Population	460,000
◆ Sewer Area	100,000 Ac
◆ Annual Rainfall	32"
◆ # of SSO Discharge Points	200

Distinctive SW Community Attributes

- Innovative SW controls, incluiding the sand filter
- One of the first communities to develop comprehensive SW management regulations

Table 7-2. SW Public Participation

City	Austin, TX	Bellevue, WA	Birmingham, AL	Boston, MA	Burbank, CA	Denver, CO	Detroit, MI	Frederick, MD	Fridley, MN	Hillsboro, OR	Orem, UT	Orlando, FL	River Falls, WI	Struthers, OH
Level of Participation														
Proactive	◆	◆		◆	◆	◆	◆			◆		◆	◆	
Reactive														
Minimum required by Law			◆					◆	◆		◆			◆
Type of Participation														
Brochures / Pamphlets				◆		◆								
Newsletters														
Public Addresses thru Media						◆								
Public Hearings/Meetings	◆			◆										
Educational & Awareness	◆	◆		◆	◆	◆						◆	◆	
Special Committee		◆											◆	
None			◆					◆	◆		◆			◆
Not Answered							◆			◆				
Public Concerns														
Recreation		◆		◆	◆									
Aesthetics			◆											
Facility Construction														
Cost for Abatement														
Flooding	◆		◆		◆	◆		◆	◆	◆	◆	◆	◆	◆
Public Health		◆					◆							
Water Quality	◆	◆		◆	◆	◆	◆				◆	◆	◆	◆
Minimal														
Uninterrupted Service		◆			◆									

Questionnaire Date. July 1998.

Table 7-3. SW Systems Characterization

City	Austin, TX	Bellevue, WA	Birmingham, AL	Boston, MA	Burbank, CA	Denver, CO	Detroit, MI	Frederick, MD	Fridley, MN	Hillsboro, OR	Orem, UT	Orlando, FL	River Falls, WI	Struthers, OH
Mathematical Model for Flow Estimates														
Yes					◆	◆	◆							
No	◆		◆	◆					◆	◆		◆		
Not Answered		◆						◆			◆		◆	◆
Watershed Approach to Consider Other Wet-Weather Impacts														
Yes	◆	◆		◆	◆	◆	◆	◆	◆	◆		◆	◆	◆
No			◆								◆			
Current Abated Wet-Weather Pollution														
Municipal Point Source		◆	◆		◆	◆		◆	◆	◆		◆	◆	◆
Industrial Point Source		◆	◆		◆	◆		◆	◆	◆		◆	◆	◆
Urban Runoff	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆
Agricultural Runoff					◆		◆			◆			◆	
Other		◆		◆			◆	◆		◆				
Not Answered											◆			
Future Abated Wet-Weather Pollution														
Municipal Point Source			◆			◆		◆	◆		◆		◆	◆
Industrial Point Source	◆		◆			◆		◆	◆		◆		◆	◆
Urban Runoff	◆		◆		◆	◆	◆	◆	◆		◆	◆	◆	
Agricultural Runoff							◆			◆			◆	
Other				◆			◆							
Not Answered		◆												

Questionnaire Date: July 1998.

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Table 7-4. Issues Driving SW Technical Considerations

City	Austin, TX	Bellevue, WA	Birmingham, AL	Boston, MA	Burbank, CA	Denver, CO	Detroit, MI	Frederick, MD	Fridley, MN	Hillsboro, OR	Orem, UT	Orlando, FL	River Falls, WI	Struthers, OH
Facility Plan														
Completed	◆	◆					◆							
In Progress						◆			◆	◆	◆		◆	◆
Not Started / None			◆	◆				◆						
Not Answered					◆							◆		
Reason for SSO Abatement														
Planned Sewer Improvements		◆	◆	◆	◆					◆	◆		◆	
Regulatory Requirements	◆	◆		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Litigation / Lawsuit			◆				◆			◆				
Significant Pollution Event	◆													
Receiving H2O Criteria														
Bacteria	◆				◆		◆		◆	◆	◆	◆	◆	◆
BOD	◆								◆	◆	◆		◆	◆
Dissolved Oxygen	◆				◆		◆		◆	◆	◆	◆	◆	◆
Floatables	◆		◆		◆		◆				◆		◆	
Heavy Metals					◆									
Nutrients	◆		◆		◆					◆	◆	◆	◆	
Sedimentation	◆		◆						◆	◆	◆		◆	
Solids	◆		◆								◆		◆	◆
Temperature													◆	
Toxins	◆		◆								◆	◆	◆	◆
Other					◆	◆					◆			
Not Answered		◆		◆				◆						
Abatement Tech Selection														
Benefit-Cost Analysis					◆				◆	◆	◆		◆	
Regulatory Requirement	◆	◆	◆		◆	◆		◆	◆	◆			◆	◆
Not Answered				◆			◆					◆		
Selected Technologies														
Construction Site Erosion Controls	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆	◆	◆	
Public Works Practices	◆	◆	◆	◆		◆		◆	◆	◆	◆	◆	◆	
Infiltration	◆			◆		◆	◆	◆	◆	◆	◆		◆	
Sedimentation	◆	◆	◆			◆	◆	◆	◆	◆	◆	◆	◆	
Other	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	
Not Answered														◆

Questionnaire Date: July 1998.

Austin has enacted three major watershed ordinances to protect both surface water and groundwater resources:

- the Comprehensive Watersheds Ordinance (1986),
- the Urban Watersheds Ordinance (1991), and
- the Barton Springs Ordinance (1992).

The objectives of the local SW management program are to:

- protect citizens from flooding,
- preserve the natural and traditional character of the city's waterways,
- protect the water quality of the Edwards Aquifer and the city's drinking water supply, and
- protect the city's recreational and aesthetic resources (such as Town Lake and Barton Springs).

Some of the ordinance requirements are very specific, such as those for source controls as part of the Barton Springs ordinance. Because of some of these requirements, especially for areas outside the city limits, successful court challenges by developers have weakened some of the laws.

Current funding for the city's erosion and sediment control program is about $750,000 (evenly derived from general city appropriations, permit fees, and from the SW utility fee). The SW management program is funded at about $8 million (mostly from the SW utility fee).

Table 7-5. SW Financial Considerations

City	Austin, TX	Bellevue, WA	Birmingham, AL	Boston, MA	Burbank, CA	Denver, CO	Detroit, MI	Frederick, MD	Fridley, MN	Hillsboro, OR	Orem, UT	Orlando, FL	River Falls, WI	Struthers, OH
SW Area														
<10,000 Ac				◆	◆			◆	◆		◆		◆	
10,000- 100,000 Ac	◆	◆	◆							◆				◆
100,000 -500,000 Ac	◆					◆	◆					◆		
Estimated Past Cost														
<10 Million	◆			◆		◆					◆			◆
10-50 Million														
100-500 Million														
>500 Million							◆							
Not Answered		◆	◆		◆			◆	◆	◆		◆	◆	
Estimated Future Cost														
<10 Million	◆													◆
10-50 Million						◆					◆			
100-500 Million														
>500 Million							◆							
Not Answered		◆	◆	◆	◆			◆	◆	◆		◆	◆	
Funding Source														
Revolving Loan				◆			◆							
Increase Sewer Rates	◆						◆							◆
State Grant Money				◆									◆	◆
User Fees from Utility District						◆			◆		◆		◆	◆
Federal Grant Money					◆		◆						◆	
Increased Taxes						◆	◆						◆	
Other					◆	◆	◆		◆			◆		
Not Answered		◆	◆					◆		◆				

Cost Estimates ENR: 5921 July 1998
Questionnaire Date: July 1998.

The city has long conducted local monitoring activities. The city worked with the U.S. Geological Survey on a cooperative effort starting in 1975 to evaluate SW from eight large mixed land use watersheds. Starting in 1981, the city also participated in NURP, monitoring runoff from two residential areas and one undeveloped area. The city expanded its efforts in 1984 to include a total of 11 single land use areas representing new development. Five additional single land use sites (older, existing areas) were monitored as part of the NPDES SW permit. Selected event mean concentration data from these monitoring activities are shown in Table 7-6.

Table 7-6. Land Use versus Event Mean Concentrations, Austin, Texas

mg/L	Suspended Solids	COD	Total P	TKN	NO2 NO3	Lead	Copper	Zinc
Open/Vacant/Parkland	80	26	0.10	0.52	0.15	0.004	0.01	0.008
Medium density, single-family	170	83	0.47	2.35	0.96	0.02	0.05	0.10
Townhouse/apartment	111	113	0.38	1.82	0.58	0.02	0.02	0.10
Commercial/office/ light industrial/utilities	111 160	113 93	0.38 0.39	1.82 1.65	0.58 0.39	0.02 0.05	0.02 0.04	0.10 0.20
Institutional	160	93	0.47	2.35	0.96	0.05	0.04	0.20
Major roads/highways	143	103	0.44	1.78	0.83	0.53	0.05	0.37

In 1989, the city started a study to identify and quantify the critical pollutants and sources adversely affecting the Town Lake water supply, listed below, along with their removal goals, in order of decreasing importance:

- nutrients (25 - 30%),
- toxic metals (50%),
- suspended solids (50%),
- trash and debris (50 - 90%), and
- oil and grease (25%)

Concentration reduction efficiencies for various SW control devices have been extensively evaluated in Austin to support the city's SW management planning activities. Table 7-7 summarizes some of the expected concentration reductions for the flows being treated. Because some devices bypass significant amounts of untreated SW due to clogging (especially in sand filters due to inadequate maintenance) or because they are undersized (such as for oil/water separators), the actual annual pollutant removals may be substantially less. In addition, Table 7-7 only reflects concentration reductions and not the greater pollutant mass reductions associated with devices having significant infiltration benefits (such as for grassed waterways).

Table 7-7. Concentration Reduction Efficiencies for SW Controls, Austin, Texas

% Reduction	Wet Pond	Sand Filter (no pretreat)	Dry Pond (earth/grass lined)	Oil/Water Separator	Grassed Waterway
Suspended Solids	93	87	16	17	68
COD	50	67	8	42	33
Total P	87	61	3	66	43
TKN	57	62	12	40	32
Lead	39	80	16	na	na

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7.2.2 Bellevue, Wash.

SW Community Characteristics

♦ Population	100,000
♦ Sewer Area	19,000 Ac
♦ Annual Rainfall	35" - 40"
♦ # of SSO Discharge Points	>100

Distinctive SW Community Attributes

- One of the first communities to establish SW utility
- Rate structure based on runoff volume generated

Bellevue has a long history of SW management. It was one of the first communities in the U.S. to establish a SW utility district and to develop a method for local financing of both flood control and water quality enhancements. Bellevue is a rapidly growing community near Seattle, with a population of about 87,000 (1990 census) and covering more than 30 square miles. The area receives 35 to 40 inches of rainfall a year with a separate drainage system. The SW is discharged to many small heavily urbanized streams which lead to Lake Washington.

Washington state law was changed in 1965 to allow the establishment of utilities as a funding mechanism for SW control. The city established its storm and surface water (SSW) utility in 1974, after several years of discussion and planning based on citizen concerns about declining water quality in Bellevue streams. The SSW utility's founding mission was "to maintain the hydrological balance, to prevent property damage, and to protect water quality; for the health, safety, and enjoyment of citizens and the preservation and enhancement of wildlife habitat." During the initial five years, the utility focused mostly on runoff volume and velocity, and erosion control. After these fundamental problems began to be addressed, the utility was able to shift its focus to also include water quality objectives.

A critical part of the development of the SSW utility was the establishment of a rate structure based on volumetric runoff coefficient (Rv) generated:

- undeveloped (Rv <0.25),
- light (0.25 <Rv<0.4),
- moderate (0.4<Rv<0.5),
- heavy (0.5<Rv<0.75), and
- very heavy (0.75<Rv<1.0).

Onsite runoff controls result in rate reductions. A major public education program was conducted to emphasize the benefits of the utility and the costs. In 1991, the average single-family household paid about $90 per year to the SSW utility. The 1986 budget was about $4.3 million, and the 1980 to 1986 capital improvement budget was

$13 million. In 1997, the SW program was funded at about $450,000 per year from permit fees, and the erosion and sediment control program is funded at about $500,000 per year from the SW utility fee and permit fees. Both programs have a combined staff of two administrators, three full-time development reviewers (plus four part-time reviewers), four inspectors (plus two part-time inspectors), and three others, including support staff.

Some opposition continued to the utility fee within the city, but it has subsided greatly as the citizens understand the benefits of the utility. The main benefit is in preventing problems instead of responding to existing problems, which tends to diminish the utility's perceived value. Adding a stronger component to more adequately address water quality issues is a future challenge being currently addressed by Bellevue.

Preferred SW practices include wet detention ponds, grass roadside drainage swales, catchbasins, oil-water separators, and filters. Ground infiltration practices are not allowed due to slowly percolating soils and problems with these practices in the past. During 1992 and 1993, 13 biofiltration facilities, 8 extended dry detention ponds, and 1 filtration facility were installed.

The SSW major programs include:

- capital improvement (by 1991, 11 ponds with real-time control had been established for flood control);
- operations and maintenance (operating flood control facilities to minimize fishery impacts, consulting with private property owners to solve private drainage problems, cleaning inlets and storm drainage, repairing structural facilities, emergency response, etc.);
- water quality (routine monitoring of all receiving waters, stream enhancement and lake restoration projects, inspection of private SW systems, etc.);
- development regulations (using the city's land use authority to regulate construction, enforce clearing, grading, and development of sensitive areas, inspect construction sites, etc.);
- public education (award-winning "stream teams" and "business partners for clean water" programs, etc.); and
- administration (policy development, financial management, rate administration, drainage planning, etc.).

Bellevue participated in NURP, resulting in much data on local characterization and control effectiveness. With this local data, the city applied for a general NPDES permit for SW in 1985, more than ten years before the SW NPDES permit program was established for the country.

The SSW utility operates a spill response team on 24-hour call to respond to accidents or citizen calls for inappropriate or illegal discharges to the drainage system or streams. It also operated one of the first oil recycling programs in the nation.

The Bellevue SSW utility efforts have succeeded because:

- the utility is a unified agency (although city reorganization in 1993 resulted in the erosion and sediment control program being assigned to a different city unit);
- the utility has the backing of strong regulations;
- the utility has strong citizen support;
- all enforcement and maintenance activities are staffed within the utility; and
- the utility coordinates extensively with other agencies and governments in the region.

The SSW utility programs do have some current conflicts with other city programs, such as biofiltration conflicting with the city's land use code landscaping requirements, and the preferred use of swales conflicting with the city's transportation code.

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7.2.3 Denver, Colo.

SW Community Characteristics

♦ Population	>1,000,000
♦ Sewer Area	>100,000 Ac
♦ Annual Rainfall	15"
♦ # of SSO Discharge Points	2,000

Distinctive SW Community Attributes

- Successful SW utilities
- Flood control receives more emphasis than water quality

Denver is known for its efforts in flood control in an arid, high elevation area that receives large amounts of runoff from upstream areas. The city's efforts to develop and evaluate site-specific SW quality control practices and its experiences with utility district are also noteworthy.

Denver was incorporated in 1858 and had a population of about 470,000 in 1990. The city covers an area of about 155 square miles and is at an elevation of more than 5,000 ft. The area receives only about 15 inches of rain a year and experiences cold and long winters. The separate stormwater system has more than 1,000 outfalls in the metropolitan area that discharge into small streams that, in turn, eventually discharge into the Platte River. Rain occurs on about 60 days a year, but only about 30 storms per year are of sufficient size to produce runoff.

The Urban Drainage and Flood Control District (UDFCD) serves an area of about 400 square miles, having a total population of more than 2 million. Flood control has received the most emphasis from the district, and receiving water quality problems are not generally thought to be associated with wet weather flows because of other influencing factors. However, a watershed approach has been taken locally where urban runoff, municipal point sources, and industrial point sources are being addressed. Federal and state regulatory requirements are the major driving forces behind local wet weather flow water quality control efforts.

Denver was a participant in NURP in the early 1980s, monitoring several catchments and control practices over several years.

About $4 million has been spent in the past on wet weather pollution control efforts, and about $10 million is projected to be spent in the future, coming from increased taxes, user fees from the utility district, and by reallocation of funds from other municipal activities. The UDFCD is coordinating NPDES SW permit activities for the cities of Denver, Aurora, and Lakewood. As more communities in the Denver area are required to participate in the

NPDES permit program, the UDFCD will be available to assist these other areas also. A joint task force was created in 1990 to define the goals, objectives, and responsibilities necessary to meet the needs of the permit process. The initial goals were to:

- coordinate application efforts of the three cities,
- jointly negotiate application requirements with the state of Colorado,
- jointly conduct activities whenever possible,
- share knowledge and experience,
- facilitate use of resources of other organizations,
- evaluate candidate SW control practices,
- develop dry weather screening work plan, and
- develop a joint SW monitoring program.

In addition to helping to coordinate these activities, the UDFCD, in conjunction with local colleges, also conducts erosion control training courses for local contractors.

The NPDES SW permits were issued by the state to the three cities in May 1996. All permit requirements must be implemented within three years. Some of the permit requirements, such as street and inlet cleaning and trash removal from channels, has been an on-going activity, but other activities will need to be implemented, including:

- annual reporting and cost estimates,
- industrial facilities program,
- municipal facility runoff controls,
- wet weather monitoring program,
- dry weather sampling protocols, and
- other major programs (including public education, new development planning procedures, and construction site sediment control).

Local construction site erosion control efforts typically include mulching, diversions, filter fencing, and sedimentation practices. Stormwater control is accomplished through many activities, including public works practices (street and inlet cleaning, litter control, oil/water separators, inappropriate discharge elimination, grass swales, and grit chambers), infiltration (porous pavement and grass filters), sedimentation (wet detention ponds and wetlands), and other activities (including dry detention ponds, filtration, and public education). The performance of many of these devices has been determined through local monitoring. The district identified severe problems with typically constructed sand filters, such as clogging caused excessive bypassing of untreated water. Design guidelines need to be modified to account for expected high suspended solids loadings and to enable more efficient maintenance. Monitoring a wet pond followed by a series of wetland cells showed moderate to high levels of control of many pollutants over a wide range of runoff conditions.

Stream restoration along the Platte River has also been successful. Denver is well known for Confluence Park, a $7.5 million project that incorporates flood control, boating access, recreation, 5 acres of wetlands, wildlife and aquatic habitat, plus a cooling water diversion structure for a power plant. Denver also had constructed more than 12 miles of recreational trails along the South Platte River within the city, which connects with six other trails having an additional 50 miles.

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7.2.4 Milwaukee, Wis.

SW Community Characteristics

♦ Population	630,000
♦ Sewer Area	61,500 Ac
♦ Annual Rainfall	30"
♦ # of SSO Discharge Points	Unknown

Distinctive SW Community Attributes

- Extensive SW quality information
- Watershed approach and nonpoint source pollution control

Milwaukee has a great deal of SW quality information and a state regulatory program that has put these data to good use in a watershed context.

Milwaukee was incorporated in 1846 and has been known as a heavily industrialized city, although it is more diversified now. It had a population of abut 630,000 in 1990 and a land area of about 96 mi². Its elevation is about 600 ft. The central part of Milwaukee has a combined sewer system, but the vast majority of the city and most of the surrounding communities have separate storm drainage. The storm drains flow to Lake Michigan, with most stormwater flowing from the Milwaukee, Kinnickinnic, and Menomonee Rivers (which form the inner harbor) from urbanized tributaries (such as Lincoln Creek). The annual rainfall in Milwaukee is about 30 inches, and snow cover is common for several months each winter. Winter temperatures can be severe and snowmelt is an important contributor to urban runoff pollution, in addition to rainfall induced runoff.

Stormwater quality management in the Milwaukee area was initiated as part of the Wisconsin Priority Watershed Program. This program (one of the oldest in the nation funding nonpoint pollution abatement) was developed in 1978 to help combat both urban and rural nonpoint sources of pollution. An important element of the program is retrofitting control practices in both rural and urban areas. Initially the program was heavily involved in rural areas, with technical assistance from the National Resources Conservation Service (NRCS). A unique aspect of the program is that it is implemented on a watershed and not on a political jurisdiction basis. Of the state's 330

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watersheds, 130 (mostly located in the southern part of Wisconsin) will likely require comprehensive management activities to control nonpoint pollutants. A 25-year plan was developed in 1982 that requires the startup of about eight or nine new watershed abatement efforts per year. The watershed plans are prepared by the state with cooperation and reviews by local government agencies. They contain detailed analyses of the water resources objectives (existing and desired beneficial uses including the problems and threats to these uses), the critical sources of problem pollutants, and the control practices that can be applied within each watershed. The plans also include implementation schedules and budgets to meet the pollution reduction objectives.

Each plan requires one year to prepare, including the necessary fieldwork. Various field inventory activities are needed to prepare the plans, including aquatic biology and habitat surveys to identify existing and potential fishery uses, streambank surveys to identify the nature and magnitude of streambank erosion problems and to help design needed controls, field and barnyard surveys to supply information needed to estimate and rank their pollution potentials and to design farm control practices, and urban surveys needed to evaluate urban runoff pollution potential and its control.

Urban planning was initiated in 1983 in the Milwaukee and Madison areas, with other urban areas of the state following. The urban practices eligible for cost sharing identified in these plans have included streambank protection, detention basins, and infiltration devices for existing urbanized areas. Construction site erosion controls are also usually required as a condition for a grant agreement in an urban area, but they are not eligible for state cost sharing. About $3 to $5 million per year will be used by the nonpoint source program over a 20-year period in controlling urban runoff.

The Wisconsin nonpoint source plan addresses watersheds, not just political areas. The Milwaukee River basin contains 500 streams, 100 lakes, and 60,000 acres of wetlands in its 900-square-mile watershed. The city of Milwaukee is at the terminus of the river, where it discharges into Lake Mich. The water quality in the watershed varies dramatically, from excellent in many headwater trout streams to poor in the heavily urbanized southern portions of the basin. The Milwaukee Basin Priority Watershed Program started in 1985 as a voluntary program to address both urban and rural sources of nonpoint pollution. More than 500 rural landowners and 26 local governments have participated in the program, with total local and state investments of about $40 million.

An outcome of the Milwaukee River South Watershed plan included goals for reducing urban SW discharges. These goals were 50% reduction for suspended solids and heavy metals, and 50% to 70% reduction for phosphorus. The city cleanup program has four elements:

- local controls on construction erosion,
- improved SW management,
- better urban housekeeping, and
- streambank erosion controls.

The city identified construction site erosion as the leading cause of sediment into the Milwaukee River South watershed. Of the annual 26,000 tons of sediment, about 62% comes from construction sites, while only 16% comes from cropland, with the remainder from urban SW and streambank erosion.

A Wisconsin Pollutant Discharge Elimination System permit (under EPA NPDES authority) was issued to Milwaukee in October 1994. It covers SW discharges from more than 200 major outfalls to area streams and Lake Mich. The permit addresses discharges from Milwaukee and another 26 local communities. These communities each pay the Wisconsin Department of Natural Resources $5,000 per year as a permit fee, totaling more than $1 million for the 5-year permit period.

An important part of the Milwaukee wet weather flow program is monitoring urban streams to identify and quantify actual receiving water problems. Milwaukee participated in the early International Joint Commission studies with Canada to characterize discharges into the Great Lakes. Milwaukee was also a participant of NURP in the early 1980s. During NURP, eight single land use catchments were extensively monitored for three years in cooperation with the U.S. Geological Survey. The benefits of street cleaning as a pollutant discharge reduction practice were included in this effort. Snowmelt characterization monitoring and effects of de-icing compounds have also been extensively studied in Milwaukee. Recently, detailed studies on toxicant sources, effects, and controls have also been conducted in Milwaukee, including a study conducted in heavily urbanized Lincoln Creek (a 19mi.^{2} watershed, 9 miles long). A seven-tiered indicator program, incorporating many physical, chemical, and biological tests, was simultaneously conducted which identified long-term toxicity problems likely associated with re-suspended contaminated sediments having high levels of organic compounds. It was found that discharges of these fine sediments could be significantly reduced through the use of well-designed and maintained wet detention basins. The instream toxicity monitoring methods developed and used during the Lincoln Creek study can be used by other municipalities to answer the following basic questions:

- Are toxic conditions present?
- What is causing the toxicity?
- How much is too much urbanization? and
- Can SW controls reduce these problems?

The benefits of SW controls have also been evaluated in Milwaukee, especially grass swales, wet detention ponds, and underground devices for critical source areas. The Southeastern Wisconsin Regional Planning Commission also prepared a comprehensive report documenting costs associated with construction site erosion and SW control.

In addition, the Wisconsin Nonpoint Source Program includes an important public education component. Milwaukee conducted a survey to identify the most likely successful public education program. The more than 3,000 responses indicated that TV news stories, newspaper articles, targeted newsletters, and pamphlets would be most effective. Site visits, workshops, and videos were unlikely to be successful. The survey also found that more than 90% of Milwaukee respondents were willing or are already doing activities to protect water quality (recycling used oil, separating household hazardous wastes, limiting landscaping chemicals, controlling dog wastes, etc.). Virtually all of the respondents rated the local waters as poor to fair and less than 10% used the local waters for any recreational activities. However, more than half were willing to pay more than $50 per household per year for programs to protect and restore local waters.

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7.2.5 Orlando, Fla.

SW Community Characteristics

♦ Population	165,000
♦ Sewer Area	100,000 Ac
♦ Annual Rainfall	50"
♦ # of SSO Discharge Points	1,000

Distinctive SW Community Attributes

- Recipient of EPA's SW award in 1990

Orlando is known for its long history of SW management, including receiving the U.S. EPA's SW award in 1990. The city has extensive local data, especially concerning the performance of SW controls in its unique area, which has heavy rains, flat topography, high groundwater, and highly percolating sandy soils.

Orlando is located in central Florida and had a 1990 population of about 165,000. The area receives about 50 inches of rainfall each year, mostly occurring in the summer. Most of the area is underlain with sandy soils. Therefore, urban development produces dramatic increases in runoff volumes and rates as the highly percolating soils are covered with impervious surfaces. The infiltrating water recharges the Floridan Aquifer, the major drinking water supply for most of central Florida. The area is relatively flat, at about 100 feet elevation. The city of Orlando contains 82 named lakes and several hundred drainage wells that receive SW runoff from the separate storm drainage system.

Florida began to investigate SW pollutant sources in the 1970s as part of the Section 208 requirements of the Clean Water Act. The Florida Department of Environmental Regulation and 12 regional agencies received many large Section 208 grants to assess the extent of the state's nonpoint pollution problem and to develop technical and administrative methods for treatment and control. The state had authority to draft regulations pertaining to SW control as part of its existing environmental laws. The first official state regulation addressing SW was adopted in 1979 based on the results of the Section 208 studies that found urban SW was responsible for:

- 80 to 95% of the heavy metal loadings to Florida surface waters,
- almost all of the sediment deposited in state waters,
- 450 times the suspended solids and 9 times the BOD loads compared to typical municipal wastewater treatment facilities, and
- nutrient loads about the same as those being discharged from typical municipal wastewater treatment facilities.

The state regulations were revised several times for clarification and to ensure long-term operation through adequate maintenance and better design.

The Florida Department of Environmental Regulation requires SW controls for new development. The requirements specify that the first 0.5 inch of runoff, or the runoff from 1 inch of rain, whichever is greatest, be treated. This regulation is thought to result in about 80% to 85% of the annual pollutant loads being treated. Orlando published one of the earliest SW management guides (Orlando Urban Storm Water Management Manual) in 1984 to assist developers in meeting these requirements. Stormwater wet detention ponds, excavated into the groundwater, were the first controls commonly used. Research has investigated the performance of these and other devices, including their potential impacts on groundwaters. Outfall screening devices and street cleaning (especially in March when the leaves from oak trees fall) were also thought to be an effective control for lakes. Sand filters, grass swales, wetlands, and alum injection have also been used and tested in the Orlando area.

The Orlando urban stormwater management program was established in the early 1980s to address increasing SW runoff quality and quantity problems resulting from new development. Orlando sponsored a lake assessment study in 1983 to evaluate the city's lakes in response to residents complaints of deteriorating water quality. The assessment study resulted in a priority listing of lakes needing remediation assistance. Large regional facilities (such as the Lake Greenwood Urban Wetland project) have been retrofitted in existing urban areas, and alum injection facilities have also been added to several existing urban lakes.

The preferred SW control practices in Orlando are off-line retention, filtration, and both dry and wet detention ponds. Source controls, as described in the local manual, are encouraged. The performance standards are to reduce the annual average suspended solids loadings by 80%.

The city received its NPDES SW permit and funds local oversight through the Orlando SW utility. The current utility fee is $36 per residential household equivalent per year. The total annual budget is $1.25 million, of which about 90% is from the utility fee. The utility has four administrators, four engineers, 18 inspectors, two scientists, and five clerical support staff. Educational programs are a voluntary component of the program, with the utility presenting more than 40 programs each year to educate the general public about SW management. Local volunteers also participate in the Florida Lake Watch program. The city has a limited program to monitor the water quality in the city's lakes to measure success of the SW management program. As noted previously, numerous research projects have also been conducted in Orlando to evaluate the performance of SW management practices.

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7.3 SW Case Histories and Benchmark Data Discussion

7.3.1 General SW Discussion

Community accomplishments in addressing SW concerns are highly varied throughout the U.S. In most cities, very little has been done beyond basic SW drainage. In a few communities (such as those selected for discussion in the case studies), early concerns by the public about declining water quality resulted in attempts to manage SW quality. After drainage problems were brought under control, usually through master planning and the construction of large-scale facilities, construction erosion control was usually implemented. With these important considerations addressed, some of the communities were able to address SW quality. Some stressed controls for new developments, while a very few examined retrofit opportunities (Wisconsin's Priority Watershed Program, for example).

Historically in almost all communities in the U.S., SW management only addressed drainage issues, because scarce local resources were needed for more pressing issues. Such communities are only able and willing to participate in SW management at the most basic and minimal level. Without specific guidance and requirements contained in local and state ordinances, very little SW quality management was conducted in most communities. In fact, some communities backed off from prior rigorous attempts at SW quality management to more minimal efforts that barely meet existing regulations.

With the Clean Water Act SW NPDES permit program in place, SW quality management is no longer a luxury program only being conducted in rapidly growing sunbelt communities that have the resources and motivation. Because of the large number of communities involved in the first and second phases of the NPDES SW permit program, the federal and state approach has been to define relatively basic requirements for the permits, with generally few specified control goals. Obviously, submitting all the municipal permits (along with the new industrial SW permits required at the same time) has produced a financial, logistic, and management problem for state agencies and EPA regions. It is apparent that the main goal was to get the permits issued in a timely manner, while accomplishing such basic and necessary goals as drainage area characterization information; screening for inappropriate discharges at storm drain outfalls; starting erosion control programs; establishing local authority over the drainage system; and developing a financial basis for management of the program. Even with the relatively simplified permit process and requirements, however, large municipalities (in phase one of the program) often spent more than $1 million each to gather the necessary information and to prepare and submit the permit applications.

The requirements included in the issued permits rarely specified any control goals or management needs beyond conducting an outfall monitoring program of about three storms a year at about five land use sites. The permits are generally issued for 5 years, with the expectation that specific control requirements would be added during subsequent periods as local problems become better defined. Nearing the tenth year of the SW NPDES program, medium cities (between 100,000 and 500,000 population) have also submitted permit applications and most have received their initial permits, and small communities (greater than 10,000 in population) are to be included in the program within a year. Therefore, the SW permit program burden on the regulatory agencies has increased, with little opportunity for increased site-specific control objectives to be included in the permits. The role of TMDL allocations was to be a tool to determine allowable discharges of SW and point source permits to a watershed's receiving waters. However, there is still much concern, and therefore delay, in allocations.

Most of the specific accomplishments of SW quality have occurred in communities with flooding/drainage problems, scarce water resources, and the financial ability (usually through local funding mechanisms). Specific requirements by local communities, and some state agencies, are the driving force behind these major accomplishments. Federal legislation now requires SW quality management at most levels of government. However, the direct application of approaches from the few communities currently having successful SW quality management programs may not be workable. All these communities have found that advances have been slow and greater public awareness and understanding (especially when local funding is involved) is needed. Specific guidance and requirements, along with strenuous enforcement, are also necessary components of successful programs; voluntary efforts by themselves are rarely adequate.

7.3.1.1 *Stormwater Quality Problems as the Driving Force*

The main purpose of treating SW is to reduce its adverse impacts on receiving water beneficial uses. Therefore, any urban SW runoff study must assess the detrimental effects that runoff is actually having on receiving water. Urban receiving waters may have many beneficial use goals, including:

- stormwater conveyance (flood prevention);
- biological uses (warm water fishery, aquatic life use, biological integrity, etc.);
- non-contact recreation (linear parks, aesthetics, boating, etc.);
- contact recreation (swimming and wading); and
- water supply.

With full development in an urban watershed and no SW controls, it is unlikely that any of these uses can be attained. With less development and the application of SW controls, some uses may be possible. But unreasonable expectations should not be placed on urban waters, as the cost to obtain these uses may be prohibitive. With full-scale development and lack of adequate SW controls, severely degraded streams will be common. However, SW conveyance and aesthetics should be the basic beneficial-use goals for all urban waters. Aquatic life use should also be a goal, but with the realization that the natural stream ecosystem will be severely modified with urbanization.

Certain basic SW controls, installed at the time of development, plus protecting stream habitat, may enable partial realization of some of these basic goals in urbanized watersheds, but careful planning and optimal utilization of SW controls are necessary to obtain these basic goals in most watersheds. Water contact recreation, consumptive fisheries, habitat for sensitive aquatic organisms, and water supplies are not appropriate goals for most urbanized watersheds. However, these higher uses may be possible in urban areas where the receiving waters are large and drain mostly undeveloped areas.

The latest National Water Quality Inventory released by the U.S. EPA showed only slight improvement in attaining beneficial uses in the nation's waters. Urban runoff was cited as the leading source of problems in estuaries, primarily from nutrients and bacteria. Problems in rivers and lakes were mostly caused by agricultural runoff, with urban runoff the third-ranked source for lakes and fourth ranked for rivers. Bacteria, siltation, and nutrients were the most significant problems in rivers and lakes.

In general, urban SW runoff monitoring has indicated that the biological beneficial uses of urban receiving waters are most likely affected by habitat destruction and long-term pollutant exposures (especially for macroinvertebrates via contaminated sediment), while documented effects from acute exposures to toxicants in the water column are rare. Receiving water pollutant concentrations resulting from runoff events and typical laboratory bioassay test results have indicated few significant short-term receiving water problems. Therefore relating actual receiving water problems to conventional numeric standards is difficult. Interest in developing special wet weather standards, especially considering contaminated sediments, intermittent exposures to high flows, and habitat destruction exists. Using local reference stations for comparison is usually necessary to identify local problems and the needed extent of SW discharge reductions.

7.3.1.2 Changes in Stormwater Management and Attitudes with Time

In 1967, researchers at the University of Wisconsin distributed a survey to engineers in the state, the main objective of which was to determine the level of service considered adequate. This questionnaire explored design procedures and policies. In 1997 a survey by the University of Alabama at Birmingham was mailed to over 350 recipients in engineering firms and municipal water authorities across the nation. This recent survey was designed to examine changes in design methods, objectives, and understanding of SW quality problems over this 30-year period. The university received about 85 responses (mostly from Minnesota, Ohio, New York, Florida and California), about half of whom were consulting engineers in private practice and the other half engineers with municipalities. Tables 7-7 and 7-8 present the findings from the 1997 survey and compare them to the 1967 survey.

7.3.2 SW Questionnaire Findings

7.3.2.1 SW Community Statistics

The returned SW benchmark questionnaires cover communities with a wide range of conditions and receiving waters. Most discharge SW into rivers, streams, or lakes, but the ocean, groundwater, and estuaries are also represented by one city each. Almost all communities discharge into several different types of receiving waters.

Three communities (Boston, Denver, and Detroit) have populations greater than 1 million, while the other 12 cities have populations less than 500,000. All manage total drainage areas of more than 1,000 acres (most greater than 10,000 acres) and had more than 50 outfalls (except for Orem, Utah, which reported less than 10 discharge points). Annual rainfall was less than 20 inches for three cities (Burbank, Denver, and Orem), between 20 and 30 inches in one city (Fridley), between 30 to 40 inches in six cities (Austin, Bellevue, Detroit, Hillsboro, River Falls, and Struthers), and more than 40 inches in four cities (Birmingham, Boston, Frederick, and Orlando).

Table 7-8. 1997 Stormwater Management Design Survey Responses

Practice	Response (Percentage of Respondents if Reported)				
Design Storm Used	5 year (10%)	10 year (42%)	25 year (7%)	100 year (9%)	
Method of Design	Rational (41%)	NRCS (SCS) (14%)	Combination (31%)	Regional (13%)	
Tools Used	Computerized tools (86%)	SWMM (25%)	HEC-1 (17%)		
Conditions of Failure	Manhole covers popping off	Water rising above curbs	Water in Basements		
Water Quality Concern	Sediment (60%)	Nutrients (35%)	Metals (34%)	Oil & Grease, Bacteria, Toxicants, Floatables, and Salts.	Staying within regulated discharge limits

Table 7-9. Stormwater Management Design Survey Comparison 1967 versus 1997 Results

	1967 Survey Responses	1997 Survey Responses
Design Storm	5 to 10 year (70%)	Approximately the same range, most using the 10 year.
Method of Design	Rational (Most cities misapplied the runoff coefficient or rainfall intensity)	Rational (Understood the use of Time of Concentration)
Indicator of Failure	Water ponding at inlets Water ponding in back yards.	Water ponding at inlets, but not a prevalent concern. Not a high priority for today's design engineers.
Water Quality Concerns	Sediments, Nutrients, Metals, Oil & Grease, Bacteria, Toxicants, Floatables, Salts, and Staying within regulated discharge limits.	

Few cities reported annual SW discharge quantity; however, the quantity may be estimated using a few assumptions. As an example, for the smallest reported service areas of 1,000 acres and 10 inches of annual rainfall with a reasonable arid area volumetric runoff coefficient of 0.2, the annual runoff volume would be about 50 million gallons. In a small city of only 10,000 acres (15 square miles), with an annual rainfall of 30 inches and a Rv of 0.3, the annual SW runoff discharges would be increased to more than 2,500 million gallons.

7.3.2.2 SW Public Participation

Only five communities (Birmingham, Frederick, Fridley, Orem, and Struthers) reported no public participation. However, at least Birmingham and Frederick do have public participation programs, but the responders possibly thought that their programs did not include any of the program elements listed. It is hard to imagine that public hearings would not be used for all major public works projects associated with SW projects.

Signs and general public education were most commonly indicated methods for informing the public, while the more successful TV addresses and newsletters were parts of only two community efforts. The least successful tools, neighborhood meetings and videos available for loan from the local libraries, were not listed by any of the respondents. Bellevue sponsored community educational projects, and receiving water monitoring by citizen volunteers was reported by Austin and Orlando. As part of its NPDES permit requirements, Birmingham is starting a new monitoring effort using local volunteers to investigate inappropriate discharges into storm drainage.

Basement flooding, along with general water quality, were the most commonly listed public concerns (11 and 9 cities, respectively). Aquatic life, street flooding, general recreation, water contact recreation, and public health were all noted by 3 cities each.

7.3.2.3 *SW Systems Characteristics*

Seven responding cities did not have a mathematical model of their SW systems, while three did. However, all (except Birmingham and Orem) indicated that a watershed approach has been taken.

Almost all cities included municipal and industrial point sources plus urban runoff among their current pollutant abatement efforts. Four communities indicated that agricultural runoff was also being controlled in their watersheds. Control efforts for the same targeted pollutant sources were generally expected to remain in the future. However, little documented performance information for urban runoff abatement efforts is available from the cities. Most cities listed estimated abatement levels only, with no monitoring programs either in the receiving waters or at outfalls to quantify any discharge reductions.

7.3.2.4 *Issues Driving SW Technical Considerations*

Only three cities (Birmingham, Boston, and Frederick) indicated that a SW facility plan was not started yet, three (Austin, Bellevue, and Detroit) indicated that the facility plans were completed, while six others indicated that plans were in progress.

All respondents indicated that regulatory requirements were the main driving force in their SW quality management efforts, with the exception of Boston. Litigation and lawsuits were also primary motivation sources for SW abatement in three cities. Five of the cities had no permitted facilities, while three cities listed up to 10 permitted facilities, and one city (Frederick) listed more than 100 permitted facilities.

Water quality criteria for local receiving waters included the following parameters (in order of most frequent mention): bacteria, dissolved oxygen, nutrients/floatables (tie), BOD/toxicants/sediment (tie), and finally temperature and heavy metals (only one city each).

Cost/benefit analyses were used by six cities, but regulatory requirements directed the selection of the abatement technology in 11 of the cities. Almost all technologies (construction site erosion controls, public works practices, and sedimentation) were being used by almost all communities. Infiltration practices were the least popular option.

7.3.2.5 *SW Financial Considerations*

Only Detroit listed significant past expenditures for past SW abatement efforts (at more than $500 million), while five others (Austin, Boston, Denver, Orem, and Struthers) all listed less than $10 million. Detroit also listed a similar level for future expenditures, while the others remained the same, except for Denver and Orem which expected an increase of $10 million to $50 million. Birmingham is starting a stream corridor protection program at a cost of about $30 million, as part of the settlement of a local lawsuit concerning wet weather flow pollution abatement.

The funding sources were varied, with fees from utility districts being most common (five cities), followed by "other" (four cities), then increased sewer rates, state grant money, federal grant money, and increased taxes (tied with three cities each), and finally revolving loans (two cities).

CHAPTER 8.0

COST-BENEFIT ANALYSIS

8.1 Syracuse, N.Y., Case Study

The Syracuse, N.Y., case study serves as a good example of a cost-benefit approach to abating wet weather pollution in that the decision-making process involved all the critical components of the community, from the technical engineers to the municipal government budget and financial management departments.

Syracuse began its CSO abatement program in the early 1970s with the country's first full-scale demonstration of an U.S. EPA vortex and disinfection facility. A very successful BMP program followed in the middle 1980s. The CSO abatement program was expedited in 1989 as a result of a legal consent order. During the early stages of the consent order process, several planning meetings were held under Section 208 of the 1972 Clean Water Act Amendments. These meetings culminated in a work plan for the CSO abatement program, which required the consensus of stakeholders on the storm frequency that would serve as a reasonable target for abatement.

All parties, including local health and state regulatory agencies, agreed that a 1-year storm frequency would be used to size the wet weather pollution abatement facilities. Figure 8-1 illustrates an inflection (knee of the curve) in the system conveyance capacity at the 1-year storm recurrence interval. It was agreed that such a storm would likely be a convective storm occurring in the summer months when base flow in receiving water streams would be low. It was also agreed that such a combination of wet weather pollution and low stream flow represented reasonably stringent conditions.

Once the 1-year storm recurrence interval was agreed upon, five abatement strategies were evaluated using a cost-benefit analysis on the basis of bacteria, solids, and BOD improvements in the receiving water. Figures 8-2 and 8-3 show these relationships. Figure 8-3 illustrates the point of inflection for the cost curve occurring at the "Regional" abatement alternative. The regional abatement alternative included satellite treatment facilities designed to control bacteria, solids and floatables, in-system storage, and some sewer separation. This alternative was adopted as the accepted CSO abatement plan. The location of these satellite treatment facilities, known as regional treatment facilities, is illustrated in Figure 8-4.

Further application of the cost-benefit analysis was used to justify the need for all satellite treatment facilities to control bacteria, solids, and floatables. Detailed system and receiving water bacterial modeling demonstrated that the facilities needed to control bacteria and solids loadings to the receiving waters were not as great as originally estimated. All parties agreed to reduce some of the regional treatment facilities to floatables control facilities. This reduced the CSO abatement costs from $267 million to $144 million.

The construction planning for the regional treatment facilities and floatables control facilities ultimately culminated in a 15-year build out period that would progressively achieve full compliance during that time. This compliance was in terms of both the presumption and demonstration clauses of the federal CSO policy as illustrated by Figures 8-5 and 8-6.

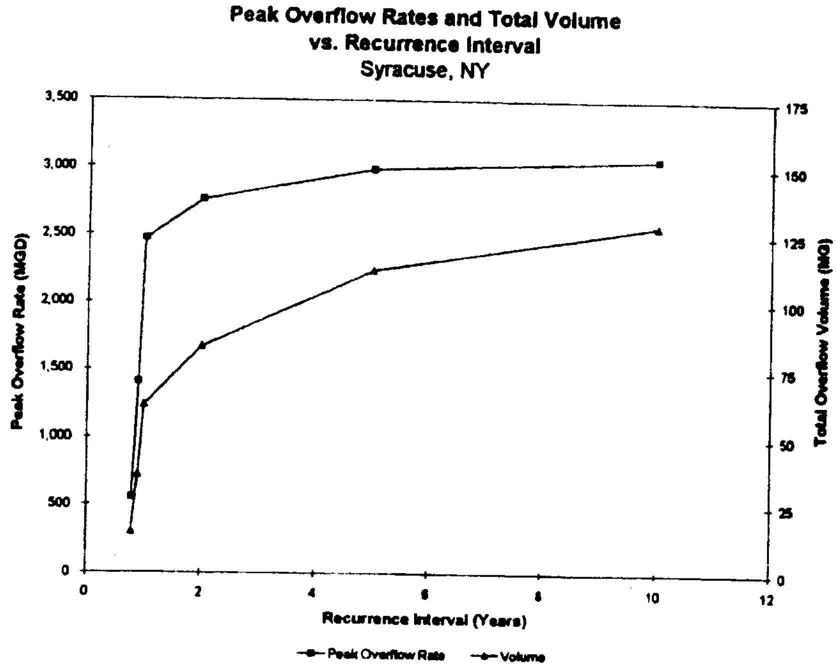

Figure 8-1. Peak Overflow Rates and Total Volume versus Recurrence Interval, Syracuse, N.Y.

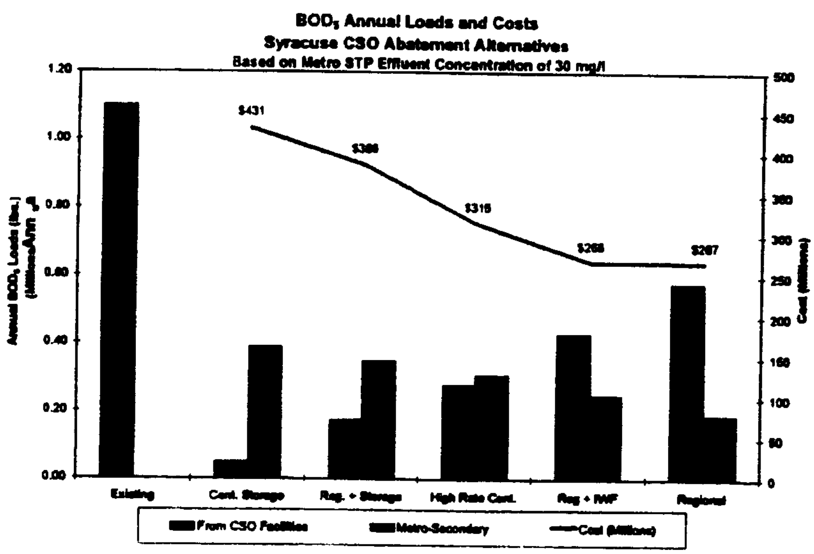

Figure 8-2. BOD Loads and Costs, Syracuse N.Y., CSO Abatement Alternatives

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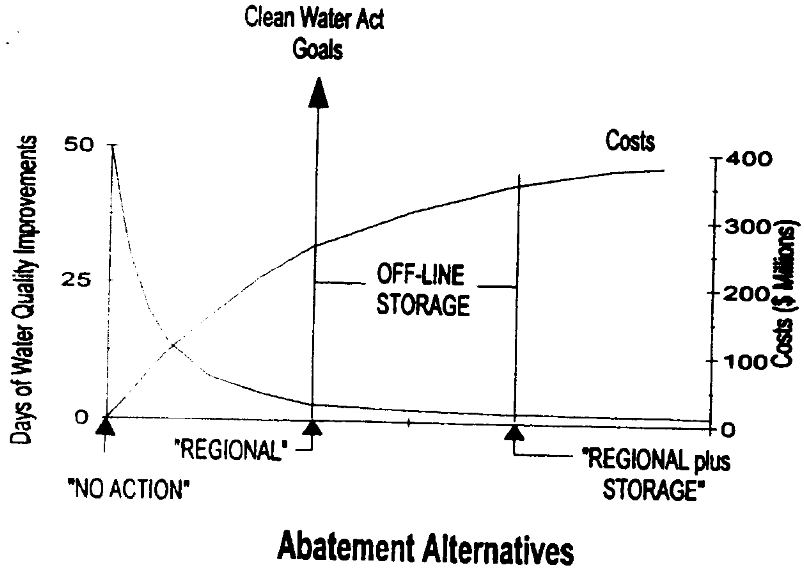

Figure 8-3. Abatement Alternatives versus Days of Water Quality Improvements, Syracuse, N.Y.

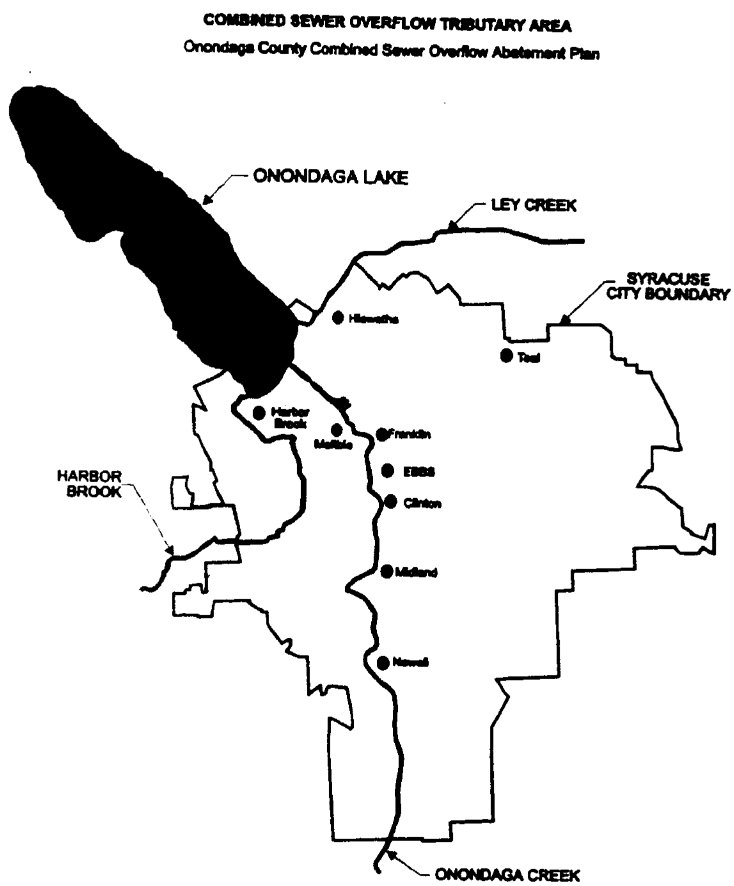

Figure 8-4. Onondaga County CSO Tributary Areas and CSO Regional Treatment Facilities

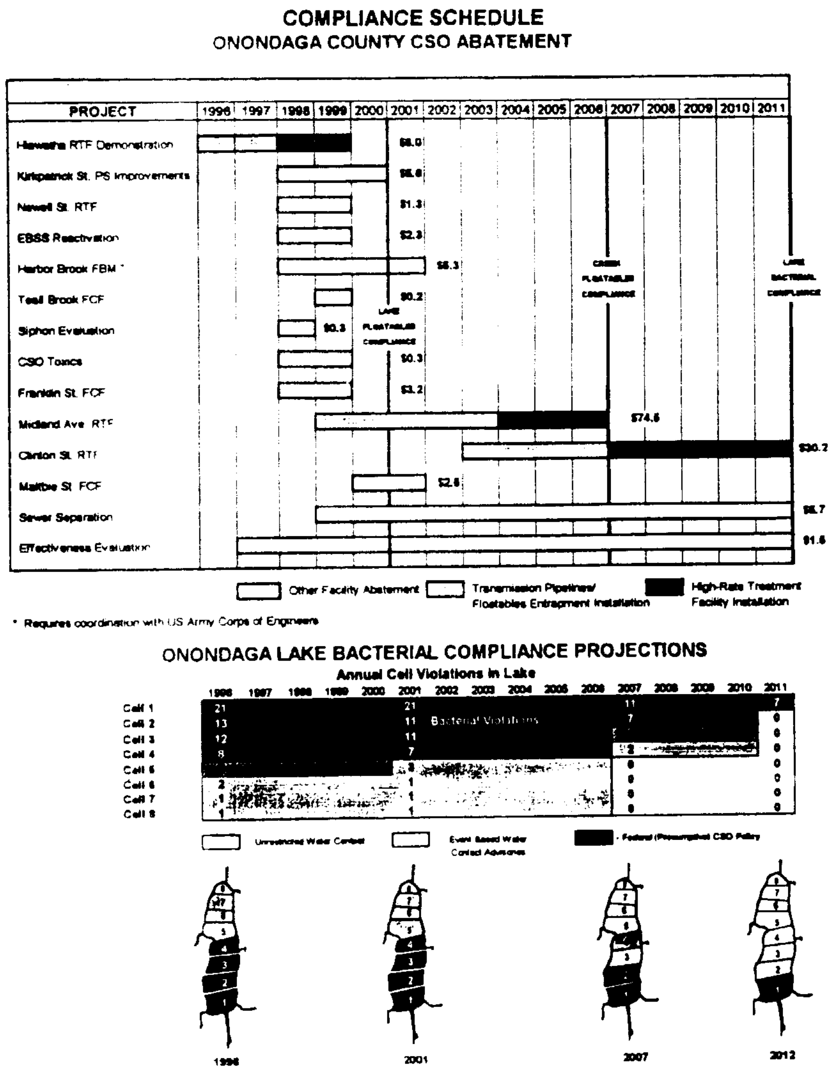

Figure 8-5. CSO Abatement Compliance Schedule, Onondaga County, N.Y.

WET-WEATHER COMBINED SEWER SYSTEM FLOWS

Regional Facility	Total Wet-Weather Flow in CSS (MG)	Average Annual Interceptor Flow (MG)	Regional Facility CSO Discharge (MG)	RTF Captured Flow (MG)	Percent Capture
INTER[illegible]					
Harbor Brook FBM	458.39	331 [illegible]	37 92	88.49	92%
Hiawatha RTF	57.90	33 50	0.62	23.78	99%
Teall FCF	84.19	76 79	7.40	0.00	91%
EBSS	284.32	0 00	56.96	228.36	80%
Newell RTF	7.22	3.62	1.70	1.90	76%
INTERMEDIATE PROJECTS					
Midland RTF	574.59	275.39	112.40	186.80	80%
Clinton RTF	543.58	401 68	88.48	55.42	84%
Franklin FCF	527.11	443.81	77.29	6.01	85%
Maltbie FCF	67.79	40.89	21.54	5.36	68%
TOTAL	2605.09	1607 66	401.31	596.12	85%

Figure 8-6. Wet Weather Combined Sewer Flows, Syracuse, N.Y.

An integral part of the decision making process during construction planning was resolving the issue of affordability. The affordability analysis was used to evaluate the financial impacts of the CSO abatement program. Once the technical solution was agreed on and planning level cost estimates were developed, the municipal budget and financial management department began to evaluate the cost impacts of various construction schedules; 15 distinct projects were evaluated in time frames varying from 15 to 25 years. An example is shown in Figure 8-7. Corresponding plots of unit charge and debit service as a percent of median household income were developed as illustrated by Figures 8-8 and 8-9, respectively. These dollars represent the combined costs of the CSO abatement program and the WWTP improvements program.

WET-WEATHER COMBINED SEWER SYSTEM FLOWS

Regional Facility	Total Wet-Weather Flow in CSS (MG)	Average Annual Interceptor Flow (MG)	Regional Facility CSO Discharge (MG)	RTF Captured Flow (MG)	Percent Capture
INTERIM PROJECTS					
Harbor Brook FBM	458.39	331.98	37.92	88.49	92%
Hiawatha RTF	57.90	33.50	0.62	23.78	99%
Teall FCF	84.19	76.79	7.40	0.00	91%
EBSS	284.32	0.00	56.96	228.36	80%
Newell RTF	7.22	3.62	1.70	1.90	76%
INTERMEDIATE PROJECTS					
Midland RTF	574.59	275.39	112.40	186.80	80%
Clinton RTF	543.58	401.68	86.48	55.42	84%
Franklin FCF	527.11	443.81	77.29	6.01	85%
Maltbie FCF	67.79	40.89	21.54	5.36	68%
TOTAL	2605.09	1607.66	401.31	596.12	85%

Figure 8-7. Annual Cost per Regional CSO Treatment Facilities

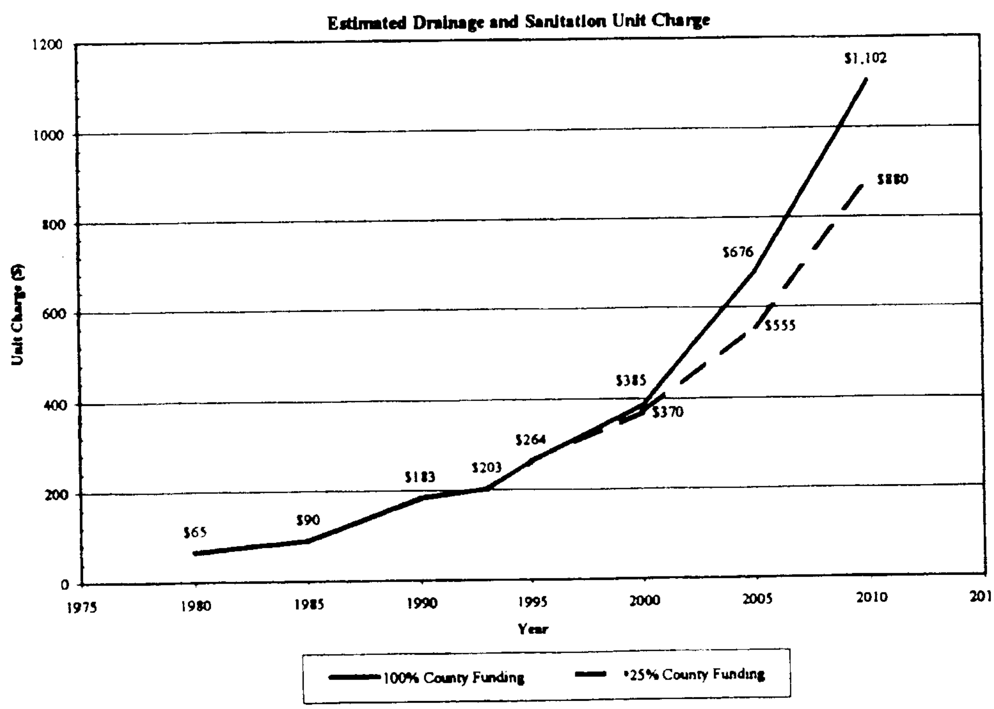

Figure 8-8. Estimated Drainage and Sanitation Unit Charges, Syracuse, N.Y.

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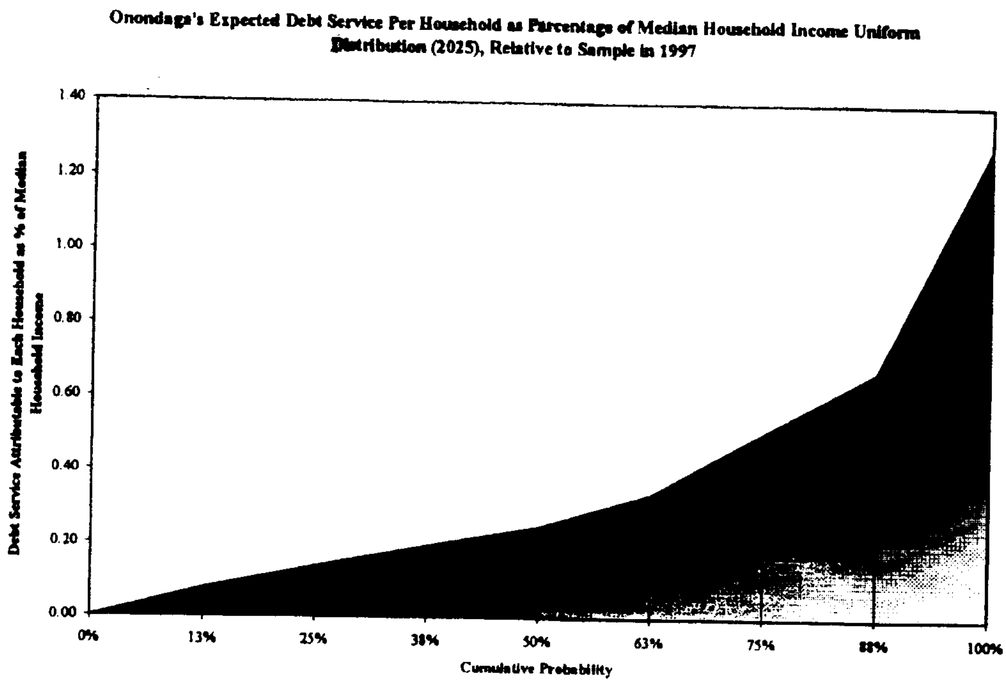

Figure 8-9. Expected Debt per Household as Percentage of Median Income, Onondaga County, N.Y.

Despite the fairly flat growth of population and service expected in the Syracuse area, the debt service fell within the allowable 2% guide stated in the federal CSO control policy. Consequently, the state and U.S. EPA required that a 15-year schedule be implemented. Milestone dates for specific completion projects of construction were incorporated into the Consent Order which was signed in October 1997.

National CSO Control Policy

The National CSO Control Policy contains four key principles intended to ensure that CSO controls are cost effective and meet the requirements of the Clean Water Act (CWA) of 1972 and its amendments:

- provide clear levels of control that would be presumed to meet appropriate health and environmental objectives;
- provide sufficient flexibility to CSO communities, especially those that are financially disadvantaged, to consider the site-specific nature of CSOs and to determine the most cost-effective means of reducing pollutants and meeting CWA objectives and requirements;
- allow a phased approach for implementation of CSO controls considering a community's financial capability; and
- review and revise, as appropriate, water quality standards and their implementation procedures when developing LTCPs to reflect the site-specific wet weather impacts of CSOs.

Nine Minimum Controls

1. Proper operation and regular maintenance programs for the sewer system and the CSOs. This control should consist of a program that clearly establishes operation, maintenance, and inspection procedures to ensure that a combined sewer system (CSS) and treatment facility will function in a way to maximize treatment of combined sewage and still comply with NPDES permit limitations.

2. Maximum use of the collection system for storage. This control consists of making relatively simple modifications to the CSS to enable the system to store wet weather flows until downstream sewers and treatment facilities can handle them.

3. Review and modification of pretreatment requirements to ensure that CSO impacts are minimized. The objective of this control is to minimize the impacts of discharges into CSSs from nondomestic sources during wet weather events and to minimize CSO occurrences by modifying inspection, reporting, and oversight procedures within an approved pretreatment program.

4. Maximizing flow to the POTW for treatment. This control entails simple modifications to the CSS and treatment plant to enable as much wet weather flow as possible to reach the treatment plant.

5. Eliminating CSOs during dry weather. This control includes any measures taken to ensure that the CSS does not overflow during dry weather conditions.

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6. Controlling solid and floatable materials in CSOs. This control is intended to reduce, if not eliminate visible floatables and solids using relatively simple measures including baffles, screens, racks, booms, and skimmer vessels.

7. Pollution prevention programs to reduce contaminants in CSOs. This control is intended to keep contaminants from entering the CSS and prevent subsequent discharge to receiving waters through street cleaning, public education, solid waste collection, and recycling.

8. Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts. This control is intended to let the public know where outfalls are located, when CSOs occur, what possible health and environmental effects are, and what recreational or commercial activities may be curtailed as a result of CSOs.

9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls. This control involves visual inspections and other simple methods to determine the occurrence and apparent impacts of CSOs.

Long Term Control Plan

The LTCP is a comprehensive plan that recognizes the site-specific nature of CSOs and their impacts on receiving waters. The long term planning approach consists of four major elements: system characterization; development and evaluation of alternatives; selection and implementation of controls; and compliance monitoring. A primary objective of the LTCP is to develop and evaluate a reasonable range of CSO control alternatives sufficient to meet water quality standards, including attainment and protection of designated uses on CSO-affected receiving waters. The CSO policy is flexible in allowing a CSO community to select controls that are cost effective and tailored to meet local conditions.

Two general approaches to attaining water quality standards are recognized in the CSO policy. These are the "demonstration" approach and the "presumption" approach. Both approaches provide CSO communities with targets for controls that achieve compliance with the CWA, particularly the protection of designated uses. Under the "demonstration" approach, water quality modeling or other tools are used to demonstrate that predicted CSO discharges resulting from the LTCP would be sufficient to attain water quality standards. The "presumption" approach is based on the premise that a LTCP that meets certain minimum defined performance criteria in terms of expected frequency of overflow or percent capture of the CSO pollutant load would be presumed to provide an adequate level of control to meet the water quality-based requirements of the CWA.

CSO communities are encouraged to meet and coordinate frequently with state water quality standards authorities and NPDES permitting authorities and to engage the general public in the planning process through public participation activities. In particular, developing goals, evaluating alternatives, and considering the local financial impacts of the LTCP should be a collaborative effort among all the participating interests. The developing performance measures or other measures of success to quantify environmental improvements and benefits related to CSO control is also a major element of the LTCP. Because of the site-specific nature of CSSs and CSO impacts, a strong linkage between performance measures and locally defined objectives is essential.

Presumption Approach

This approach allows a community to achieve an adequate level of control to meet the water quality- based requirements of the CWA if one of the following conditions are met.

1. No more than an average of four (4) overflow events per year. The permitting authority may allow up to two additional overflow events per year. An overflow event is one or more overflows from a CSS as a result of a precipitation event that does not receive the minimum treatment specified as:

   - primary clarification (removal of floatation and settleable solids equivalent to primary clarification) and
   - disinfection of effluent to meet water quality standards, including removal of harmful disinfection chemical residuals if feasible.

   Or, if the above is not met:

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2. The elimination or capture for treatment of no less than 85 percent by volume of the combined sewage collected on a system-wide annual average basis; or

3. The elimination or removal of no less than the mass of the pollutants identified as causing water quality impairment through the sewer system characterization, monitoring, and modeling effort, for the volumes that would be eliminated or captured for treatment under paragraph 2 above.

Demonstration Approach

The community that undertakes this approach should demonstrate each of the following:

1. The long-term plan is adequate to meet water quality standards (WQS) and protect designated uses, unless uses cannot be met as a result of other pollution sources, e.g., natural background conditions.

2. The CSO discharges remaining after plan implementation will not preclude the attainment of WQS designated uses of the receiving waters or contribute to their impairment. Where these conditions are not met in part because of natural background conditions or other pollutant sources, then wasteload allocations should be used to apportion loads. The total maximum daily load should serve as the basis for such allocations.

3. The long-term plan will provide the maximum pollution reduction benefits reasonably attainable.

4. The plan is designed to allow cost-effective expansion if additional controls are necessary.

Financial Capability Assessments

For CSO abatement, a community's financial capability is particularly important, since there are no clear wet weather standards for most states; the selection of a "design" storm has become a subjective decision based upon cost-benefit relationships. Additionally, other pollutants from the watershed in question may preclude the attainment of the "fishable-swimmable" goals of the CWA.

The policy identifies seven factors to be included in consideration of a community's financial capability, namely:

1. median household income;

2. total annual wastewater and CSO control costs per household as a percent of median household income;

3. overall net debt as a percent of full market property value;

4. property tax revenues as a percent of full market property value;

5. property tax collection rate;

6. bond rating; and

7. unemployment.

The following is an excerpt of the U.S. EPA document, "Draft CSO Guidance on Financial Capability Assessment and Schedule Development," developed by the CSO Partnership (*The CSO Bulletin*, April 1996).

"The CSO Policy provides that implementation schedules for CSO controls may be phased, based in part on a community's financial capability. The Guidance seeks to provide criteria for assessing financial capability and to relate that capability to appropriate compliance schedules. The goal of the guidance is to 'provide general boundaries to aid all parties in negotiating reasonable and effective schedules' for implementing CSO controls.

"The Guidance proposes a two-step approach for calculating economic capability. The first step focuses on the financial impact of current and proposed wastewater and CSO controls on individual households. The second step examines the debt, socioeconomic, and financial condition of a CSO community. The results of both steps are then combined into a 'Financial Capability Matrix' which is used to assess the financial burden attributable to CSO controls and to establish what EPA views as appropriate compliance schedules.

"Step One. This step calculates a Residential Indicator (RI), which is a measure of the CSO community's average cost per household for existing and proposed wastewater treatment and CSO controls, expressed as a percentage of local median household income (MHI). The Guidance proposes to establish three ranges for RIs with RIs of less than one percent MHI characterized as imposing a 'low' financial impact, RIs from one or two percent of MHI imposing a mid-range impact and RIs above two percent of MHI imposing a high impact.

"Step Two. The second step is to consider a community's financial Capability Indicators. EPA specifies six proposed indicators in the Guidance for evaluating community debt, socioeconomic, and financial conditions which affect a community's financial capability to implement CSO controls. The results of the six indicators are used to classify the community's financial capability as 'weak,' 'mid-range,' or 'strong.'

"The results of step one (Residential Indicator) and step two (Financial Capability Indicators) are then combined in a financial Capability Matrix which provides the basis for the permittee and NPDES permitting authority to negotiate an appropriate compliance schedule. The Financial Capability Matrix divides communities into three categories based upon their calculated burden under the Guidance (low, medium, o high), with equal weight given to the Community's RI and Financial Capability Indicators.

"Finally, the Guidance proposes the following general boundaries for compliance schedules based upon a community's calculated burden:

Low burden:	0-5 year compliance schedule
Mid-Range burden:	5-10 year compliance schedule
High burden:	10-15 year compliance schedule

"According to the Guidance, communities in the 'High burden' category may be able to negotiate compliance schedules as long as 20 years.

"The lack of supporting information to explain and justify EPA's selection of the Residential Indicator categories and the Financial Capability Indicator categories will make it difficult to evaluate whether the proposed categories are appropriate for CSO communities nationwide. For example, EPA does not provide any discussion of the number of CSO communities that can be expected to fall into the three categories proposed in the Financial Capability Matrix (low, mid-range, or high burden). Also, it is unclear how EPA arrived at its proposed ranges for the compliance schedules for communities falling with the three categories of financial burden."

MEMORANDUM: IMPLEMENTATION OF THE CSO CONTROL POLICY (REPRINT FROM U.S. EPA — OFFICE OF WATER)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAY 19 1998

MEMORANDUM

SUBJECT: Implementation of the CSO Control Policy

FROM: Robert Perciasepe
Assistant Administrator
Office of Water

Bob Perciasepe

Steven A. Herman
Assistant Administrator
Office of Enforcement and Compliance Assurance

TO: Water Management Division Directors, Regions 1-10
Regional Counsels, Regions 1-10
State Directors

The purpose of this memorandum is to discuss implementation of the Combined Sewer Overflow Control Policy (CSO Policy) and identify areas where heightened efforts are necessary.

The Environmental Protection Agency (EPA) published the CSO Policy on April 19, 1994 (59 FR 18688), following a negotiated policy dialogue among representatives from States, environmental groups, municipal organizations, and EPA. The CSO Policy provides for a phased process to bring communities with combined sewer systems into compliance with the technology-based and water quality-based requirements of the Clean Water Act. To date, EPA has released six guidance documents and continues to work with stakeholders to foster implementation of the Policy.

The CSO Policy is now four years old and continues to be recognized as an example of innovation and good government. In principle, EPA and its stakeholders continue to affirm the Policy's key themes, such as permitting flexibility, stakeholder coordination and public participation, financial capability as a factor affecting implementation schedules, and examination of water quality standards as appropriate. In practice, however, many challenges remain, and implementation of the Policy has not met some initial expectations.

Nine Minimum Controls. The CSO Policy's first key milestone was implementation of the nine minimum controls by January 1, 1997. The nine minimum controls are measures that can reduce CSOs and their effects on receiving water quality without requiring significant engineering studies, construction activity, or financial investment. In a November 18, 1996, memorandum to the Regional and State Directors, we communicated the importance of meeting this deadline.

Under the CSO Policy, implementation of the nine minimum controls should become an enforceable obligation through inclusion in an appropriate enforceable mechanism. The Policy describes how the nine minimum controls and other CSO requirements are to be included in National Pollutant Discharge Elimination System (NPDES) permits (renewed permits or reopened and reissued permits) or administrative orders. The November 18, 1996, memorandum reminded NPDES authorities that the approach identified in the CSO Policy — not to seek civil penalties for past CSO violations — would not apply unless the permittee has no discharges during dry weather and meets the objectives and schedules of the CSO Policy, including the January 1, 1997, deadline for implementing the nine minimum controls. By now, every CSO community should be implementing the nine minimum controls, and most NPDES permits should contain measurable, enforceable, and specific conditions requiring implementation of the nine minimum controls, including submittal of appropriate documentation.

Although the January 1, 1997, implementation deadline has passed, our best information from EPA Regions and States indicates that only about 52 percent of CSO communities are currently implementing the nine minimum controls. Approximately another 25 percent have not yet implemented the nine minimum controls but are under an enforceable requirement to do so in the future.

There are several reasons for this. Many communities' permits have not yet been reissued to include the nine minimum controls, and permittees are reluctant to implement the nine minimum controls in the absence of an enforceable requirement. Some States have focused their efforts on requiring long-term control plans or have resisted using enforcement mechanisms as implementation tools. We believe, however, that the nine minimum controls are an essential element of any community's CSO program and that full implementation of the nine minimum controls is crucial to the success of the CSO Policy. The goal of 100 percent implementation remains a high Agency priority. We will continue to track implementation of the nine minimum controls and coordinate with EPA and State enforcement authorities as necessary to foster compliance.

We also stress the need for communities to provide appropriate documentation that they have implemented the nine minimum controls and for NPDES authorities to review this information thoughtfully. To date, although 52 percent of CSO communities have implemented the nine minimum controls, approximately 42 percent have submitted documentation. The Agency does not believe documentation is simply a "paperwork" exercise. Rather, documentation describes the community's comprehensive effort to use the nine minimum controls to reduce the frequency, volume, and impacts of CSOs. Without strong documentation, a CSO community and its permitting authority cannot meaningfully assess the effectiveness of the nine minimum controls and the extent to which additional controls, if any, may be needed.

Long-Term Control Plans. The CSO Policy calls for initial ("Phase I") NPDES permits to require development of a long-term CSO control plan as soon as practicable, but generally within two years after issuance of the permit, Section 308 information request, or enforcement action requiring a plan. The long-term control plan should include measures that provide for compliance with the technology-based and water quality-based requirements of the Clean Water Act, including attainment of water quality standards under either the "presumption approach" or the "demonstration approach." The subsequent ("Phase II") permit should require immediate implementation of the control measures in the long-term control plan. The long-term control plan should include a fixed-date implementation schedule. Requirements for expeditious implementation of the long-term control plan should be placed in an appropriate enforceable mechanism.

Regions and States indicate that approximately 33 percent of CSO communities are moving ahead to implement long-term CSO controls. Approximately another 28 percent are subject to an enforceable requirement to develop a long-term CSO control plan. We do not have adequate information to determine how much of the current CSO planning and control activity is being undertaken consistent with the CSO Policy.

Long-term planning consistent with the CSO Policy is key to the success of local CSO control efforts. We urge Regional and State authorities to work actively with permittees to ensure that long-term control plans address important elements of the CSO Policy such as characterization, monitoring, and modeling of the combined sewer system and receiving water; public participation; evaluation of the cost and performance of alternatives; and coordination with State water quality standards authorities and NPDES authorities. EPA Headquarters will continue to track progress in the development of long-term control plans consistent with the CSO Policy.

Water Quality Standards (WQS). Long-term CSO control plans must ensure that both the technology-based and water quality-based requirements of the CWA are met. With respect to water quality-based requirements, the CSO Policy provides that "[d]evelopment of the long-term plan should be coordinated with the review and appropriate revision of WQS and implementation procedures on CSO-impacted receiving waters to ensure that the long-term controls will be sufficient to meet water quality standards" (59 FR 18694). The CSO Policy places a high priority on eliminating or redirecting CSOs that discharge to sensitive areas such as beach areas and shellfish beds. Remaining overflows must neither cause nor contribute to a violation of WQS.

In locations where uses have been designated without consideration for the wet weather conditions of urban streams, it is appropriate to evaluate the attainability of WQS. The CSO Policy recognizes the States' flexibility to review their WQS and encourages them to define recreational and aquatic life uses more explicitly where appropriate. Such refinements could define, for example, seasonal conditions or a particular size storm event when primary contact recreation would not occur. In making such adjustments to uses, however, States must ensure that downstream uses are protected and that the use is fully protected during other seasons or after the storm event has passed. Furthermore, a use attainability analysis would be required in such cases, since use attainability analyses are required prior to the removal of a designated use or the modification of a use to one requiring less stringent criteria. Such a structured scientific analysis is an appropriate mechanism for determining the attainability of a use. In any case, if a State has a reasonable basis to determine that the current designated use could be attained after implementation of the technology-based controls of the CWA, then the use could not be removed.

We strongly encourage Regions and States to work with permittees to ensure that long-term plans are developed consistent with WQS. We also encourage greater coordination among EPA, States, and permittees in refining designated uses as appropriate in CSO-impacted receiving waters. In many cases the permittee's development of a long-term control plan, and the State's review and revision of WQS, will occur concurrently and interdependently. Site-specific data collected as part of the development of the long-term control plan and data from watershed analyses should assist States in evaluating the adequacy of the long-term control plan to contribute to the attainment of WQS. Such data will also provide important information necessary for determining whether a use is attainable and, where the designated use is not attainable, the appropriateness of a variance or other revision to the applicable WQS. Variances may be appropriate, in limited circumstances on CSO-impacted waters, where the State is uncertain as to whether the WQS can be attained and time is needed for the State to conduct additional analyses on the attainability of the WQS.

Measuring Program Performance. The CSO Policy continues to have a high level of support within EPA and among stakeholder groups. With visibility, of course, comes scrutiny. Understandably, the Policy continues to provoke questions about how well a flexible approach can address a costly and complex environmental issue. In addition, implementation of the CSO Policy is occurring amid public demands that investments in pollution control yield tangible environmental benefits.

Under the Government Performance and Results Act (GPRA), EPA developed a pilot performance plan to track the implementation status of the CSO Policy. Program indicators developed under the performance plan include progress in implementation of the nine minimum controls, development of long-term plans, and reduction in the frequency, volume, and adverse water quality impacts of CSOs. The data base developed to implement the performance plan will continue to provide useful insights into the status of CSO Policy implementation and will be a useful program management tool.

Accountability for the CSO Program is also embodied in the Agency's Strategic Plan under GPRA for the water program. Objectives to be attained by 2005 currently include a 30 percent reduction from 1992 levels in annual point source loadings from CSOs, publicly owned treatment works, and industrial sources. EPA's FY 1998 goal is for 80 percent of CSO communities' permits to be issued consistent with the CSO Policy; for FY 1999, the goal is 100 percent consistency.

We also encourage you to support efforts by CSO communities to develop other, locally defined, indicators of progress in controlling CSOs. Locally defined measures of success can provide meaningful incentives to select and implement CSO controls that not only meet CWA requirements but are cost-effective, tailored to local water quality objectives, and likely to yield results that the public, and specifically rate-payers, will support.

In closing, we urge you to help make the CSO Policy a success. We remind you that implementation of the CSO Policy continues to be a high priority for the Water Program and is among the top program priorities for the Office of Regulatory Enforcement in FY 1998. It is essential that all CSO communities be moving aggressively toward two important goals: full implementation of the nine minimum controls and coordination with NPDES and WQS authorities in the development and implementation of long-term control plans. We welcome continued dialogue among EPA Headquarters, Regional, and State permitting and enforcement authorities on removing any identified impediments to achieving these goals.

If you have questions concerning this memorandum, please contact either Ross Brennan of the Office of Wastewater Management at (202) 260-6928, or John Lyon of the Office of Regulatory Enforcement at (202) 564-4051.

ENFORCEMENT MANAGEMENT SYSTEM — CHAPTER X (REPRINT FROM U.S. EPA — OFFICE OF WATER)

Setting Priorities for Addressing Discharges from Separate Sanitary Sewers

Discharges of raw or diluted sewage from separate sanitary sewers before treatment can cause significant public health and environmental problems. The exposure of the public to these discharges and the potential health and environmental impacts are the primary reasons EPA is developing this additional guidance on these discharges. This document provides a method of setting priorities for regulatory response, and serves as a supplement to the Enforcement Management System guidance (EMS, revised February 27, 1986). As such, this document addresses only those discharges which are in violation of the Clean Water Act. As a general rule, the discharges covered by this guidance constitute a subset of all discharges from separate sanitary sewer systems.

Legal Status

In the context of this document, a "discharge from a separate sanitary sewer system" (or "discharge") is defined as any wastewater (including that combined with rainfall induced infiltration/inflow) which is discharged from a separate sanitary sewer that reaches waters of the United States prior to treatment at a wastewater treatment plant. Some permits have specific requirements for these discharges, others have specific prohibitions under most circumstances, and still other permits are silent on the status of these discharges.

The legal status of any of these discharges is specifically related to the permit language and the circumstances under which the discharge occurs. Many permits authorize these discharges when there are no feasible alternatives, such as when there are circumstances beyond the control of the municipality (similar to the concepts in the bypass regulation at 40 CFR Part 122.41 (m)). Other permits allow these discharges when specific requirements are met, such as effluent limitations and monitoring/reporting.

Most permits require that any non-compliance including overflows be reported at the end of each month with the discharge monitoring report (DMR) submittal. As a minimum, permits generally require that overflow summaries include the date, time, duration, location, estimated volume, cause, as well as any observed environmental impacts, and what actions were taken or are being taken to address the overflow. Most permits also require that any non-compliance including overflows which may endanger health or the environment be reported within 24 hours, and in writing within five days. Examples of overflows which may endanger health or the environment include major line breaks, overflow events which result in fish kills or other significant harm, and overflow events which occur in environmentally sensitive areas.

For a person to be in violation of the Clean Water Act: 1) a person must own, operate, or have substantial control over the conveyance from which the discharge of pollutants occurs, 2) the discharge must be prohibited by a permit, be a violation of the permit language, or not be authorized by a permit, and 3) the discharge must reach waters of the United States. In addition, discharges that do not reach waters of the United States may nevertheless be in violation of Clean Water Act permit requirements, such as those requiring proper operation and maintenance (O&M), or may be in violation of state law.

Statement of Principles

The following six principles should be considered as EPA Regions and States set priorities for addressing violating discharges from separate sanitary sewers:

1. All discharges (wet weather or dry weather) which cause or contribute significantly to water quality or public health problems (such as a discharge to a public drinking water supply) should be addressed as soon as physically and financially possible. Other discharges may, if appropriate, be addressed in the context of watershed/basin plans (in conjunction with state or federal NPDES authorities).

2. Discharges which occur in high public use or public access areas and thus expose the public to discharges of raw sewage (i.e., discharges which occur in residential or business areas, near or within parks or recreation areas, etc.) should be addressed as soon as physically and financially possible.

3. Dry weather discharges should be addressed as soon as physically and financially possible.

4. Discharges due to inadequate operation and routine maintenance should be addressed as soon as possible. (Physical and financial considerations should be taken into account only in cases where overflow remedies are capital intensive.)

5. Discharges which could be addressed through a comprehensive preventive maintenance program or with minor capital investment should be addressed as soon as physically and financially possible.

6. With respect to principles 1 through 5 above, schedules of compliance which require significant capital investments should take into account the financial capabilities of the specific municipality, as well as any procedures required by state and local law for publicly owned facilities in planning, design, bid, award, and construction. (See later sections on Schedules).

APPENDIX D

STORMWATER REGULATIONS

Phase I: The Municipal Stormwater Program

Under the WQA of 1987, U.S. EPA must issue NPDES permits to large- and medium-sized municipal separate storm sewer systems (MS4s). Under the statute, the permits:

- may be issued on a system or jurisdiction-wide basis;
- shall include a requirement to effectively prohibit non-stormwater discharges into the storm sewers;
- must apply a new standard to " require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and design and engineering methods" . 33 U.S.C. § 1342(p)(3)(B).

Large and medium MS4s are defined by EPA as those:

- located in an incorporated place with population of (i) 100,000 or more but less than 250,000 (medium MS4s) or (ii) 250,000 or more (large MS4s);
- located in counties with a population of 100,000 or more but less than 250,000 (medium MS4s) or located in counties with a population of 250,000 or more (large MS4s), excepting, in both instances, systems located in the incorporated places, townships or towns within such counties; or
- designated by EPA as part of a large or medium MS4 due to the interrelationship between the discharges of the designated MS4 and a large or medium MS4.

EPA has listed the jurisdictions that are covered under the definitions of medium and large MS4s in the permit application rule, and in Appendixes F, G, H and I to 40 C.F.R. Part 122. 55 Fed. Reg. 48073-74. The listing was based on the 1980 census. As data from the 1990 census becomes available, EPA will revise the list.

To date, EPA has only issued a rule with permit application requirements for MS4s. 55 Fed. Reg. 47990 (November 16, 1990). Permit applications for MS4s have two parts. Part 1 was due November 18, 1991 for large MS4s and May 18, 1992 for medium MS4s. 40 C.F.R. § 122.26(e)(3) and (4). Part 2 was due November 16, 1992 for large MS4s and May 17, 1993 for medium MS4s. Id. EPA was supposed to have issued final permits to large MS4s by October 1, 1993 and to medium MS4s by May 17, 1994. 40 C.F.R. § 122.26(e)(7).

The regulations define " municipal separate stormwater" as a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels or storm drains) owned or operated by a state or local government entity and is designed or used for collecting or conveying stormwater that is not a combined sewer or part of a POTW. 40 C.F.R. § 122.26(b)(8). Operators of combined sewer systems (systems designed as both sanitary and storm sewers) or POTWs are excluded from the permit application requirement because these systems should already be permitted under existing NPDES programs.

Operators of medium and large MS4s may submit a jurisdiction or systemwide permit application. 40 C.F.R. § 122.26(d). Where more than one public entity owns or operates a municipal separate storm sewer system within a geographic area (including adjacent or interconnected MS4s), such operators may be co-applicants to the same application.

Part 1 of the MS4 permit application must include the following elements:

- General Information. Information about the permit applicant or co-applicant.
- Legal Authority. A description of the legal authority to control discharges to the MS4. If existing legal authority is inadequate to control pollutants in stormwater discharges, a plan to augment existing legal authority must be submitted.
- Source Identification. Detailed identification of all discharges to the MS4, including a topographic map, location of municipal outfalls, projected growth, location of structural controls, and location of waste disposal facilities.
- Discharge Characterization. Information characterizing the nature of system discharges including existing quantitative data, the results of field screening analysis to detect illicit discharges, identification of receiving waters, a plan to characterize discharges from the system, and a plan to obtain representative data.
- Management Programs. A description of the existing management programs to control the discharge of pollutants from the system, including a description of existing structural and non-structural controls.
- Fiscal Resources. A description of the financial resources currently available to complete Part 2 of the application.

Part 2 of the permit application provides information to supplement Part 1 and gives municipalities an opportunity to propose a program of structural and non-structural measures to control the discharge of pollutants" to the maximum extent practicable." 55 Fed. Reg. 48045. Part 2 requires:

- Satisfaction of the Criteria. A demonstration that the legal authority of the permit applicant to control discharges of pollutants to the system satisfies the criteria set out in 40 C.F.R. § 122.26(d)(2)(i).
- Supplementation of the Source Identification Information Submitted Under Part 1. This includes identification of all " major outfalls" (a defined term) and an industrial activity description of each facility which may discharge stormwater associated with industrial activity to the system.
- Characterization Data. Discharge characterization data from between 5 and 10 outfalls or field screening points designated by EPA or the state as representative of commercial, residential and industrial land use activities based on Part 1 information. The data shall also include estimates of the annual pollutant load of the cumulative discharges to waters of the United States, a proposed schedule to provide seasonal pollutant load and event mean concentration data for any constituent detected in any required sampling, and a proposed monitoring program for representative data collection for the term of the permit.
- Proposed Management Program. A proposed stormwater management program to reduce the discharge of pollutants to the maximum extent practicable.
- Assessment of Controls. Estimated reductions in loadings of pollutants from system discharges resulting from the municipal stormwater management program.
- Fiscal Analysis. An analysis of capital, operation and maintenance expenditures, by fiscal year for each year of the permit term, to complete the characterization data requirements and stormwater management program requirements.

The centerpiece of the Part 2 application is the proposed stormwater management plan. This plan's purpose is to reduce the discharge of pollutants to the "maximum extent practicable using management practices, control techniques, and system design and engineering methods" 40 C.F.R. § 122.26(d)(2)(iv). Under the regulations, proposed programs will be considered by the permit writer when developing permit conditions. Id. The management plan allows the permittee to propose, in the first instance, the components of a program it believes are appropriate for preventing or controlling the discharge of pollutants. 55 Fed. Reg. 48052.

Stormwater management programs are to be based on:

- a description of structural and source control measures to reduce pollutants from runoff from commercial and residential areas;
- a description of a program, including a schedule, to detect and remove or permit illicit discharges and improper disposal in the system;
- a program to monitor and control pollutants in stormwater from municipal landfills, hazardous waste treatment, disposal and recovery facilities, industrial facilities subject to section 313 of SARA Title III, and other municipal facilities identified as contributing a substantial pollutant loading to the system; and
- a program to implement and maintain structural and non-structural best management practices to reduce pollutants from construction sites.

The stormwater management program must address illicit discharges to the system. The regulations define illicit discharges as any discharge to an MS4 that is not composed entirely of stormwater, except discharges pursuant to an NPDES permit and discharges resulting from fire fighting activities. 40 C.F.R. § 122.26(b)(2). However, as noted in the requirements for a stormwater management plan, not all such flows must be prohibited. Certain types of flows such as landscape irrigation, groundwater infiltration, air conditioning condensate, lawn watering, and street wash waters only need to be prohibited when such flows are identified as significant sources of pollutants. 55 Fed. Reg. 48037.

Phase II: Stormwater Regulations

The 1987 Water Quality Act required EPA to establish a two-phased approach for the control of stormwater discharges. Phase I consists primarily of permitting stormwater discharge associated with industrial activity or stormwater discharges from large or medium municipal separate storm sewers. Phase II covers all stormwater discharges not addressed under Phase I and could include all other municipalities, as well as light industrial and commercial activities.

CWA Section 402(p)(5) requires EPA to conduct two studies on Phase II stormwater discharges. The first study will identify those classes of discharges that may be addressed in Phase II and evaluate the nature and extent of pollutants in such discharges. The second study will evaluate procedures and methods to control Phase II stormwater discharges to the extent necessary to mitigate impacts on water quality. EPA has requested public comment on ways to implement the second phase of the stormwater permitting program for sources and activities not regulated under Phase I. 57 Fed. Reg. 41344 (September 4, 1993). EPA specifically requested comment on a variety of options that range from comprehensive permitting of all municipal, light, industrial, and commercial activities that generate stormwater runoff to little or no NPDES permitting of Phase II sources. EPA's final approach to the Phase II stormwater permit program will be developed in the near future.

SUMMARY OF CURRENT STATEWIDE SW MANAGEMENT PROGRAMS

The following is a summary of some of the current statewide stormwater management programs gathered from late 1997 to mid 1998:

Alabama

Alabama has NPDES-delegated authority from the U.S. EPA. Alabama Department of Environmental Management (ADEM) issues general permits through its Industrial Branch as well as its Mining and Nonpoint Source Section. ADEM requires municipal stormwater permits for Birmingham, Huntsville, Montgomery, and Mobile. Construction site sedimentation and erosion control regulations are implemented by the Mining and Nonpoint Source Section of ADEM. Along the Gulf of Mexico construction site discharges and other industrial operations are regulated by the Coastal Zone Management Program (Thompson). Local communities can also provide additional requirements. As an example, Mobile has experienced flooding problems for many years. An engineering study identified 92 separate stormwater drainage projects having an estimated cost of about $100 million (Steeves and Chapman 1988). This study recommended that a stormwater management utility be established within the city's Department of Public Works. In 1987, after many public meetings, Mobile adopted a water management plan and approved the concept of a user's fee to pay for these needed stormwater drainage improvements. Besides flood control objectives, this utility would also monitor water quality and plan for future water quality improvement projects. The annual operations and maintenance budget for this utility was estimated to be about $3.5 million. The estimated fees to pay for this service would be about $3 per household per month.

Alaska

Alaska does not have NPDES permitting authority. However, permits issued by the USEPA become state permits once the Alaska Department of Environmental Conservation demonstrates its ability to issue and enforce these permits. Aside from the basic EPA stormwater permit requirements, the state of Alaska also requires a "qualified personnel provided by the discharger" to inspect certain areas. These areas include disturbed areas of construction sites that have not been stabilized, storage areas exposed to precipitation, structural control measures, and locations of entrance and exit to the site. These designated areas must be inspected within 24 hours of any rain event greater than 0.5 inches.

Arizona

Stormwater permits in Arizona are issued by the USEPA, as the state does not have permitting authority. Therefore the stormwater permit requirements are nearly identical to those in the general nationwide program, with a few additional requirements. Arizona requires a secondary containment system able to hold the entire contents of the largest single tank plus adequate freeboard to accommodate a 25-year, 24-hour rain event for industries storing chemicals defined as priority under SARA. Best management practices have been outlined with regard to runoff control. These BMPs are currently required for agricultural operations using nitrogen fertilizers. Other sources of runoff, such as urban stormwater runoff, resource extraction, grazing, and silviculture, will soon be subject to BMP compliance as well. Several cities in Arizona have additional regulations to prevent pollution from stormwater discharge. Examples are the cities of Phoenix, Tempe, and Mesa, which all require retention basins to control construction site runoff.

Arkansas

Arkansas has delegated stormwater permitting authority, meaning it issues and regulates its own permits based on the guidelines set forth by the EPA. In addition to these guidelines, the state has established some numeric effluent limitations. For example, coal pile runoff should not exceed concentrations of 50 mg/L maximum suspended solids and pH must be within 6-9. The state has determined parameters which must be measured by permittees as well. Primary metal industries and wood treatment facilities must sample for BOD5, and land disposal facilities must test for ammonia and nitrate plus nitrite nitrogen.

The Arkansas Department of Pollution Control and Ecology publishes guidance for detention ponds and erosion control. If a study of a proposed development indicates flooding problems, a development permit would be denied without stormwater control. Examples of acceptable controls are onsite storage, offsite storage, or an improved drainage system. The method used for stormwater detention is the modified rational hydrograph method. This guidance includes tables and graphs for determining time of concentration and rain intensity. The required volume of detention is evaluated according to the following methods:

Volume of detention for projects of less than 50 acres shall be evaluated by the "simplified volume formula." Volume of detention for projects 50 acres or greater but less than 200 acres may be evaluated either by the "simplified volume formula" or the "modified rational hydrograph method." For projects larger than 200 acres, the owner's engineer shall submit a proposed method of evaluation for sizing the retention basin or detention basin to the Department Public Works. The method will be evaluated for professional acceptance, applicability, and reliability by the city engineer. No detailed review for projects larger than 200 acres will be made before the method of evaluating the retention or detention basin is approved. Other analytical methods of evaluating volume of detention require approval by the city engineer.

California

California is an NPDES-delegated state with general permitting authority; however, the state has instituted a fairly large number of requirements stricter than those outlined by the EPA. In contrast to the EPA permit, California has established that the primary activity at a facility does not necessarily determine the category of industrial activity at a location. Each area of the facility is treated differently. For example, at a school, although its primary activity is education, the vehicle service area is nevertheless treated as a transportation area. Whether the activity is primary or auxiliary is of no concern under the regulations; each use is considered individually under the permit. Strict guidelines are also in effect as to sources considered to be point sources. Sheet flow from a parking lot is considered to be a point source requiring a permit. This is not the case in most states. Monitoring programs are also stricter than those in effect nationally; guidelines for establishing these programs and the objectives they must accomplish are clearly outlined in the regulations. Sampling must include pH, total suspended solids, specific conductance, and total organic carbon, as well as toxic chemicals specific to an individual site. The state has determined that it is not feasible at this time to establish numeric limits for those parameters not listed under a specific industry. Construction site permits require erosion and sediment controls, post-construction stormwater controls, and inspection of the site before and after storm events to evaluate the effectiveness of the measures taken.

Colorado

Colorado issues its own stormwater permits as an NPDES-delegated state. The state has established some numeric effluent limitations. Concentrations of pollutants are limited for the following industries: phosphate manufacturing, fertilizer manufacturing, petroleum refining, cement manufacturing, and coal pile runoff. Construction sites having stormwater permits must be inspected every 14 days and after any precipitation or snowmelt event that causes surface runoff. Coal mining permits establish specific numeric limits for effluents at active and post-mining outfalls. In addition to these limits, control measures also govern drainage control, subsidence, acid runoff control, grading, and other reclamation activities. Any drainage from coal mines must flow into a treatment pond, which is then treated as a point source discharge. In order to obtain a municipal stormwater permit, an area must first establish a record of all stormwater outfalls requiring a lot of monitoring. Secondly, a stormwater management program must be established. Ben Urbonas of the City of Denver, at a 1987 Maryland training program, reported that simple peak runoff rate controls were not adequately protecting Denver's streams. Urbanization increased flooding flow rates by about two times in the Denver area, but the critical pollutant carrying flows associated with common storms were increased by several hundred times. Denver then began concentrating on the use of on-site detention, along with sand filters coupled to extended detention facilities, to better control stormwater quality.

Connecticut

NPDES permitting authority has been delegated to the state of Connecticut by EPA. Permit guidelines have been made more stringent for some specific permits. Industrial sites must have additional means by which to store potentially hazardous materials and measures must be made so that chemicals are stored under a roof to minimize stormwater contamination. Salt storage piles must follow the same general guidelines. Monitoring must be done for a range of pollutants three times a year. Acute biomonitoring tests must be conducted yearly for a large number of permittees. Also, industrial stormwater permits disallow visible floatables including scum, except for those naturally occurring. Construction permits, too, have a relatively large number of additional requirements. Sediment basins must accommodate drainage areas greater than 5 acres of disturbed soil; full descriptions of measures to be taken to eliminate or reduce stormwater runoff when construction is finished must be included; permittees need to install stormwater management programs that will remove 80% of total suspended solids from stormwater; and velocity dissipation devices are also required.

Delaware

Delaware is an NPDES-delegated permitting state, following for the most part the general guidelines set forth by EPA. The state has established additional regulations to address stormwater runoff from construction activities. No more than 20 acres of a single development may be disturbed at a time, and any site that is not worked for more than 14 days must be stabilized. In new developments, stormwater management measures are required. Permanent measures must remove 80% of the total suspended solids for the site and be capable of storing runoff from storms up to 100 years. Acceptable BMPs are detention ponds, retention ponds, or sand filter systems. The method encouraged by the state is the development of wetlands to manage the stormwater.

District of Columbia

The District of Columbia does not have NPDES permitting authority and therefore permits for this region are issued by EPA. It follows that this region's regulations are nearly identical to those enforced nationally. However, there have been some additional restrictions put on industrial dischargers. A numeric limit of 50 mg/L total suspended solids has been set for effluent consisting entirely of coal pile runoff. It is unlawful to meet this limit by merely diluting the runoff with other flows, such as stormwater. Values for pH from coal runoff must fall between 6 and 8.5. In the Chesapeake Bay drainage, industrial dischargers must provide control measures to achieve a 40% reduction in nitrogen and phosphorous loads entering the waters of the bay.

Florida

Florida has had stormwater regulations since 1979 (Livingston 1988). The initial stormwater rule was revised in 1982 and requires a stormwater permit for all new stormwater discharges and for modifications to existing discharges that were changed to increase flow or pollutant loadings. This state permit program had to be implemented within the framework of the Clean Water Act. Required best management practices must be designed according to site-specific conditions and are to be monitored to ensure correct performance. If the monitoring indicates poor performance, the controls must be corrected.

Controls that may be required for specific projects include grass drainage swales, percolation ponds, wet detention ponds with filtration, and wetland treatment. Florida has encouraged innovative control designs that promote multiple uses and can be located on city-owned property. Examples of recent innovative controls include the construction of a spreader swale that causes stormwater to overflow onto a city park for percolation. Existing lakes are also being modified to enhance their stormwater control capabilities.

Florida is a state with NPDES permitting authority. Additional regulations have been placed on several industries. For example, SWP3 site descriptions for construction sites must include rational method estimates of runoff coefficients for before, during, and after the construction project. Post- construction controls are to be designed to remove at least 80% of the average annual pollutant loads from a given site that has discharge flows into outstanding Florida waters. These controls may include stormwater detention structures, retention structures, the use of vegetated swales, or other such similar measures. Velocity dissipation devices must be employed to supply non-erosive outfall discharges. The main goal of these stipulations is to "equalize pre and post development stormwater peak discharge rates and volumes." The state has stormwater management programs at the state, watershed and local level. In 70 communities in the state, stormwater utilities have been set up and financed by local user fees. Charges are applied based on parcel size and proportion of impervious area to natural area.

Georgia

The Georgia Erosion and Sediment Control Act of 1975 requires that a permit be obtained for many land disturbing activities. These permits examine specific development and erosion control plans but were not required to specifically address stormwater quality controls.

Local governments can adopt ordinances to enforce this law, but the Environmental Protection Division of the Georgia Department of Natural Resources will have permitting and enforcement responsibilities if no local regulations are passed. However, local review of erosion control plans by the regional Soil and Water Conservation District must be provided. The Natural Resources Conservation Service (NRCS) is commonly asked to provide technical assistance in these reviews. Georgia erosion control plans are prepared with little specific guidance from the Erosion and Sediment Control Act and therefore rely on close working relationships with the local NRCS offices.

Georgia is a permitting state under the NPDES program. The major difference in Georgia's stormwater regulation is the addition of the Georgia Erosion and Sedimentation Act of 1975. This act requires a permit for any land disturbing activity larger than 1.1 acres.

Hawaii

Hawaii has NPDES-delegated permitting authority. All permittees in this state must comply with the state's basic water quality criteria, which lists prohibited substances. Examples of these are oil, materials that will form objectionable sludge, substances that will affect the taste or odor of water, pathogenic organisms, and others. Discharges are further restricted as to the specific concentrations allowed. They can not contain pollutants in 24-hour average concentrations greater than the values obtained by multiplying the minimum dilution by the applicable standards, and non-carcinogenic pollutants in 30-day average concentrations. For construction sites, BMP plans must be implemented to control construction runoff; these controls must be checked weekly during dry periods and within 24 hours after any rainfall of 0.5 inches or greater. Pre-construction groundcover may not be disturbed more than 20 days before construction begins. Temporary soil erosion measures must be used where construction will continue for 30 days or more. Measures must be taken to ensure that runoff does not cause erosion. Examples of these measures are: runoff must be discharged through a lined channel or pipe; and "all surface water" flowing toward a construction area should be diverted. Muddy waters that have been pumped from a construction site must be held in a settling basin and treated before being released. In addition to the state regulations, many local city and county governments have additional regulations for controlling stormwater pollution.

Monitoring requirements are outlined for industrial dischargers. Stormwater pollution control plans (SWPCPs) must be developed and implemented by industrial dischargers. These SWPCPs parallel EPA's baseline SWPCPs. Hawaii requires a secondary containment system for industries handling chemicals defined as priority under SARA.

Idaho

Idaho does not have NPDES permitting authority; its permits are issued by EPA Region 10. The state has an additional voluntary program for controlling agricultural nonpoint source pollution. Idaho has additional regulations for runoff from silvicultural and mining sites. The following tables on pages E-5 and E-6 "summarizes the current regulations for storm water pollution control" in Idaho.

Illinois

Illinois has NPDES delegated permitting authority from U.S. EPA. The Illinois EPA has general permitting requirements similar to the EPA's baseline general permit for the following: industrial dischargers, stormwater pollution prevention plans (SPW3), and construction sites disturbing 5 acres or more of land. Individual municipalities have provisions in their building codes to regulate construction site erosion. The state of Illinois does not regulate detention ponds used for flow attenuation purposes. Those facilities are regulated by some Illinois counties. The Illinois EPA publishes the Illinois Urban Manual which includes soil conservation service conservation practice standards "Impoundment Structure – Full Flow" and "Impoundment Structure – Routed." This agency also distributes U.S. EPA publication, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

Land Use Activity	Agency of Local Function	Permit, Approved Process, or Authority	Type of Construction
Plan Review			
Storm Water Pollution Prevention Plan Review (optional at local level)	U.S. Environmental Protection Agency (EPA)	National Pollutant Discharge Elimination System (NPDES) discharge permits	industrial, commercial and residential over 5 acres
Drainage Plan review	Local public works or building department	Consult local authority	commercial, residential
Storm Water Discharges			
To a right-of-way	Local or county highway district	Consult local authority	industrial, commercial, residential
To a natural waterway	EPA and/or local/watershed-based authority	NPDES discharge permit	industrial, commercial, residential
To a privately owned canal or drain	Local canal or drainage district or EPA	Permission from local canal company or drainage district, NPDES discharge permit	industrial, commercial, residential
To a Bureau of Reclamation (BOR) canal	BOR, EPA	Permission from BOR, NPDES discharge permit	industrial, commercial, residential
From selected industrial facilities	EPA	NPDES stormwater discharge permit	Industrial
Storm Water Disposal			
To subsurface through an injection well	Idaho Department of Water Resources (IDWR) regional office	Underground Injection Control (UIC) Program	Industrial, commercial, residential

Indiana

Indiana has NPDES-delegated general permitting authority from EPA. Indiana issues general stormwater permits for industrial dischargers and construction sites disturbing 5 acres or more of land. IDEM (Indiana Department of Environmental Management) also regulates stormwater runoff from certain industries using NPDES wastewater permits. Examples of these industries would include the steel and coal mining industries. There are no state level requirements for stormwater (only) detention ponds. A facility is free to build one if and how it chooses. Sometimes to control flooding at the local level, there are requirements for stormwater detention. If a pond is going to receive wastewater in addition to stormwater (i.e., process wastewater) then it would be considered a water pollution treatment/control facility, and there are criteria that must be met.

Iowa

Iowa has NPDES-delegated permitting authority. State regulations dictate that facilities in sensitive watersheds that contribute to the water quality problems of the area must follow more stringent guidelines. Coal pile runoff is subject to numeric limits of less than 50 mg/L total suspended solids, and pH must be between 6 and 9. The state has also passed sedimentation and erosion regulations for agricultural and construction sites. These laws are enforced on a complaint-driven basis and can lead to an order to undertake corrective action.

Site Preparation/Construction			
All new development/ redevelopment	Local public works or building department	Local or county ordinance(s)	commercial, residential
Construction over 5 acres	EPA	NPDES stormwater permit	industrial, commercial, residential
Development project potentially affecting an existing highway	Idaho Transportation Department, local or county highway district	Idaho Code, Title 18, Chapter 39, Section 7-8	industrial, commercial, residential
Development project potentially affecting an existing drainage facility	Local public works or building department, canal company, drainage district	Local or county ordinance(s)	industrial, commercial, residential
Dewatering			
Discharges to right-of-way	Local or county highway district	Consult local authority	industrial, commercial, residential
Discharge to a privately-owned canal or drain	Local canal company, Drainage district	Permission from canal company or drainage district, NPDES discharge permit	industrial, commercial, residential
Other Permits			
Stream Channel Alteration	IDWR	Stream Channel Alteration Permit	industrial, commercial, residential
Filling of wetlands, other natural waterways of the U.S.	U.S. Army Corps of Engineers 343-0671	404 (dredge and fill) permit	industrial, commercial, residential

Kansas

NPDES permitting authority has been delegated to the state of Kansas by EPA. The Kansas Department of Health and Environment (KDHE) administers the NPDES program which follows the EPA's baseline general permit with additional requirements for conforming to water quality standards established by the state. Construction site permitees are required to prepare stormwater pollution prevention plans (SPW3s). However, industrial stormwater dischargers are not required to develop SPW3s. A sediment basin is required for construction sites were 10 or more acres of land are disturbed at one time. The basin will provide at least 3,600 cubic feet of storage per acre drained, unless the flows are diverted around both the disturbed area and the sediment basin. KDHE has a nonpoint source pollution program and the Department of Agriculture has statewide authority to develop pesticide management areas. One of these has been instituted for the area over the Delaware River.

Kentucky

Kentucky is another state with NPDES delegating authority. In Kentucky, this program falls under the Kentucky Pollution Discharge Elimination System (KPDES) permit program administered by the Kentucky Division of Water. This program applies to construction sites that will disturb 5 acres or more of land and other industrial facilities. Required BMPs for industrial dischargers are similar to EPA's baseline general permit. Construction site permits suggest BMPs that are baseline and are mostly voluntary. However, mandatory requirements at local municipality levels are required to be included and implemented.

Louisiana

Louisiana is an NPDES-delegated state with the authority to issue its own discharge permits. In addition to the guidelines set forth by EPA, Louisiana has implemented some supplementary standards. Numeric limits have been set for industrial dischargers, limiting the amount of total organic carbon that may be discharged to 50 mg/L and oil and grease discharges are limited to 15 mg/L. Oil and gas exploration activities have standards for COD (daily max 100 mg/L), total organic carbon (50mg/L), and oil and grease (15 mg/L). These activities are also limited in the amount of chlorides they may discharge into brackish waters. Facilities covered by industrial permits must have a stormwater pollution prevention plan that outlines how numeric limits will be achieved. This plan must also identify potential pollution sources and describe the practices that will reduce pollution and fulfill permit requirements. Louisiana has also developed state stormwater regulations that require a Louisiana Water Pollution Discharge System permit if the potential for water contamination exists, or large volumes of stormwater will be discharged, or in areas where industrial materials are stored. Coastal areas are also of great concern and are therefore subject to additional regulations. Projects within coastal areas must be designed to avoid discharge of nutrients into coastal waters, and to prevent the alteration of oxygen concentration. Development may not damage streams, wetlands, or other features of the environment, and must attempt to avoid the destructive discharges of sediment, pathogens, or toxic substance and to prevent reductions in the productivity of the waters. Attention must also be paid to dissolved oxygen content and heavy metals.

Maine

Maine does not have NPDES permitting authority; therefore its permits are issued by EPA Region 1. The program requirements are similar to EPA's baseline; however, the Maine Department of Environmental Protection (DEP) Bureau of Land and Water Quality wrote the Natural Resources Protection Act that imposes additional regulations intended to protect the quality of the receiving water. Under this act, nearly all types of water bodies, as well as dunes, fragile mountain areas, wildlife habitats, and wetlands are protected through regulations covering activities of concern. Permits are required when the soil will be altered, or discharges (including fill) may be introduced into these areas. Maine's Stormwater Management Law requires construction permits for proposed projects in the direct watershed of a water body most at risk with 20,000 square feet or more impervious area, or in any watershed with 1 acre or more of impervious area or 5 acres or more of disturbed area. This law contains rule standards regarding construction site stormwater quantity and quality. The peak flow of stormwater must not exceed the peak flow prior to construction and does not increase the peak flow of the receiving waters. To protect the quality of the receiving waters three standards are contained in the rule: total suspended solids (TSS), phosphorous, and basic stabilization. The table on the following page is a summary of these standards.

Maryland

Maryland enacted its first statewide erosion control legislation in 1970 (McElroy and Halka 1985). This initial legislation required an erosion control plan before a building permit was granted. It also required that all Maryland cities and counties adopt grading and sediment control ordinances acceptable to the Maryland Water Resources Administration. After ten years experience with this legislation, it was deemed ineffective because of the lack of consistency in local ordinances, inadequate local administrative commitment, inadequate field inspections, and inadequate enforcement processes. It was concluded that most of the communities did not have the necessary financial resources to adequately fund the program. Therefore, several changes were made to the legislation. As of 1978, all project engineers or foremen in charge of onsite clearing were required to attend a state training program. In 1984, all inspection and enforcement operations were assumed by the state and the inspection staff was increased to 34 people.

The objective of the Maryland stormwater program was to maintain as nearly as possible natural runoff characteristics. Infiltration and detention facilities are important control practices used to meet this objective. The state found that a more comprehensive approach was needed to control stormwater runoff than was provided with a peak flow criterion alone. It therefore gave consideration to volume reduction, low flow augmentation, water quality control, and ecological protection.

Maryland prepared a model stormwater ordinance in 1985 for consideration by local governments. Because of its involvement in ongoing efforts to improve water quality in the Chesapeake Bay, Maryland is also retrofitting stormwater controls in existing developed areas. The state's nonpoint pollution control program also includes agricultural sources, shoreline protection, retention of existing forestland, providing conservation easements, controlling dredging and fill projects, controlling mining area runoff, and repairing failing septic tanks.

NPDES permits are issued through the state. Releases of oil and other hazardous substances must be prevented or minimized in stormwater discharges. The state has also established a sediment and erosion control

Project Location/Type	Standards
Watershed of a lake not most at risk. Project with <3 acres of impervious area or £ 5 acres of disturbed area	Basic Stabilization Standard
Watershed of a lake most at risk (severely blooming lake)	Basic Stabilization Standard and Phosphorous Standard
Watershed of a lake most at risk (not severely blooming lake). Project with ≥ 3 acres of disturbed area	Basic Stabilization Standard and Phosphorous Standard
Watershed of a lake most at risk (not severely blooming lake). Project with <3 acres of impervious area and <5 acres of disturbed area	Basic Stabilization Standard and 80% TSS Standard or Basic Stabilization Standard and Phosphorous Standard
Direct watershed of a lake other than a lake most at risk and project with > 3 acres of impervious area	Basic Stabilization Standard and Sliding Scale TSS Standard or Basic Stabilization Standard and Phosphorous Standard (may be waived by DEP)
Direct watershed of a lake other than a lake most at risk and project with ≥5 acres of disturbed area and <3 acres impervious area	Basic Stabilization Standard and Phosphorous Standard
Direct watershed of a coastal wetland most at risk	Sliding Scale TSS Standard
Watershed of a river, stream, or brook most at risk and the project drains to the water body at or above a public water supply intake	Basic Stabilization Standard and Sliding Scale TSS Standard
Watershed or a river, stream, or brook identified as a sensitive or threatened area and drains to the water body at or within two miles above a public water supply intake	Basic Stabilization Standard

Source: *A Developer's Guide to the Maine Stormwater Management Law (Organized Areas)*

program for implementation at construction sites, which includes requirements for runoff controls. Stormwater management is a requirement at construction sites both during and after construction activity. Developers must implement runoff controls for 2- and 10-year storm events that will restrict the flow from exceeding the pre-development level. A list of recommended BMPs is provided by the state, with the most preferred being infiltration devices, followed by vegetative swales, retention ponds, and detention ponds.

Massachusetts

Permits in Massachusetts are issued by EPA as the state does not have permitting authority. It does however impose some state-specific regulations on the permits. New or increased stormwater discharges to coastal or outstanding resource waters are ineligible for permits. In order to minimize erosion, outfall pipes must be set back from receiving waters whenever the discharges are increased, or the system altered in any way. BMPs are also outlined for use in stormwater management in the state, and the best practical method of treatment must be employed in maintaining the goals of the program.

Michigan

The Michigan Environmental Protection Act of 1970 imposed a duty on all governmental agencies and individuals to prevent and minimize water pollution while carrying on normal activities (Dean 1981). A number of

Michigan court cases thereafter determined that local governments had the responsibility to consider the environmental effects of new subdivision developments, including stormwater effects. Previously, the Michigan Subdivision Control Act of 1967 required local drain commissioners to review subdivision plat proposals only to assure adequate drainage.

A number of county drainage laws in Michigan now also affect stormwater quality. As an example, Oakland County prefers the use of infiltration of stormwater in wetlands, lowlands, and depressions to the use of dry detention basins in providing drainage control. Infiltration can have a positive effect on preventing surface water quality degradation caused by stormwater discharges, while dry detention ponds have little stormwater quality benefit. In addition, almost all of the 35 Oakland County local governments encourage the use of swales and other on-site controls. Wet detention ponds are also used when necessary. However, many local governments are concerned by the lack of maintenance of detention facilities and therefore discourage their use.

Michigan issues its own permits under the delegated authority of EPA. Of particular note is Michigan's requirement for certification of stormwater operators. Each industrial facility with a general permit must have treatment and control measures, and these must be carried out by a certified individual. A list of requirements are also provided for applicants for the permit; some of these are: erosion controls must be properly implemented, inspection of controls must be performed on a pre-determined basis, containment for spills of material must be provided, waste material produced in the treatment of stormwater must be properly disposed of, and there are several guidelines as to certified operators.

Minnesota

Minnesota has NPDES-delegated authority. Construction site controls more stringent than the national standard have been applied in this state. They are as follows: temporary protection must be provided for areas of exposed soil with a continuous positive slope within 100 feet from a water of the state or other devices connected to a water of the state; and exposed soils on positive slope areas must be protected with either temporary or permanent cover within certain time frames:

Type of slope	Area has not been or will not be worked by contractor for
Steeper than 3:1	7 days
10:1 to 3:1	14 days
Flatter than 10:1	21 days

In addition, the bottoms of temporary drainage ditches must be stabilized within 100 feet of the receiving water within 24 hours of the ditch being connected to the water. In order for a pipe to be connected to a drainage ditch, it must first be equipped with a velocity dissipation device. Sedimentation BMPs must be installed on the down-gradient perimeters of the site before any up-gradient activities may begin. These BMPs must remain in place until the site has been permanently stabilized. Vehicle transport of sediment must also be minimized.

Temporary sedimentation basins must be provided to collect runoff from disturbed sites of 10 or more continuous acres. Basins shall provide 1,800 ft3 per acre drained storage below the outlet pipe. The basin outlets must be designed to prevent short circuiting and discharge of floating debris.

The Minnesota Pollution Control Agency (MPCA) publishes a best management practice manual entitled *Protecting Water Quality in Urban Areas*. The MPCA issues NPDES/SDS general stormwater permits for industrial and construction activity. These permits list the requirements at the federal and state level. The industrial activity permit covers "facilities discharging storm water associated with industrial activity as defined in 40 CFR 122.26(b)(14)." This permit requires a storm water pollution prevention plan, including drainage maps, significant materials inventory, and exposure evaluation; BMPs categorized as source reduction, diversion, and treatment; implementation schedule; inspections and maintenance; reporting; etc. The construction activity permit covers erosion control and inspection and maintenance requirements for construction activities that disturb 5 or more acres of total land area.

Mississippi

Permits are issued by the state of Mississippi under authority delegated to it through EPA NPDES program. Mississippi issues nine different types of general stormwater permits including one for construction sites and one that is a baseline permit. Special criteria for chlorides, sulfates, and total dissolved solids apply to all discharges into the Mississippi River. Stormwater permits state that discharges must be free of debris, oil scum or other floating material except in trace amounts, eroded soils that will form objectionable deposits, suspended solids, turbidity, and color at levels higher than the receiving water, and chemical concentrations higher than the state limits allow.

Stormwater controls, including erosion control measures, are required for all construction sites. These must divert flow away from disturbed soils, keep exposed soil time and area to a minimum, implement BMPs and remove sediment from stormwater before it leaves the site. Sediment basins are required for sites with drainage areas over 5 acres. The recommended capacity of the basin (SCS manual) should be 67 yd^3 per acre drainage area, with maximum surface area and an outlet as far from the inlet as possible. Stormwater controls must be described with respect to vegetative controls, structural controls, post-construction controls, and measures to minimize vehicle transport of sediment.

Missouri

Missouri has a unique method for funding nonpoint runoff controls. In 1983, the Missouri legislature passed a constitutional amendment to raise the state sales tax by 0.1 percent to increase state funding for parks and historical sites, and for soil conservation (Howland 1985). State voters, in turn, passed the amendment in the 1984 general election. This tax increase was only to be in effect for 5 years (from 1985 to 1990), and the soil conservation portion (about $15 million per year) was mostly to be used for cost-sharing of agricultural runoff controls. However, this funding method could also be used to fund urban stormwater controls.

Missouri has NPDES-delegated permitting authority. Construction site permits similar to EPA's general construction permit are required for sites disturbing 5 or more acres of land, over the life of the project. Construction sites over 10 acres are required to construct sedimentation basins. The basin shall be sized to contain 0.5 inch of sediment from the drainage area and be able to contain a 2-year, 24-hour storm. Industrial-specific stormwater pollution prevention plans are required for general industrial permits. Permits for some activities in this state place numeric effluent limits on stormwater discharges with respect to oil and grease, total suspended solids, pH, and other pollutants.

Montana

Montana has NPDES-delegated permitting authority. The Montana Department of Environmental Quality (DEQ) issues three general permits: a permit authorizing discharges from construction sites, a permit authorizing discharges associated with industrial activity, and a permit for oil and gas and mining activities.

Nebraska

Nebraska has NPDES-delegated permitting authority. Nebraska Department of Environmental Quality (NDEQ) issues two general permits: a permit authorizing discharges from construction sites of 5 acres or more and a permit authorizing discharges associated with industrial activity. Permittees of either general permit are required to develop and implement a stormwater pollution prevention plan (SWPPP) that will minimize erosion on disturbed areas, minimize the discharge of sediment and other pollutants in stormwater runoff, and maintain compliance with the requirements of the permit. A detention pond is required on construction sites where slopes are equal to or steeper than 3:1. Clay soils are present in many areas of Nebraska, and when erosion occurs suspended clay particles are not efficiently removed simply by use of a detention facility. Therefore, use of a detention pond does not circumvent the need to implement erosion and sediment controls. NDEQ does not have authority related to flow management issues, only water quality issues. Many local municipalities require new developments to construct permanent detention basins for the purpose of stormwater flow management. These requirements are intended to help prevent and reduce downstream flooding that would otherwise result from the increase in runoff that typically occurs with development. SWPPs for industrial permittees do not require use of detention basins.

Nevada

Nevada has NPDES-delegated permitting authority. The state general permit is identical to EPA's baseline NPDES stormwater program. Construction sites disturbing 5 or more acres, industrial facilities, and mining sites are covered by this permit. Specific BMPs are not required. Detention facilities are regulated by local governments. In the Lake Tahoe area there are stricter regulations administered by the Tahoe Regional Planning Agency.

New Hampshire

New Hampshire does not have NPDES permitting authority. Its permits are issued by EPA Region 1. The program requirements are identical to EPA's. In addition, the state has a shoreline protection program that issues site-specific permits for construction sites in or on the border of surface waters with contiguous area of 50,000 ft^2 if within a protected shoreline, or 100,000 ft^2 or more in all other areas.

New Jersey

New Jersey has NPDES-delegated permitting authority. The Department of Environmental Protection (DEP) issues two general permits: a permit authorizing discharges from construction sites of 5 acres or more and a permit authorizing discharges associated with industrial activity. Industrial dischargers must implement a SWPPP. Construction sites disturbing 5,000 ft2 of land are regulated by state erosion and sediment control laws.

New Mexico

New Mexico is a non-delegated state for the NPDES program. The NPDES program is under the direction of EPA Region 6 in Dallas, Texas. Questions about this program can be directed to the Stormwater Hotline at 1-800 245-6510.

New York

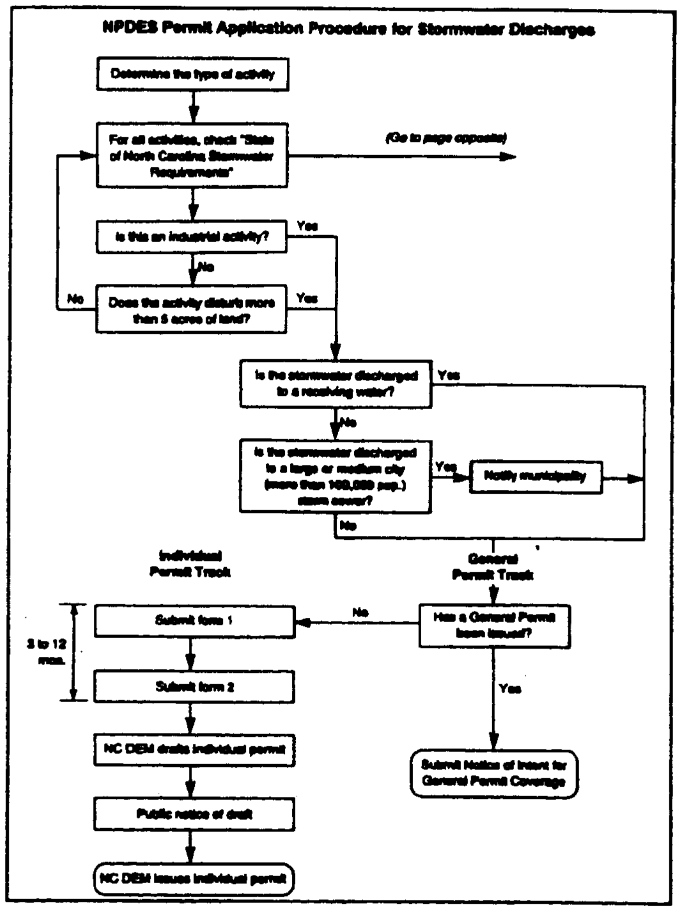
New York has NPDES-delegated permitting authority. The state includes some additional requirements in its construction permits. Structural practices must be built to divert stormwater from exposed soils and limit runoff from these areas. State guidelines also mandate that there may not be any visible and substantial changes with respect to color, taste, odor or turbidity downstream from construction sites. Vegetative and structural practices must be used to ensure that stormwater discharges do not vary significantly from pre-development conditions.

North Carolina

North Carolina has NPDES-delegated permitting authority. North Carolina presently issues 23 types of general permits including a permit for construction sites disturbing 5 or more acres of land and permits for various types of industrial activities. All types of permits require the implementation of a SWPPP. The state also imposes a set of regulations specific to stormwater for coastal waters, outstanding waters of the state, high quality waters, and water supply waters. To help the public determine what regulations are applicable for a project or industrial activity the following flow charts are published by the state in its Stormwater Management Guidance Manual.

North Dakota

North Dakota has NPDES-delegated permitting authority. The North Dakota Department of Health (NDDH) issues three general permits: a permit for construction sites disturbing 5 or more acres of land, a permit for industrial activity, and a permit for mining activities.



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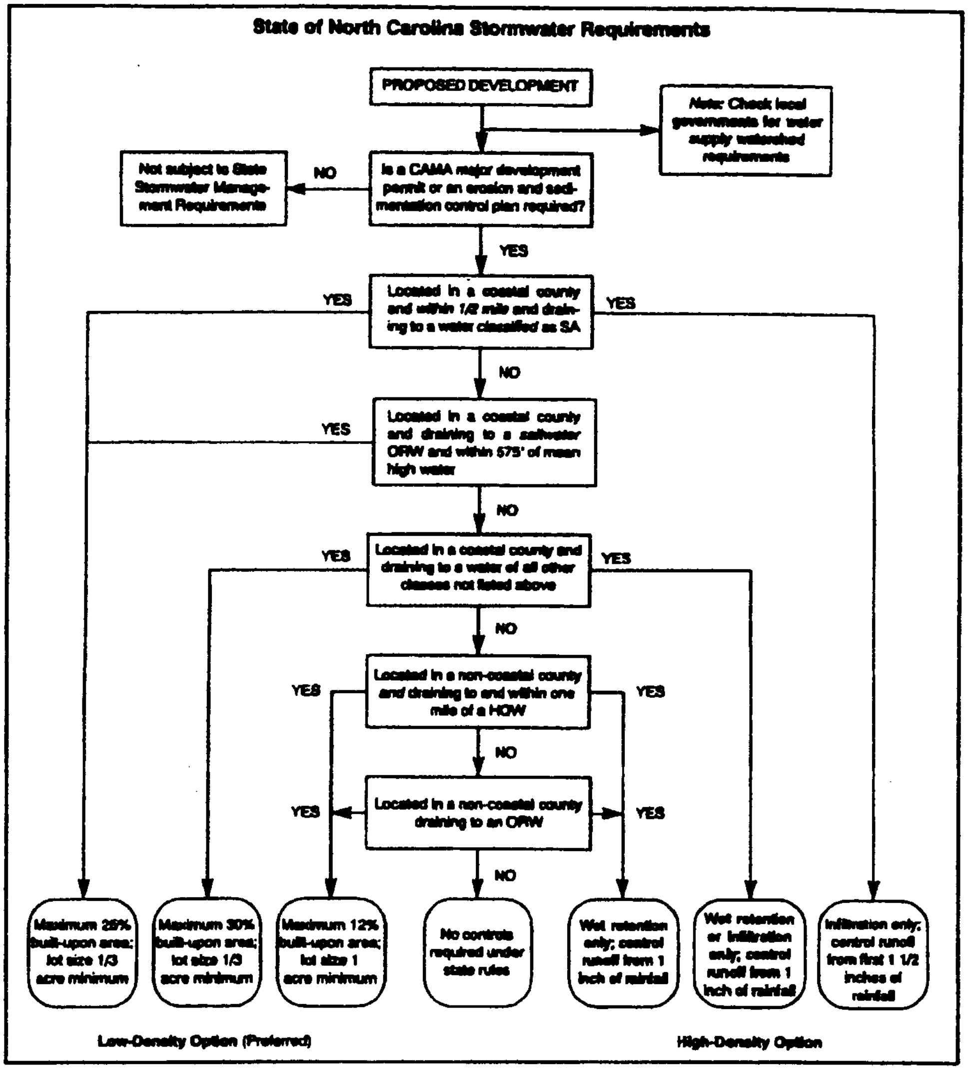

Ohio

Ohio issues its own NPDES permits under authority delegated by EPA. The state imposes additional runoff guidelines. Revegetation of construction sites must be achieved on a specified time scale, regulations apply to the protection of waters flowing near a site, and statewide regulations require the use of sediment ponds if sediment fences are determined to be insufficient. Ponds capable of holding 67 cubic yards of runoff per acre are required.

Oklahoma

NPDES permits in Oklahoma are issued by the state. Oklahoma Pollution Discharge Elimination System (OPDES) administers the NPDES program. OPDES's permit is identical to EPA's construction permit. Several cities in Oklahoma require builders and developers to design detention facilities so that the rate of runoff from a new building or development does not exceed the historic rate before development or construction runoff.

Industries in the state are subject to additional regulations. Oklahoma plans to adopt EPA's multi-sector permit for industrial sites. Whole effluent toxicity testing is required for dischargers twice annually. The Oklahoma Conservation Commission coordinates the runoff programs in the state, which are voluntary and provide assistance in making management decisions.

Oregon

Oregon has delegated NPDES permitting authority. Discharge limits are set for some industrial stormwater dischargers for certain parameters. These parameters typically include settleable solids, debris, conductivity, and *enterococci*.

Pennsylvania

The state of Pennsylvania has NPDES-delegated permitting authority. The general permit for industrial dischargers resembles EPA's baseline with the following numeric limits: 7 mg/L for dissolved iron, pH from 6 to 9, and a limit of 50 mg/L total suspended solids for coal pile runoff. The state's general construction permit covers sites between 5 and 25 acres unless the runoff from the site will be discharged into a protected water of the state. Any disturbed area, regardless of size, must implement erosion controls. For disturbed areas less than 5 acres, sedimentation traps with the capacity of 2,000 ft^3 may be used. A sedimentation basin is required at construction sites disturbing more than 5 acres. The basin must have a capacity of 7,000 ft^3 per acre, have a 24" freeboard, and have outlets designed to pass a minimum flow of 2 ft^3 per second per acre. A permit is required for timber harvesting operations that would disturb more than 25 acres of land. Water quality based limits may be established for any discharger to ensure adequate water quality in receiving waters.

Rhode Island

Rhode Island has NPDES permitting authority. The state has developed some additional regulations above baseline EPA guidelines. Rhode Island has standards for stormwater practices that include BMPs that must be incorporated into developments. Local governmental agencies may regulate stormwater discharges, but their regulations must be at least as strict as the state regulations. To limit suspended solids releases, the state's Coastal Zone Management Program requires new developments within 200 feet from a shoreline to remove 80% of the suspended solids discharged from a site after development.

South Dakota

South Dakota has NPDES-delegated permitting authority from EPA. The South Dakota Department of Environment and Natural Resources (DENR) has general permitting requirements similar to EPA's baseline general permit for industrial dischargers and construction sites disturbing 5 or more acres of land.

Tennessee

Tennessee has NPDES-delegated permitting authority. In addition to the basic requirements, the state has developed some additional provisions. At construction sites, vegetative and structural management techniques must be applied. Examples of these are: clearing and grubbing is minimized, soil exposure must be minimized through sequencing, large projects must be built in stages; strict checking and maintenance of controls is required; a responsible individual must be established and temporary and permanent soil stabilization measures must be used.

Texas

Austin has had a watershed protection ordinance since 1981 after it was found that continued urban development was having adverse affects on the local groundwater supply. This ordinance was amended in 1986 and contains specific standards for development within critical watersheds (Austin 1986). The Austin program is currently funded by a combination of user's fees and city general revenues. Common controls in all proposed land uses include buffer zones adjacent to all streams where no development is allowed, severe building restrictions on slopes greater than 15 percent, and required setbacks from springs, seeps, and sinkholes. Many innovative erosion and stormwater controls have been used in Austin, including sand filters, portable filter fence supports, and suspension of all city-required building inspections for any site in violation of its erosion and stormwater control plan. Porous pavement is not considered an effective stormwater quality control when protecting groundwater and is therefore not given any credit when calculating allowable impervious covers. Austin also has an ongoing monitoring program to evaluate the performance and required maintenance of stormwater controls.

Texas is in the process of becoming an NPDES-delegated state. Until that time, its permits will be issued by EPA. Texas has established probably the most extensive list of numeric standards for stormwater discharges There are discharge limits for arsenic, barium, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver and zinc.

Utah

Utah has NPDES-delegated permitting authority. In addition to the basic permit requirements, the state imposes supplementary regulations in some cases. Coal mining facilities are subject to restrictions on the total maximum flow and concentrations of total suspended solids in their discharges. To remediate these concerns, mines must use sedimentation controls, such as detention ponds, and mine site dewatering. Dewatering discharges are subject to limits in the concentration of iron, total dissolved solids, pH, suspended solids, and grease. The Salt Lake City Stormwater Utility has been established and institutes a user fee for use of stormwater systems. Several other cities in Utah have adopted similar plans.

Vermont

The state of Vermont has permitting authority under the NPDES program. A statewide permitting program has also been established that requires treatment and volume control measures to manage runoff from new developments once construction is completed. These management plans, including project designs, hydrologic calculations, and planned controls, must all be submitted to the DEP. Permits are issued on a site-specific basis. These are often issued with the stipulation that the post- development discharge rate does not exceed the rate before development. Sites have guidelines to follow during construction, as well. Ten environmental criteria have been established, addressing wetlands, headwaters, floodways, streams, shorelines, traffic concerns, water and air pollution, waste disposal, esthetics, and impacts on wildlife habitats.

Virginia

Virginia has NPDES-delegated permitting authority. As with most states, Virginia has instituted some additional guidelines. With respect to development, post-construction pollutant concentrations must not increase compared to pre-development concentrations. The Chesapeake Bay area uses phosphorous as an indicator pollutant. Sites that undergo redevelopment must implement measures to achieve a 10 percent reduction in average pollutant loads. Construction activities sponsored by the state also have a set of stormwater regulations they must follow.

Washington

The city of Bellevue has had a storm drainage utility since 1974. Its primary mission is to "manage the storm and surface water system, to maintain a hydrologic balance, to prevent property damage, and to protect water quality for the health, safety, and enjoyment of citizens and for the preservation and enhancement of wildlife habitat" (Bissonnette 1985). Bellevue stresses the use of natural drainage systems to transport and dispose of stormwater. Swales, lakes, ponds, wetlands, and detention ponds form important parts of this system. In 1985, the utility's operating budget was more than $5 million and the 1980 to 1985 capital improvement budget was about $13 million. The necessary revenues are obtained through user service fees, assessed according to the amount of runoff and pollutants generated for each area served.

A number of cities throughout the U.S. currently have storm drainage utilities, mostly modeled after Bellevue's. These utility districts all charge a fee to provide urban runoff control services. Bellevue's runoff and receiving waters were extensively studied during the Nationwide Urban Runoff Program. It was found that the beneficial uses of the streams were being seriously impaired by excessive flows, erosion, and sedimentation (Pitt and Bissonnette 1984). These problems are currently being reduced by runoff and erosion controls. Metallic and organic toxicants will also need to be controlled in future years in Bellevue.

West Virginia

West Virginia has been granted NPDES permitting authority by EPA. West Virginia issues two general permits, one for industrial dischargers and one for construction sites disturbing 3 or more acres of land. Construction sites having a drainage area of 5 acres or less should have a sediment trap with a storage volume equal to 3,600 ft^3 per acre. Sites over 5 acres should have a sediment basin which will provide a storage volume equal to 3,600 ft^3 per acre. The state has established additional numeric effluent limitations for coal piles with respect to pH and total suspended solids.

Wisconsin

Wisconsin has had a priority watershed protection program for more than 15 years. This program involves extensive state-funded cost sharing to retrofit nonpoint water pollution controls in watersheds that cannot meet water quality objectives with point source controls alone. Initially, this program almost exclusively involved agricultural water pollutant sources, with little urban runoff controls. In 1983, the state legislature passed legislation requiring the preparation of a model ordinance to control construction site erosion and stormwater runoff (Pitt 1986). The state will spend about $100 million over the next twenty years in retrofitting urban runoff controls in the priority watersheds. In order to protect this investment, all state funded and conducted construction, along with urban areas participating in the priority watershed program, are required to follow these ordinances.

The Wisconsin model ordinance for the control of construction site erosion has been adopted by many communities, including Milwaukee. This ordinance includes basic controls to reduce such erosion sources as vehicle tracking and dewatering of excavations, along with required diverting of up-slope waters, mulching of disturbed areas, and the use of downstream sedimentation controls. Extensive plan reviews and site inspections are also included in the ordinance. The ordinance is supplemented with a manual to ensure uniform design and appropriate applications of construction control practices.

Wisconsin has NPDES-delegated permitting authority. The DNR limits its stormwater program to municipalities in urban areas with documented water quality problems. These municipalities are required to collect data and assess their specific stormwater problems as well as develop a plan to address these concerns. Permits mandate that municipalities make and meet a timeline for development of a stormwater program, implement a successful program that reduces and prevents stormwater pollution, screen all storm sewer outfalls for sewer connections and other improper waste disposal; estimate pollutant loadings to the waters of the state; calculate the concentrations and constituents of pollutants in stormwater; monitor stormwater with respect to pollutant loads; assess the effectiveness of their stormwater program; and report on their progress.

Wyoming

Wyoming has NPDES-delegated permitting authority. The state has imposed additional controls on construction site activities. Sites that discharge into perennial water bodies must not increase the turbidity by more than 10-15 turbidity units above the background. Discharges into water bodies that are ephemeral are exempt from this standard but may not deposit sediment that degrades the habitat. All stormwater control devices must remove 80% of total suspended solids. Sites must establish structured runoff control plans with a designated responsible individual. Sites with a high potential for soil erosion should identify and implement BMPs to control erosion.

Historical Review of Wet Weather Pollution Management

Throughout history, many strategies have been implemented to control wet weather pollution for reasons such as flood control, water quality improvement, aesthetic improvement, waste removal, and others. To provide guidance for developing communities, a reference manual for wet weather flow systems in newly urbanizing areas is being developed as part of a cooperative agreement among the Urban Watershed Management Branch of EPA, the University of Alabama at Birmingham (Pitt, et al. 1997) and ASCE (Heaney, et al. 1997). The following historical review is a summary from this effort (Pitt, et al. 1997) and was mostly prepared by Steven J. Burian, a Ph.D. student at the University of Alabama.

F.1 Wet Weather Pollution Management: Ancient Times

Management of wet weather pollution is an age-old problem. Several ancient civilizations can be credited with implementing successful surface water drainage systems. Evidence exists that the dwellers of the city of Mohenjo-Daro (now part of West Pakistan) used sanitary sewer systems and had drains to remove stormwater from the streets (Webster 1962).

Mesopotamian engineers planned and built effective drainage and sanitary works, including vaulted sewers and drains for household waste, gutters and drains for surface runoff, and other appurtenances made of baked brick and asphalt (Maner 1966).

Of all the societies of western Asia and Europe, from antiquity until the 19th century, only the Romans set out to build a carefully planned road system with properly drained surfaces (Hill 1984). Virtually all that the early Romans knew about engineering came to them out of the civilizations of the eastern Mediterranean (Kirby, et al. 1990). Specific drainage structures used by the Romans included occasional curbs and gutters to direct surface runoff to open drainage channels alongside roadways (Hill 1984). To improve drainage, the roads would be graded in such a fashion to direct the surface runoff from the streets toward the drainage channels.

Draining excess water was not the only function of the system. It was soon discovered that disposal of wastes in these trenches removed the waste from the immediate area. However, the trenches relied on heavy rainfalls to adequately flush them of waste and debris, since overflow discharges from aqueducts were not sufficient to effectively convey the wastes. The wastes would therefore accumulate and cause unsanitary, not to mention repugnant, conditions. The solution to this was to cover the trenches; these covered trenches eventually evolved into planned sewers.

The Romans planned and constructed the "cloacae," or sewers, to drain their uplands to the nearby network of low-lying streams (Gest 1963). These sewers were originally open streams that drained most of the land prior to urbanization. The philosophy was to use the existing natural drainage channels to remove wet weather flows and pollution. It was decided that the proper way to use the channels was to build the city over them and provide drains from the surface to the underground streams. As time progressed, the Romans became more elaborate with their construction of sewers (Gest 1963).

F.2 Wet Weather Pollution Management: Middle Ages to the 1800s

The first sewers built in Europe following the fall of the Roman Empire were simply open ditches. Examples of this type of sewerage system in Europe are evident in Paris and London as well as in a few other European cities during the 1300s and 1400s (Kirby and Laurson 1932; Reid 1991). The open ditches used for drainage of stormwater were usually constructed in existing drainage pathways (Kirby and Laurson 1932) or down the centers of streets (Reid 1991). Besides being conveyances for stormwater, the open drainage channels became receptacles for trash, kitchen wastes, and sanitary wastes, the accumulation of which caused hazardous and nuisance conditions. To remedy this situation, Europeans simply covered the drainage channels, or sewers, which were emitting terrible odors and producing unsightly conditions. Interestingly, this solution is similar to that used 1,500 years earlier by the Romans during the construction of the "cloacae."

From the time of the Roman Empire to the 1800s, wet weather pollution management strategies experienced very little noteworthy advances, and in fact regressed considerably in terms of sanitation. However, towards the start of the Middle Ages, as disease epidemics occurred in major metropolitan areas of Europe, some believed proper sanitation was partly dependent on adequate sewerage.

Paris and London provide examples of European cities that developed piecemeal drainage systems in response to crisis situations and funding availability. A consequence of developing wet weather and sanitary systems in this way was an incoherent and varied overall system. In addition to the poor design and construction practices at the end of the Middle Ages, maintenance and operation of the systems were virtually neglected in most situations. Sewer systems of urban areas in Europe during the 1600s and 1700s were grossly under-planned, poorly constructed, and inadequately maintained.

F.3 Wet Weather Pollution Management: 1800s

The enlightened, post-renaissance society began to realize that adequate sewerage was necessary to promote proper sanitation. The early part of the 1800s marked the beginning of a series of decisions and technical advances that resulted in improvements related to wet weather pollution management.

F.3.1 Improvements in Design and Construction Practices

Innovations in construction materials improved sewerage systems in the early 1800s. As an example, in Paris until the 1820s, sewers had been constructed of cut stone or brick with rectangular or roughly rounded bases, which led to solids deposition problems (Reid 1991). Engineers substituted millstone and cement mortar for the hewn stone, which allowed for the construction of curved and smooth sewer floors. This lessened the flushing effort required for sewer cleansing. The quality of brick and clay pipe also improved during this time and became the materials of choice. The next major improvement in sewer materials was the use of concrete, which did not occur until the end of the 1800s (Metcalf and Eddy 1928).

In addition to improvements in construction, several advances were made in the design of sewer pipes. Sewers could now be constructed in curved shapes instead of simply rectangular shapes. These curved shapes included egg-shaped, oval, and v-notched patterns for combined sewer systems and provided improved hydraulic transport efficiencies over the rectangular sewer shape. Studies in England indicated that the lower part of a v-notch channel could carry sanitary waste well, while the upper portion could provide sufficient capacity to transport stormwater from the streets (Gayman 1997).

Another problem with sewers was the grade at which they were constructed. Often, caution was not exercised either during design or construction, and the sewers did not have a sufficient slope to transport wastewater during dry weather periods. Sewers began to be constructed on slopes sufficient to prevent ponding in the system.

F.3.2 Beginnings of Comprehensive Sewerage Design

The improvement in construction practices and pipe designs did not eliminate the problems with sewer systems in Europe. System design strategy became the focus of the next wave of innovations in sewerage practice. Hamburg, in 1843, is considered to have implemented the first comprehensively planned sewerage system (Metcalf and Eddy 1928). The circumstances were advantageous for this, as a large part of the city had been destroyed by fire in 1842.

London followed suit with a detailed study by many engineers of note, resulting in the decision to devise a comprehensive sewerage plan. In 1852, Joseph William Bazalgette was commissioned to plan and design the system (Kirby and Laurson 1932). Actual work on the main drainage of London began in 1859 and was practically completed in 1865.

Meanwhile, the sewers of Paris were still being constructed without any coordinated plan until 1823. At that time, construction practices began to improve, which allowed engineers such as Duleau to plan an adequate system of drainage for portions of the city. The interceptor sewer concept dates to this period in Paris and London (Kirby and Laurson 1932).

The 1800s saw rapid urbanization in the United States. In response to this urbanization in the United States, comprehensive design of wet weather pollution management systems began to be practiced. Chicago had the first comprehensive design implemented by a major American city. E.S. Chesbrough designed the system in a report completed in 1858 (Metcalf and Eddy 1928). He and other contemporary engineers soon consulted on similar comprehensive plans for additional U.S. cities (J.W. Adams for Brooklyn, New York for example).

The planning of early American sewerage was influenced by two general factors, the topography of the city and the place of disposal (Metcalf and Eddy 1928). The grade of the ground surface affected decisions concerning the mode of sewer transport, the size of the sewers, and the arrangement of small- and large-sized sewers, with gravity being the desired vehicle for transportation. In most situations, the use of natural drainage patterns in conveying stormwater was preferred, especially when streets were planned according to the lay of the land. The second factor mainly concerned the direction and distance that the sewage would be conveyed. Specific considerations included the dilution capability of the receiving stream and determination of the proper disposal location.

The comprehensive designs implemented in the U.S. made use of empirical data obtained from European practice for capacity and probable quantities of rainwater to be carried by the sewers (Webster 1921). It is noteworthy that among the branches of engineering, American sewerage is observed to have developed many of its features through experience, rather than experimenting (Metcalf and Eddy 1928).

F.3.3 Combined Versus Separate Systems of Sewerage

Although sanitary waste was a constant input to the stormwater systems of Europe, designs did not recognize the addition of sanitary wastewater in combined systems until 1843 in Hamburg. This does not imply that illegal connections of sanitary wastewater were not present, as this was often the case. The first types of wastewater legally allowed into the sewer system were dishwater and other liquid kitchen wastes. When the flushing toilet (water closet) came into general use in the early 1800s existing cesspools became overwhelmed. Eventually, this led to the permitted discharge of sanitary wastes into the sewers previously restricted to surface runoff, creating combined sewage. London did not allow legal sanitary connections to its sewer system until 1847 (Kirby and Laurson 1932), and Paris followed suit in 1880 (Reid 1991).

The combined sewage scheme became widely implemented in spite of the opponents who thought it sensible to keep the sanitary wastes and stormwater separate. Edwin Chadwick and John Phillips, both from England, were two of the earliest proponents of the separate system of sewage. Phillips proposed the separate system for London in 1849, but eventually Bazalgette's combined system with interceptors was implemented (Metcalf and Eddy 1928). Although supporters for separate systems existed, combined systems were mostly constructed because they were usually cheaper to design and build.

Bourne (1866) made one of the first American arguments for separate sewerage. He advocated the separate system for reasons of sanitation. Benezette Williams designed one of the earliest comprehensive separate systems in the U.S. in 1880 for Pullman, Ill., which was eventually implemented (Odell 1881). Another adamant supporter of separate sewer systems in the U.S. was Col. George E. Waring, Jr. (Waring 1879). Waring designed several early separate systems, including one for Memphis, Tenn. in 1880. Other cities that implemented separate sewer systems, constructed only sanitary sewer lines for the most part, with no pipes for stormwater (gutters and ditches carried this water) (Tarr and McMichael 1977). Some systems performed adequately, but others failed miserably with repeated blockages and backups in the sanitary sewer lines. Waring's designs called for the size of the house connection to the lateral sewer to be small (typically 4 inches) (Metcalf and Eddy 1928). This small size (in comparison to other designs of 6 inches or more) is what many believed to be the basic cause of failures in Waring's systems.

To learn more about separate and combined sewer systems, an American named Rudolph Hering visited Europe in 1881 at the behest of the U.S. National Board of Health. His findings from the trip became a report to the National Board of Health on the benefits and drawbacks of each type of system (Hering 1881). Hering's recommendations included using combined systems in large or rapidly growing cities, while using separate systems for areas where rainwater did not need to be removed underground. Despite Hering's report and the support of his conclusions by many, the debate continued between the advocates of the two types of sewerage.

F.3.4 Identification of Water-Borne Diseases

Several individuals throughout history have conjectured that sanitary and other types of wastes and unsanitary living conditions could be linked to diseases (Tarr and McMichael 1977). During the early 1800s, evidence pointed to the link between sewage discharges, polluted receiving waters, and disease outbreaks. A key factor was the new knowledge that had come from the researches of noted scientists such as L. Pasteur, R. Koch, R. Warington, T. Schlösing & A. Muntz into the nature and activities of bacteria.

A publication by Dr. Jack Snow in 1849 discussed the communication of cholera by contaminated water; he later had a hand in identifying the source of the Broad Street cholera epidemic in London during 1854. But it was Pasteur, in 1857, who established the formative theory that infectious disease is caused by germs or bacteria (Kirby, et al. 1990). By the 1880s the theory was firmly established by Koch and others. This research led to the attempt to filter drinking water during the late 1800s to remove water-borne disease-causing organisms.

F.3.5 Treatment of Separate Sanitary and Combined Wastewater

Regardless of the type of sewerage (combined or separate), the primary method of disposal was still discharging to local receiving waters in the late 1800s; control and treatment of sewer discharges was very limited. Typically, combined sewage, sanitary wastewater, and stormwater were simply discharged into a stream or river of adequate capacity to dilute the waste. The sewerage systems would be designed such that the maximum amount the receiving water system could dilute would be discharged. In the late 1800s, sewage was treated primarily by three methods: irrigation of farmlands, intermittent filtration, or chemical precipitation (Whipple, et al. 1906; Tarr and McMichael 1977). These systems of treatment were more conducive to the smaller and easier controlled sanitary sewage flows from a separate system. Centralized municipal wastewater treatment facilities were just beginning to be constructed in the late 1800s.

Whipple, et al. (1906) discussed the combined sewage treatment operations being used in the U.S. at the beginning of the 1900s. The usual method for combined sewer systems entailed sending as much of the storm flow/sanitary sewage mixture to a dry weather wastewater treatment plant by way of an intercepting sewer. In most cases, the interceptor sewer conveyed a certain amount of the waste stream to the plant, with the remainder being overflowed directly to the receiving water system, thus creating a combined sewer overflow (CSO). Treatment plants and collection systems were typically designed to treat twice the flow rate, or more, of the typical dry weather flow (Whipple, et al. 1906). During wet weather, sewer system flows were observed to increase by a factor of 100 over dry weather flows on occasion. Occurrences such as this could not be economically considered in conveyance or treatment system design, and thus, excess sewage flows greater than the design capacity of the conveyance system would result in frequent overflows.

Although research had displayed the connection between sewage-polluted waters and disease, sewage treatment was not widely practiced. It was debated whether it was more economical to treat the sewage prior to discharge or treat the water source before distributing as potable water. It was argued that the sewage could be assimilated or treated in the receiving water and would be much less polluted by the time it was withdrawn for drinking water supplies. This argument had validity, except it neglected the fact that sewage discharges were detrimental to the receiving water in addition to the drinking water supply.

F.3.6 Urban Hydrology

In the mid-1800s, estimating surface runoff was based on empirical results. For example, much of the European engineering community used Roe's table to size sewer pipes draining a specified size catchment (Metcalf and Eddy 1928). The table was supposedly empirically derived from Roe's observations of London sewers in the Holborn and Finsbury divisions over a span of 20 years.

In the second half of the 1800s the hydrologic and hydraulic design methods used to size sewers were enhanced. Most notably, Mulvaney (1851) and Kuichling (1889) developed the rational method in this time period. The rational method, in general, was based on the assumption that a realistic flow of the chosen frequency can be obtained if the rain intensity of duration similar to the travel time of water in the sewer system was applied to the drainage catchment. The flow was subsequently used to design the size of the sewer pipes. Prior to the rational method, runoff determinations took the form of empirical formulae. These equations were all derived based on site-specific data; consequently, they yielded poor results when applied to other drainage basins (Buerger 1915).

Intensive efforts in rainfall data collection and analysis occurred in the U.S. during the second half of the 19th century (Berwick, et al. 1980). The primary motivation was to study the relationship between the intensity of the rain and its duration for the needs of storm drain design. Talbot, in 1899, performed some of the initial work, using U.S. Weather Bureau records at 499 stations to plot storm intensities versus duration on a cross-section paper. Two envelope curves were drawn, one depicting the very rare rainfalls, and the other the ordinary rainfalls. These curves became the forerunner of the present day intensity-duration-frequency curves for drainage design. Since the time Talbot constructed his curves, many cities, public agencies, and engineering firms have developed similar equations for specific locations (Berwick, et al. 1980), while some still use Talbot's results directly.

F.4 Wet Weather Pollution Management: 1900s

F.4.1 Urban Hydrology Continued

The engineering community did not immediately accept the rational method. Well into the 1900s, the older empirical formulae mentioned above were still being used (Buerger 1915). Only after a slow transition in the early part of the 1900s did the rational method become the dominant technique for drainage design in the U.S. and worldwide.

The early 1900s also witnessed attempts to describe the rainfall/runoff process more accurately (Rafter 1903; Gregory 1907; Justin 1914; Buerger 1915; Grunsky 1922). By the 1920s the use of rain gauge records enabled more typical "design storms" to be used, in which rainfall intensity rose to a peak and then died away. The unit hydrograph (UH) concept is an example of these enhanced procedures based on design storms. Sherman (1932) developed the concept of the UH for gauged watersheds, and subsequently others modified it and applied it in different manners (Pettis 1938; Brater 1939). Until the introduction of unit hydrographs, few design techniques had considered using the storm hydrograph and runoff hydrograph; only the peak rate of runoff was used. Horner and Flynt (1936) first applied hydrograph techniques to storm sewer design (Horner and Flynt 1936; Eagleson 1962).

Following the UH applications, a renewed interest in the rainfall/runoff process was observed in the 1940s. Previous methods for determining runoff from rainfall had been mostly based on coefficients to account for losses of rainfall. In the late 1930s and early 1940s, rainfall abstractions became a concentrated topic of research. Horner and Jens (1942) developed a methodology to mathematically describe the process of infiltration, among other abstractions, and applied hydrograph techniques to a small basin.

F.4.2 Environmental Awareness and Receiving Water Impacts

During the 1960s, wet weather pollution was recognized by many as causing receiving water quality problems. To mitigate the problems, methods of control and treatment for urban runoff and CSOs were devised. Although it was known that controlling wet weather flows and pollution would not eliminate the problem, such methods were considered helpful in reducing the problems and in certain situations to be more cost effective than improving the capacity for dry weather wastewater treatment.

With the interest in reducing receiving water impacts through control and treatment of wet weather pollution, numerous research projects were initiated in the 1960s and 1970s. The main focus of these projects was to evaluate the effectiveness of control and treatment alternatives for combined sewer overflows. The control and treatment alternatives included physical/chemical methods such as detention, swirl technology, filtration, screening, and disinfection; biological methods such as rotating biological contactors, contact stabilization, trickling filters, treatment lagoons, and activated sludge; and storage/treatment methods.

The next step in the 1970s was the attempt to evaluate problems on a larger scale. This was manifested in Section 208 (from the Federal Water Pollution Control Act of 1972) planning studies and the watershed-wide planning philosophy that gained attention in the late 1970s and early 1980s. The planning studies focused on mitigating the impacts of urban runoff on receiving waters on a watershed scale versus a single outfall or a single stream reach.

In the early 1980s, problems remained with attempting to predict relationships between wet weather discharges and receiving water impacts. To remedy this problem, data was sought that would characterize the pollutants of concern and the impacts they would have on receiving waters. One of the major research efforts was the Nationwide Urban Runoff Program (NURP), conducted in the United States by EPA and USGS (EPA 1983). The overall goal of NURP was to collect data and develop information for use by local decisionmakers, states, EPA, and other interested parties.

F.4.3 Technical Tools and Design Methods

In the late 1960s and early 1970s computer development and its applications to the field of wet weather pollution management had a significant impact on the direction of development of wet weather pollution management. Computer applications were used in modeling environmental systems and processes, such as STORM (HEC 1973) and SWMM (Metcalf & Eddy Engineers, et al. 1971), and analysis and design of wet weather conveyance systems became more dependent on new computer applications.

In addition to computers, the mathematical and statistical methods being applied to wet weather pollution management were also improving. The use of statistics was seen in the analysis of long-term simulation results, the analysis of collected rainfall, runoff, water quality data, the evaluation of the optimum urban runoff control system configuration, among other uses (Howard 1976; DiToro and Small 1979; Hydroscience, Inc. 1979). The 1980s involved improving much of the technology and ideas initially introduced in the 1960s, 1970s and early 1980s. Personal computer advancements during the late 1980s and early 1990s were such that most wet weather pollution management technology currently revolves around the use of personal computers. Computational aids such as GIS, databases, and model pre- and post-processors have seen many advances during the 1990s, the use of which has improved the planning, design, and operation stages of wet weather pollution management significantly in terms of time, effort, and money.

F.5 Wet Weather Pollution Management: Lessons Learned from the Past

An advantage of developing user-friendly design methods and tools is the reduction in the time lag between development and implementation. Practitioners generally embrace technology that is simple to understand while still providing the means to perform the job in the most cost-effective manner possible. The methods and tools that have gained acceptance through history have been simple to implement and easy to understand, although not necessarily the most accurate or appropriate.

Considering the other points previously discussed, a sustainable system development will have the benefit of significantly reducing the environmental impacts associated with a project over time, while promoting economic stability as well. The literature is replete with examples of entire systems (Paris in the Middle Ages) or parts of systems that were designed without considering the long-term sustainability of the project. The systems performed poorly and resulted in additional time, effort, and money being used to rehabilitate and maintain the design.

Another consideration noticed during the review of the literature is that past design engineers and planners were forced to consider the socioeconomic, political, and legal ramifications associated with their plans and designs. These topics can be the primary inhibitors to the implementation of innovative technology and in the future must be addressed for progress to be made (Berwick, et al. 1980).

WERF QUESTIONNAIRE

QUESTIONNAIRE
WATER ENVIRONMENT RESEARCH FOUNDATION
ASSESSMENT OF DECISION CRITERIA USED TO DETERMINE BENEFITS OF CSO/SSO/SW INVESTMENTS

The Water Environment Research Foundation has contracted with Moffa & Associates to assess decision criteria used to determine benefits of CSO, SSO and stormwater investments. The objectives of this project are to document or benchmark policy interpretations of EPA regions and state regulatory agencies and the progress of various municipalities in achieving water quality goals. This information will be structured in the form of matrices wherever possible so that a municipality could better appreciate their relative position in developing solutions to their CSO, SSO and stormwater problems.

Your assistance in providing this information is needed to produce these guidance documents.

General Information | **Date Completed:**

1. Contact Person | Title | Organization Name

Street Address | City | State | Zip Code | Phone No.

2. What type(s) of wet-weather pollution are you responding about? (Circle all that apply)

(a) CSO (b) Stormwater (c) SSO

3. What type(s) of receiving water are impacted by the wet-weather pollution? (Circle all that apply)

(a) River (b) Stream (c) Lake (d) Ocean (e) Estuary
(f) Other

4. (a) Total Population: ______ (c) Ownership of Sewer System: ______

(b) Area of Sewer System: ______ (d) Area of Watershed: ______

5. (a) Annual Rainfall: (b) Number of Raindays:

Public Participation

1. What are the concerns of the public?

2. Is there a public participation program? (Circle) Yes No

If Yes, describe how the public participation program engages / educates the pubic.

Conveyance System Information

1. Has the conveyance system been mathematically modeled? (Circle)

CSO:	Yes	No
SSO:	Yes	No
Stormwater:	Yes	No

2. Number of discharge sources

CSO: | Stormwater: | SSO:

3. Frequency of discharges per year

CSO: | Stormwater: | SSO:

4. Volume of discharge per year, if available

CSO: | Stormwater: | SSO:

Water Environment Research Foundation

QUESTIONNAIRE
WATER ENVIRONMENT RESEARCH FOUNDATION

Watershed Approach

1. Has a watershed approach been considered for planning wet-weather pollution abatement? (Circle) Yes No

2. Has a watershed approach been used to plan wet-weather pollution abatement? (Circle) Yes No

   If Yes, what are the other sources of pollution? (Circle all that apply)

   (a) Municipal Point Source (b) Industrial Point Source (c) Agricultural Runoff (d) Urban Runoff
   (e) Other:

   If Yes, has the watershed been mathematically modeled? (Circle) Yes No

3. Has a watershed approach been used to manage wet-weather pollution abatement? (Circle) Yes No

4. What pollution sources are currently being addressed? (Circle all that apply)

   (a) Municipal Point Source (b) Industrial Point Source (c) Agricultural Runoff (d) Urban Runoff
   (e) Other:

5. What pollution sources are going to be addressed in the future? (Circle all that apply)

   (a) Municipal Point Source (b) Industrial Point Source (c) Agricultural Runoff (d) Urban Runoff
   (e) Other:

Water Quality

1. When did your organization recognize the wet-weather pollution?

2. Why did your organization take action to abate the wet-weather pollution? (Circle all that apply)

   (a) Planned Sewer System Improvements (b) Regulatory Requirements
   (c) Significant Pollution Event (d) Litigation/Lawsuit

3. Describe the significant pollution event:

4. Are any wet-weather facilities permitted? (Circle) CSO: Yes No
   SSO: Yes No
   Stormwater: Yes No

   If yes, how many CSO: ________, how many SSO: ________, how many Stormwater: ________

5. Describe the critical permit requirement(s)

Technical Considerations

1. Is a Facility Plan completed? (Circle) Yes No

2. Is a Facility Plan being developed? (Circle) Yes No

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3. What is the basis for technical considerations? (Circle all that apply)

(a) Regulatory Requirements (Federal, State)

(1) CSO
a. Demonstrative Approach
b. Presumptive Approach

(2) Stormwater
a. Regulations

(3) SSO

(b) Receiving Water Criteria

(1) Bacteria (2) Floatables (3) BOD (4) Dissolved Oxygen (5) Nutrients (6) Solids (7) Other

(c) Public Concern

4. How were the technical controls selected? (Circle all that apply)

(a) Cost - Benefit Analysis (b) Regulatory Requirements (Federal, State) (c) Other

If Regulatory Requirements or Other, describe

5. What control technologies have been or will be implemented to abate wet-weather pollution? (Circle all that apply)

CSO
(a) BMPs
(b) Vortex
(c) Out-of-System Storage
(d) Screening
(e) In-System Storage
(f) Disinfection
(g) Flow Balance Method
(h) Netting
(i) Other:

SSO
(a) I / I Reduction
(b) Other

Stormwater
(a) Source Control
(b) Other

6. Describe the effectiveness of the control technologies, if available

7. Describe the impact of the control technologies on receiving water quality, if available.

Financial Considerations

1. What are the total capital costs for wet-weather pollution abatement? (do not include life-cycle replacement) (Include year dollar figure represents)

Past: $______________ In 19_____ dollars

Projected $______________ In 19_____ dollars

2. What are the impacts on annual sewer rates?

Percent Increase:

3. What are the sources of funding? (Circle all that apply)

(a) Revolving Loan
(b) Federal Grant Money
(c) State Grant Money
(d) Increased Taxes
(e) Increased Sewer Rates
(f) Other:

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GLOSSARY

Aesthetics: Of or pertaining to the sense of attractiveness.

Assimilation: In water bodies, the process that removes pollutants and/or their impacts.

Best management practices (BMP): Non- and low-structurally intensive wet weather flow and pollution control methods that can have multi-benefits, including drainage network enhancement and flood control; groundwater recharge; aesthetic enhancement; pavement cleansing and reduction of dust, dirt, litter, and debris; subpotable water reuse; etc.

Biochemical oxygen demand (BOD): An operational measure of potential for depletion of dissolved oxygen by the biological and chemical degradation of organic material by bacteria.

Biological treatment processes: Means of treatment in which bacterial or biochemical action is intensified to stabilize, oxidize, and nitrify the unstable organic matter present. Trickling filters, activated sludge processes, and lagoons are examples.

Catchbasin: A chamber or well, usually at the street curbline, for the admission of surface water to a sewer or subdrain, having at its base a sediment sump to retain grit and detritus below the point of overflow; whereas, a stormwater inlet does not have a sump and does not trap sediment.

Catchment: The area producing the runoff passing a particular channel or stream location.

Collection system control: A method of abating wet weather flow or pollution in the collection or drainage system.
Combined sewer: A sewer receiving intercepted surface (dry and wet weather) runoff, municipal (sanitary and industrial) sewage, and subsurface waters from infiltration.

Combined sewer overflow (CSO) Flow from an outfall (discharge conduit) of a combined sewer collection system in excess of the interceptor capacity that is discharged into a receiving water and/ or an auxiliary CSO control (storage) treatment system.

Computer model: A model in which the mathematical operations are carried out on a computer.

Cost-benefit relationship: The relationship between unit costs to unit benefits usually represented as a curve.

Cost-effective solution: A solution to a problem that has been identified as being financially optional (e.g., the solution associated with the knee-of-the-curve of a cost-benefit relationship).

Critical design conditions: Environmental and flow conditions chosen to represent the conditions under which compliance with water quality standards, criteria, or objectives is desired.

Detention: The slowing, dampening, or attenuating of flows either entering the sewer system or within the sewer system by temporarily holding the water on a surface area, in a storage basin, or within the sewer itself.

Detention time: The time period that flow is detained in a storage/sedimentation basin or tank.

Disinfection: The killing or inactivation of human disease-causing microorganisms or pathogens.

Dispersion: Pollutant or concentration mixing due to turbulent physical processes.

Dissolved oxygen deficit: Difference between saturated dissolved oxygen and ambient concentrations.

Domestic sewage: Sewage derived principally from dwellings, business buildings, institutions, and the like. It may or may not contain groundwater.

Dry weather flow (DWF): Usually referred to as the flow in a combined sewer system without stormwater.

Dual treatment: Those processes or facilities designed for operating on both dry and wet weather flows.

Ecological habitat: The environmental niche in which an organism lives.

End-of-pipe impacts: Impacts that occur in the immediate vicinity of an outfall.

Engineering News Record (ENR): A recognized magazine providing accepted construction-cost indices.

Eutrophication: The process of aging whereby the increase of mineral and organic nutrients favors aquatic plants over animal life and results in increasing daily variations in dissolved oxygen concentrations, reduced biologic diversity, and reduced water clarity.

First flush: The condition, often occurring in wet weather flow discharges, in which a disproportionately high pollution load is carried in the first portion of the discharge or overflow.

Floatables: Large floating material sometimes characteristic of sanitary wastewater and storm runoff.

Frequency of return: The rate at which a particular type storm can be expected to occur (e.g., 1 year), such storms being classified by storm intensity and duration.

Infiltration: The process whereby water enters a sewer system from underground through such means as defective pipes, pipe joints, connections, or manhole walls. Infiltration does not include, and is distinguished from, inflow.

Inflow: The process whereby water enters a sewer system through such means as cellar and foundation drains, roof leaders, surface drainage, and cross connections from storm drains and catch basins. Inflow does not include, and is distinguished from, infiltration.

In-line storage: A type of storage that has no pumping requirements and can consist of either storage within the sewer (in-sewer/in-pipe) or channel, or storage in the in-line basins.

Interceptor: A sewer designed to receive dry weather flow from a number of transverse combined sewer trunks and additional quantities of intercepted surface runoff during low-flowing sanitary sewage periods and to convey such waters to a point for treatment.

Knee-of-the-curve: The point along a cost-benefit curve at which there is a noticeable change in the quantity of cost for an increment of benefit.

Lateral: A sewer that has no other common sewer discharging into it.

Longitudinal dispersion: One-dimensional dispersion (mixing) occurring along the length of the stream or estuary.

Mathematical modeling: Application of mathematical formulae to represent the processes and effects of natural and manmade systems for the purpose of forecasting responses to different conditions and inputs.

Model: Any representation of a system by something other than the system itself.

Model calibration: Refinement of mathematical model parameters and coefficients through comparison to data by making scientifically consistent and rational adjustments.

Model parameter: A quantity that cannot vary in a particular model run.

Model variable: A quantity that can vary in a particular model run.

Nonpoint: Diffuse; not attributable to a particular location.

Nonpoint source pollution: Any unconfined and nondiscrete conveyance from which pollutants are discharged.

Off-line storage: A type of storage that requires detention facilities (basins or tunnels) and facilities for pumping storm flow either into or out of the detention facilities.

Pathogen: A disease-causing microorganism.

Pathogenic bacteria and viruses: Bacteria and viruses capable of causing disease in humans.

Physical treatment processes: Means of treatment in which the application of physical forces predominate. Screening, sedimentation, flotation, and filtration are examples. Physical treatment operations may or may not include chemical additions.

Physical with/without chemical treatment processes: Means of treatment in which the removal of pollutants is brought about primarily by physical processes, with or without chemical addition to enhance removal efficiency.

Receiving waters: Natural or manmade water systems into which materials are discharged.

Recurrent frequency. The historical frequency at which a condition or situation occurs.

Regulator: A structure that controls the amount of sewage entering an interceptor by storing in the upstream trunk line or by diverting some portion of the flow to an outfall.

Sanitary sewer: A sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with relatively low quantities of ground-, storm-, and surface waters that are not admitted intentionally.

Sanitary sewer overflow (SSO): A sanitary sewer overflow is flow from an outfall (discharge conduit) of a sanitary sewer collection system in excess of the interceptor capacity that is discharged into a receiving water. Sanitary sewer overflows are the result of the unplanned relief of a sewer system intended only for sanitary sewage. An SSO typically occurs when the flow exceeds the carrying capacity of the system and although SSOs can, and do, occur during dry weather, they are most commonly associated with wet weather events.

Sanitary wastewaters: Wastewater of human origin.

Satellite facilities: Storage/treatment facilities at remote locations upstream of the dry weather flow sewage treatment plant and usually at the regulator/overflow site.

Sediment oxygen demand: Biochemical consumption of dissolved oxygen in overlying waters by decaying sediments across the water-sediment surface.

Sensitivity analysis: The variation of model parameters to determine the sensitivity of the model to each parameter.

Sewer: A pipe or conduit generally closed, and normally not flowing full, for carrying sewage or other waste liquids.

Sewer flushing: Flushing applied to combined sewer systems during dry weather flow periods to remove settled material periodically or as it accumulates, and to hydraulically convey it to the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm-flow periods and lessening the need for CSO treatment.

Sewerage: System of piping, with appurtenances, for collecting and conveying wastewaters from source to treatment and/or discharge.

Simulation: The application of a model.

Source control: A method of abating wet weather flow or pollution at the upstream, upland source where the pollutants originate and/or accumulate.

Storage The slowing, dampening, or attenuating of storm-generated or combined sewer flows either entering the sewer/drainage system or within the sewer/drainage system by temporarily holding the flow on a surface area, in a storage basin, within the sewer itself, or within a receiving water.

Storm duration: The period over which rainfall occurs.

Storm flow: Overland flow, sewer flow, or receiving-stream flow caused totally or partially by surface storm runoff, storm-related subsurface infiltration, or snowmelt.

Storm frequency: See *frequency of return.*

Storm intensity: The rate of rainfall usually expressed as inches per hour.

Storm sewer: A sewer that carries intercepted surface runoff, street wash and other wash waters, or drainage, but excludes domestic sewage and industrial wastes except for unauthorized cross-connections.

Storm sewer discharge: Flow from a storm sewer that is discharged into a receiving water or to a sewer system.

Stormwater: Water resulting from precipitation that percolates into the soil; runs off freely from the surface; or is captured by storm sewer/drainage, combined sewer, and, to a limited degree, sanitary sewer facilities.

Subcatchment: A portion of a catchment producing the runoff that passes a channel or stream location upstream of the location defining the catchment.

Supernatant: The relatively clear liquid layer above the sediment layer in the vertical column.

Surcharging: The transition between open channel flow and pressure flow in sewers.

Surface runoff: Precipitation and water (e.g., street wash) that falls onto the surfaces of roofs, streets, ground, and so on, and is not absorbed or retained by that surface, thereby collecting and running off.

Swirl regulator/concentrator: A cylindrically-shaped CSO control device that provides the dual function of a regulator and a solids-liquid concentrator. As a concentrator, it achieves good removal of the heavier settleable solids fraction in CSO. (See also *regulator.)*

Toxicity: The degree to which a pollutant causes physiological harm to the health of an organism.

Trace metals: Metals present in small concentrations. From a regulatory standpoint, this usually refers to metal concentrations that can cause toxicity at trace concentrations.

Trunk: A sewer, also known as a main sewer, that receives the discharge of one or more submain sewers.

Urban runoff: Surface runoff from an urban drainage area that reaches a stream or other body of water or a sewer/channel.

Water quality criteria: A threshold value or concentration for a pollutant or pollutant effect as chosen by regulatory agencies to distinguish between acceptable and nonacceptable environmental conditions; usually chosen based on laboratory observations of organism response.

Water quality standard: A threshold value or concentration enforced by law as a requirement to maintain acceptable environmental water quality conditions; usually chosen based on laboratory observations of organism response.

Wet weather flow: Usually referred to as the flow in a combined sewer system with stormwater, but may also constitute the flow in a separate storm or sanitary drainage system with stormwater.

Wet weather pollution: The discharge from a conveyance system resulting from wet weather flows. This discharge may occur to a receiving water as well as streets and basements (street and basement flooding).

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NRDC's Comments on EPA's Report to Congress on the Phase II Stormwater Regulations

Dated January 7, 2000

Addressed to:

Mr. George Utting
U. S. Environmental Protection Agency
Office of Wastewater Management
Mail Code 4203
401 M Street, S.W.
Washington, D.C. 20460

Re: COMMENTS ON Report to Congress on the Phase II Stormwater Regulations, EPA 833-R-99-001, October 1999

Dear Mr. Utting:

The Natural Resources Defense Council (NRDC) is a national, non-profit organization of scientists, lawyers and environmental specialists dedicated to protecting public health and the environment. Founded in 1970, NRDC has more than 400,000 members nationwide, served from offices in New York, Washington, Los Angeles and San Francisco. On behalf of our 400,000 members, NRDC is pleased to submit these comments on EPA's Report to Congress on the Phase II Storm Water Regulations.

NRDC believes that the Report to Congress adequately addresses Section 431(a) of the Department of Veterans Affairs and Housing and Urban Development and Independent Agencies Appropriations Act of 2000, Pub. L. No. 106-74 (1999). NRDC provides these comments to add to the discussion of the costs and benefits of storm water regulation. NRDC believes that EPA's report overestimates the compliance costs of storm water regulation. In several places, EPA states that it took a conservative approach (i.e., tending to overestimate costs) in estimating the compliance cost of the Phase II storm water regulations on local governments. Even while taking this conservatively high approach, EPA determined that the rule "is not expected to have a significant impact on a substantial number of local governments." However, while EPA recognizes substantial benefits associated with the rule, it neither quantified these benefits nor included them in the evaluation of costs. As such, the net cost to local governments is actually less than EPA indicates in the Report to Congress. Therefore, it is important to recognize that the benefits to regulated entities of implementing the Phase II rule are significant and are likely to offset some or all of the costs identified in this report.

Benefits of the Phase II Rule

The Phase II rule is an important step toward meeting the requirements of Section 402(p) of the Clean Water Act to protect the nation's waters from storm water discharges. It brings many currently unregulated, but harmful, sources of stream, lake, and estuary impairment under a familiar and flexible regulatory framework.

It is well documented that municipal storm water runoff and construction activity cause significant harm to the environmental and public health (see generally NRDC, Stormwater Strategies: Community Responses to Runoff Pollution, May, 1999; U.S. EPA, The National Urban Runoff Program (NURP) Study, 1983; U.S. EPA, The National Water Quality Inventory (305(b)), 1996 Report to Congress, 1998). Furthermore, we have found that uncontrolled storm water runoff often results in substantial adverse economic impacts.

In addition to the well-documented impacts of urban runoff, numerous studies, reports, and case studies show that storm water pollution prevention does not have to be an overwhelming issue for municipalities and developers. Effective storm water programs yield a broad spectrum of environmental and community benefits including, but not limited to, those benefits listed on pages I-4 through I-6 of the Report to Congress. In many cases, these programs have a significant economic advantage as presented in Stormwater Strategies: Community Responses to Runoff Pollution, NRDC, May 1999. These benefits could be used to more accurately reflect the benefits versus the costs of the Phase II rule. We expand upon EPA's discussion of these benefits below.

Enhanced Commercial Fishing: Fish consumption advisories are up 80% from 1993 to 1996 (NRDC, Contaminated Catch, April, 1998, p.1). NRDC's research shows that storm water runoff contributes to the contamination of fish and shellfish. For example, storm water runoff is a principal source of PCB contamination in fish (NRDC, Contaminated Catch, April, 1998, p.14). In addition, 38% percent of the nation's estuaries are impaired. Urban runoff is the second leading source of their impairment (U.S. EPA, The National Water Quality Inventory (305(b)), 1996 Report to Congress, 1998, pp. 62-63). Most of our nation's fish and shellfish industry relies on productive estuarine waters and their adjacent wetlands to provide healthy habitat for some stage of fish and shellfish development. Productive coastal waters contribute significantly to the economies of numerous communities. NRDC found that storm water pollution prevention programs can have a significant benefit to improving the quality of out nation's fisheries and shellfisheries. Efforts in Puget Sound, for example, where shellfishing contributes over $20 million to the economy annually, have resulting in upgrading nearly 5,000 acres of shellfish beds between 1997 and 1999. At the same time only 313 acres were downgraded. However, 20% of the shellfish beds still remain closed to commercial harvest due to sources of pollution including storm water. Puget Sound is currently the nation's leading oyster producer. Shellfishing is a significant proportion of the local economy, providing the second highest number of jobs and contributing to the tourism industry as well.

Enhanced Recreational and Subsistence Fishing and Opportunities for Boating, Swimming, and Noncontact Recreation: In addition to EPA's findings, research shows that recreational rivers have a positive economic effect on local regions. Protecting and managing rivers for recreation may provide a clean, economically viable means for enhancing local economic development (Cordell et al., "Economic Effects of River Recreation on Local Economies, Water Resources Bulletin, February, 1990). One study determined that water based recreation in the northern Connecticut River is valued at $26 to $31 million and creates a minimum of 650 to 750 jobs (National Wildlife Federation, Rivers, Recreation, and the Regional Economy: A Report on the Economic Importance of Water-based Recreation on the Upper Connecticut River, August 1996, p.8). Another study found that more than 52 million people spent more than 551 million days fishing in 1991(this does not include most salt water fishing) demonstrating that clean, productive waters are important economic and community resources (American Sports Fishing Association, 1991). The U.S. Fish and Wildlife Service estimates that over 35 million anglers spent over $38 billion dollars in pursuit of their pastime in 1996, money that would not be spent if there were no fish to catch (1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation: National Overview, 1997, pp. 4-5). Researchers have also found that water quality and aesthetic quality enhance the value of recreational fisheries. Storm water runoff is a significant contributor to beach closings in coastal and Great Lakes states. Investigators identified storm water as the source of 30% of the 1998 reported beach closings (NRDC, Testing the Waters 1999, July 1999, p. 1). EPA found that a typical swimming day is worth $30.84 to each individual, money that communities forego if they close a beach due to storm water runoff (U.S. EPA, Pathogens and Swimming: An Economic Assessment of Beach Monitoring and Closure, 1995).

Enhanced Nonconsumptive Wildlife Uses: NRDC agrees with EPA's assessment that storm water controls that result in greater numbers or diversity of viewable wildlife species will produce benefits. Storm water management strategies, including constructed storm water wetlands, wet detention ponds, vegetated buffers, and open space preservation, all provide or enhance habitat for wildlife. See Stormwater Strategies at pages 65, 72, 90, 92, 93, 148, 151, 167, 191, 224, and 243.

Reduced Flood Damage: Many storm water controls and management practices do prevent and mitigate flood damage, especially non-structural practices that minimize impervious cover, preserve wetlands, floodplains, and open space, or mimic these natural features. Increasingly, communities are realizing the link between increased urbanization and increased flooding ("Suburbia Learns It Has Paved Over the Natural Defense to Flooding," New York Times, September 29, 1999, p.B1). Responsible floodplain management and regulation of new development, encourage by the National Flood Insurance Program, saves over $800 million every year in flood losses. Communities can implement these same practices to control storm water runoff and realize both flood control and water quality benefits.

Drinking Water Benefits: EPA correctly makes the link between storm water runoff and drinking water quality. A study in Massachusetts on the Wachusett Reservoir Watershed Protection Plan rated storm water as a "high existing threat" to water quality. The study also rated construction activity and future development as a "high threat." The study rated pesticides, fertilizers and road salting, all documented sources of runoff pollution, as "moderate threats." In general, the study concluded that the most significant threats are associated with urbanization (Rizzo Associates, Inc., Watershed Protection Plan: Wachusett Reservoir Watershed, 1991, pp. 3-5 - 3-34). Microbes are almost always present in high concentrations in urban runoff, are notoriously variable, and derived from a variety of watershed sources (Schueler, T. R., "Microbes in Urban Watersheds," Watershed Protection Techniques, Vol. 3, No. 1, April 1999, pp. 551). Researchers often found standards of indicators exceeded by a factor of 50 to 75. Research cites bacteria as the third greatest pollution concern in a national survey of 272 surface water supply utilities (U.S. EPA, Office of Water, The Quality of Our Nations Waters: 1996, EPA841-S-97-001, 1998). In many cases, water supplies need expensive filtration to remove harmful microbes from drinking water supplies. Several major cities still rely on unfiltered water for much of their municipal water supply including New York, Boston, Portland, and Seattle. Pollution from storm water runoff and other sources may require filtration of these water supplies. The estimated cost of filtration for New York City's Catskill/Delaware system is $4.57 billion translating to $365 million in annual debt services and $140 million in yearling operating costs. A filtration plant is projected to increase NYC water and sewer rates by 45% (1994 testimony of NYC Comptroller Alan Hevesi).

Water Storage and Navigational Benefits: The nation loses approximately 820,000 acre-feet of water storage capacity each year due to pollution. EPA estimates that storm water runoff reduces annual dredging and construction costs by 7.9%, with an annual benefit of $170 million to $510 million, through storm water controls (U.S. EPA, Economic Analysis of Storm Water Phase II Proposed Rule: Final Draft, December, 1997, p. 7-11). The U.S. Army Corps of Engineers dredges 83 million cubic yards of sediment linked to pollutant sources each year. EPA estimates that 7.5% of this dredging is attributable to storm water at a cost of $13.4 million annually (U.S. EPA, Economic Analysis of Storm Water Phase II Proposed Rule: Final Draft, December, 1997, p. 7-12). In many cases, these dredged sediments are laden with nutrients, heavy metals, and toxic chemicals—making disposal expensive.

Public Health Benefits: NRDC agrees that storm water runoff is a serious threat to public health. The Phase II rule establishes a framework that helps protect public health by preventing runoff that pollutes swimming waters and contaminates seafood caught by recreational, commercial, and subsistence anglers. As previously stated, beach-water quality monitoring reports documented storm water runoff as the source for at least 30% of reported beach closings in 1998. Swimming in polluted waters can make you sick (NRDC, Testing the Waters 1999, July 1999, pp. 5-8). A study in Santa Monica Bay, comparing swimming near flowing storm-drain outlets to swimming at a distance of 400 yards form the outlet, found a 66% increase in a group of symptoms indicative of respiratory disease and a 111% increase in a group of symptoms indicative of gastrointestinal illness in those who swam close to a storm drain (Santa Monica Bay Restoration Project, An Epidemiological Study of Possible Advese Health Effects of Swimming in Santa Monica Bay,1996, pp. iv, v, 122). As previously states, microbes are ubiquitous in stormwater. Bacteria in shellfish poses a serious health threat. Nearly 40% of all shellfish beds in the nation have harvesting limitations due to high bacteria levels (NOAA, 1990 Shellfish Register of Classified Estuarine Waters: Data Supplement, 1992). National studies list urban runoff and failing septic systems as the leading causes of shellfish bed closures (U.S. EPA, Office of Water, The Quality of Our Nations Waters: 1996, EPA841-S-97-001, 1998).

Enhanced Aesthetic Value: There is often a premium associated with properties fronting well designed, aesthetically pleasing bodies of water including ponds, wetlands, and waterways used to treat or convey storm water runoff. The Department of Housing and Urban

Development found that, when all else is equal, the price of a home located near a body of water increases by up to 28%. In converse, there is likely a devaluation of properties located near degraded bodies of water (See Table 1 in Economic Benefits of Runoff Controls U.S. EPA, OWOW, Sept., 1995, EPA 841-S-95-002, p. 2). Furthermore, several studies have found that storm water runoff prevention and control strategies have significant aesthetic value or add value to property. For example, a study of the effects of greenbelts—an effective storm water control strategy—on property values found a $4.20 decrease in the price of a residential property for every foot one moves away from the greenbelt (Correll et. al., "The Effects of Greenbelts on Residential Property Value: Some Finding on the Polictical Economy of Open Space," Land Economics, Vol. 54, No. 2, May, 1978, p. 211). See also generally Lehner et al., Stormwater Strategies: Community Responses to Runoff Pollution, May 1999; U.S. EPA, Economic Benefits of Runoff Controls, OWOW, Sept., 1995, EPA 841-S-95-002; Schueler, T. R., "The Economics of Watershed Protection," Watershed Protection Techniques, Vol. 2, No. 4, June 1997; Fausold and Lilieholm, The Economic Value of Open Space: A Review and Synthesis, The Lincoln Institute of Land Policy, 1996; Metropolitan Washington Council of Governments, An Evaluation of the Cost of Stormwater Management Pond Construction and Maintenance,1983.

Additional Benefits and Economic Advantages of the 6 Minimum Measures

NRDC's report Stormwater Strategies: Community Responses to Runoff Pollution (May 1999) presents 77 detailed case studies and 88 additional examples highlighting environmentally beneficial and economically advantageous approaches to storm water management. The case studies come from a wide variety of communities throughout the United States and provide examples of effective strategies that meet the required six minimum measures. We summarize some examples of the benefits below.

Public Outreach and Education

Florida Yards and Neighbors Program: Program evaluation found that after participating in Florida Yards and Neighbors program, 13% more homeowners are using slow-release fertilizer and 23% more are reducing fertilizer use. The evaluation also found that more homeowners employed integrated pest management practices after participating in the program. Florida Yards and Neighbors program currently reaches out to 47 Florida counties.

Naturescaping for Clean Rivers, Portland, Oregon: Participants in the Naturescaping for Clean Rivers program have adopted better storm water management practices. For example, 49% have reduced the size of their lawn, 53% have increased composting, 27% now use less or no fertilizer, and 24% are using alternatives to pesticides.

Diazinon Toxicity Education, Fort Worth, TX: Public education and outreach efforts in Fort Worth have helped reduced home diazinon use, and appear to have a link to observed water quality improvements. The reduced toxicity of the water saves the city costly fines and treatment costs.

Multi-Agency Advertising Campaign, Alameda County, CA: An Alameda County add campaign cost-effectively raises awareness about storm water pollution. Evaluation of the campaign showed that 70% of those aware of the campaign changed their behavior, 36% became aware of pollution from illegal discharges, and 46% became aware of local educational opportunities.

Lake Harriet Watershed Awareness Project: This lawn care education program cost-effectively reduced storm water concentrations of pesticides by over 60% on average.

Public Involvement/Participation

Urban Watch Program, Monterey, CA: This partnership between the city of Monterey, the Coastal Watershed Council, and the Monterey Bay National Marine Sanctuary trains volunteers to monitor the city's storm water outfalls.

In-turn, the city uses the monitoring to identify storm water problems and target their outreach efforts. The program costs approximately $8,000 per year but saves the city almost $40,000 per year.

Water Quality Monitoring program, Chattanooga, TN: Chattanooga contracted with graduate students to monitor and map the city's storm water system. By using graduate students, the city saved over $65,000 while providing practical experience to students.

Outdoor Classroom, Oberon Middle School, Jefferson County, CO: Students at the Oberon Middle School constructed and continue to monitor a storm water wetland that treats runoff from their school. The benefits of this effort include cleaner water, an outdoor classroom, increased knowledge about storm water quality, recycled water used for irrigation, improved aesthetics, and a sense of community pride.

Illicit Discharge Detection and Elimination

Cohasset Harbor Board of Health, MA: The Cohasset Harbor Board of Health was able to reopen 400 acres of shellfish beds after issuing just two enforcement orders to private land owners.

Sanitary Surveys, Mason County, WA: Mason County's septic system inspection and maintenance requirements have improved water quality and allowed the state to reopen over 900 acres of shellfish beds. The program cost ($95 per inspection, $290 per dye test, and $285 per repair oversight) was minimal when compared to the value of the shellfish beds (projected to be $20 million in 2000)

Clean Charles 2005, Boston, MA: To date, this effort to eliminating illegal hookups and discharges to the Charles River has stopped roughly one million gallons of sewage discharge per day. Program administrators invest the fines, including one $400,000 fine, back into the program or into remediation efforts.

Clean Bay Business Program, Palo Alto, CA: This inspection and pollution prevention program awards "Clean Bay Business" status to compliant automotive businesses. The program increased compliance from 4% in 1992 to 94% in 1998 through ordinance requirements, increased inspections, and incentives. In addition, violations fell by 90% over 4 years. The total cost of the program, per facility, is only $300 for the first year and $150 per year thereafter.

Construction Site Storm Water Runoff Control

Study of Economic Advantages of Green Lots, Ohio and Indiana: This study comparing the preference for grass covered lots versus lots with bare soil among homebuyers, developers, and realtors. The study found that homebuyers perceived grass lots to be worth $750 more than comparable bare lots, with developers placing a $250, premium on the green lots and realtors $717 premium. The net benefit to the developer, based on the homebuyer valuation, is $450 per lot (seeding cost $300 per lot). In addition, vegetated lots have the environmental benefit of preventing erosion, sedimentation, and storm water runoff (Herzog et al., "Study of Economic Advantages of Green Lots, Ohio and Indiana," Journal of soil and Water Conservation, Accepted).

San Francisco Bay Regional Water Quality Control Board: Education and enforcement have brought compliance with erosion and sediment control requirements up from 30% in 1990 to 90% in 1998.

Certified Construction Reviewer program, DE: Approximately 100 tons per year of dirt and mud washes off each acre of the average Delaware construction site. Certifying private inspectors to ensure proper instillation and maintenance of BMPs improves compliance and saves municipalities money. For example, New Castle county requires a certified construction reviewer for about half their sites. This results in improved water quality and savings of approximately $111,000 per year in staffing costs.

Charlotte and Mecklenburg County, NC: These two municipalities teamed up to increase their attention to construction sites. The sharing of resources and responsibilities has increased compliance with erosion and sediment control requirements by 15%. It has also led to an increase in construction site inspections and enforcement actions, generating fines totaling $15,000 to $20,000 per year.

Post-Construction Storm Water Management in New Development and Redevelopment

The growth in urbanized areas has been dramatic over the past 50 years, increasing from 20,000 square miles in 1950 to over 60,000 square miles in 1990 (Bureau of the Census). Much of this growth has occurred near coastal areas, which are particularly vulnerable to and often severely degraded by storm water pollution. It is estimated that half the U.S. population will live in coastal areas by the year 2010. Furthermore, development is destroying wetlands, which are critical to minimizing the impacts of urban runoff. Wetlands are being destroyed at a rate of roughly 117,000 acres per year (Clean Water Network, Wetlands Fact Sheet, 1999).

Low-Impact Development, Prince George's County, MD: The principle behind low-impact development is to control runoff at the source using techniques such as bioretention, rain gardens, and alternative site design. Bioretention significantly reduces pollutants and has visual/aesthetic benefits as well. Property managers have found that bioretention maintenance costs are the same as grass only medians, approximately $200 per year per island. Developers of the Northbridge development in Bowie, Maryland found that using low-impact design principles, instead of a more conventional site design, reduced the impacts of storm water runoff, without increasing costs or decreasing the desired number of dwelling units. Furthermore, the homes sold better.

Prairie Crossing, Grayslake, IL: Prairie Crossing is a storm water sensitive development that minimizes impervious cover and uses a swale-prairie-wetland conveyance system to manage runoff. This approach removes 85% of pollutants and reduces runoff volume by 60%. This design saved the developer $2.7 million in capital costs and reduces maintenance costs. The homes sold at same rate or better than nearby conventional developments.

Village Homes, Davis, CA: Developers of Village Homes used natural features to convey runoff, clustering to reduce impervious cover, and better site design principles to reduce storm water pollution. This approach saved the developer $800 per lot in infrastructure costs. In addition, the homes sold in half the time and sold, on average, for $11 per square foot more than homes in nearby developments. The developers earned a 23% annual return on their investment. The design also reduced vehicle miles traveled per car, in the development, by 15% when compared to the average for the area, which has additional pollution prevention benefits.

U.S. Army, Fort Bragg, NC: A redesigned parking lot reduced impervious cover by 40% while increasing parking spaces by 20%. The design also incorporated a storm water treatment system into the parking lot. The new design cost 20% less to build than the original design saving the army $1.6 million.

Staten Island Blue Belt, New York, NY: The Blue Belt project makes use of natural drainage features to control runoff from 11 watersheds covering 6,000 acres of Staten Island. The city expects the project to save $50 million, including land acquisition costs, over conventional storm water management. Relying on natural features improves water quality and reduces flooding, while having the additional benefits of enhanced recreation, open space, education opportunities.

Prairie Waterway, Farmington, MN: To control runoff, eliminate drainage problems, and allow for some growth, Farmington constructed a natural, open storm water conveyance system. In addition to improving water quality, the Prairie Waterway saves residents $250,000 per year in wastewater treatment costs since it cost less to build and maintain than a conventional drainage system.

Pollution Prevention/Good Housekeeping for Municipal Operations

Vermont Agency of Transportation Smart Salting Program: Realizing that the temperature of the road surface can be considerably warmer than air temperature, the Vermont Agency of Transportation uses infrared temperature sensors on salt trucks to calculate more accurately the amount of salt needed to melt snow and ice. This approach reduces salt usage by 28%, on average, and saves the agency $2.2 million per year. For the pilot of this statewide program, the agency realized an 850% return on their investment in the sensors. Additional benefits include preventing drinking water contamination.

The Legacy Golf Course, Springfield, TN: The Legacy practices a number of runoff pollution prevention strategies including integrated pest management and the use of organic and slow release fertilizers. This approach improves water quality and saves this municipal golf course money.

Highway and Golf Course Partnership, Murray City, UT: A partnership between Murray City and Utah Department of Transportation (UDOT) saved the city about $1 million in golf course construction costs and UDOT $300,000 in land acquisition and storm water piping costs. The collected runoff is use as irrigation water, saving the city approximately $100,000 annually. The city uses revenues from this popular course to support the purchase land along the Jordan River to create a public greenway.

Innovative Funding Strategies

There are a number of ways that municipalities and developers can cost-effectively reduce or prevent storm water pollution, as discussed above. Municipalities can also improve their storm water programs by ensuring adequate funding for these programs. In the Report to Congress, EPA did not discuss options for local governments to generate funds for storm water programs such as a storm water utility, which would help offset compliance costs. Storm water utilities are a dedicated and equitable funding source for municipal storm water programs. There are almost 300 storm water utilities in operation in at least 20 states. They serve cities with populations ranging from 5,000 to 3.5 million. Preliminary legal research found that virtually all states and municipalities have the legal authority to set up such utilities (NRDC, Establishing a Stormwater Utility: A State-by-State Survey of the Law, June 1999). Rates for residential users appear to be in the range of $20 to $50 per year. Commercial and industrial users are often assess based on the amount of impervious cover at the site (i.e. their relative contribution of runoff). Revenues generated from utilities can be significant. Bellevue, WA (population 92,000) generated $7 million in 1990; Austin, TX (population 466,000) generated $15 million in 1998; Louisville, KY (population 671,000) generated $16.2 million in 1998. The revenues go to maintaining and improving storm water infrastructure. The dedicated and equitable nature is popular among administrators, elected officials, and citizens.

Impact of Phase II Rule on Local Governments

NRDC supports EPA's conclusion that the Phase II rule is not expected to have a significant impact on a substantial number of local governments. As discussed above, the overall societal benefits of controlling contaminated storm water discharges into our surface waters are vast. The benefits of implementing the storm water Phase II rule to local governments are also significant and offset much, if not all, of the estimated compliance costs. NRDC believes that the compliance cost to local governments is reasonable considering the environmental, public health, and community benefits of the storm water management measures required under the Phase II rule. NRDC also encourages EPA to consider the benefits and costs of storm water management relative to other municipal services. NRDC again points out that EPA did not, in this document, compare the benefits of the Phase II rule to the compliance costs, and that the methods used to calculate compliance cost relied on inflated cost assumptions.

In addition, NRDC agrees with EPA's conclusion that the Phase II rule provides considerable flexibility to municipalities. As shown above, there are a wide variety of approaches available to communities to control or prevent storm water runoff. There is also flexibility to develop cost-effective programs, implement innovative approaches, ease cost burden, and collaborate with other entities. The rule enables municipalities to choose, from a tool box of best management practices, the most appropriate strategies for their setting. In other words, local governments can tailor their programs around local issues, conditions, and concerns.

In conclusion, NRDC believes that the Report to Congress adequately addresses the requirements of the Appropriations Act. However, the report does not sufficiently consider the benefits to regulated entities of implementing the Phase II rule. Therefore, it fails to accurately reflect the impacts of the Phase II rule on local governments.

Sincerely,

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RECONCILING FLOOD AND DIFFUSE POLLUTION CONTROL OBJECTIVES IN URBAN WATERSHED MANAGEMENT

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ABSTRACT

Urban watersheds and receiving waters are adversely affected by urbanization that increases risk of flooding and, in the same time, reduces the chemical, physical (habitat) and biological integrity of the affected water bodies. Restoration of ecological integrity and flood control objectives in the past were conflicting, often to a degree that flood control alone lead to ecological degradation of the receiving water bodies by damaging the habitat. The two objectives in today's urban restoration/flood control projects must be reconciled.

This article describes a methodology and research that optimize both objectives. Numeric and flooding risks are will be correlated to the citizens "Willingness to pay" for reduction of either or both risks. Preliminary results of focus group surveys indicate that reduction of ecological risks and restoration of physical, chemical and biological integrity of urban streams is preferred by most citizens while the willingness to pay for flood control is related to the past history of flooding.

KEYWORDS
Flood risks, Stormwater pollution, Watershed management, Ecological risks, Integrity of urban streams, Public opinion surveys, Willingness to pay.

INTRODUCTION

Management of smaller and medium size urban streams today must today consider several objectives such as

I. Flood control
II. Preservation and restoration of ecological integrity of the receiving water body affected by point and nonpoint discharges and changes in hydrology and hydraulics.
III. Providing contact and noncontact recreation to urban population
IV. Other uses such as water supply, navigation, or hydropower production

Some of the objectives are conflicting some other are complementing each other. For example, preservation and restoration of ecological integrity and providing habitat for aquatic life complements recreational objective. As matter of fact, a healthy ecology of the stream is a prerequisite to the contact recreational use. On the other hand, flood control often is in conflict with ecological and recreational objectives. In the context of watershed and water body management these conflicts must be reconciled and uses must be optimal.

The increased magnitude and frequency of high flows caused by urbanization has several major adverse effects on floodplain, stream channel and on the ecology of the urban stream. The hydrologic effects include: (1) floodplain enlargement; (2) increase of the frequency of flooding inside the floodplain; (3) increase of peak flows during storm events; (4) increase of the magnitude and frequency of all runoff events of all sizes; (5) as a result of increased medium floods channels become unstable and more erosive (degrading); (6) imperviousness impedes recharge of shallow groundwater aquifers, which diminishes base flow contributions (after urbanization some streams may become ephemeral or effluent dominated); (7) more flow moves on the surface with a faster velocity which increases the volume of surface runoff contribution.

The most important adverse ecological impacts are: (1) loss of bank habitat by increased stream bank erosion and channel alteration to accommodate increased flows; (2) siltation of the channel by increased sediment loads; (3) water column and sediment contamination by pollutant discharges from point and nonpoint sources; (4) increased temperature due to more warmer surface flows and loss of stream shading by vegetation; (5) loss of pollution intolerant species.

The effects of urbanization are not only limited to the stream channels. The entire stream corridor consisting of the stream channel and floodplain must be considered in a comprehensive analysis of urban streams. Typically, urban developers try to reclaim floodplain and often development that was outside of the floodplain becomes a part of it as the floodplain enlarged as a result of urbanization.

Ecological and hydrological/hydraulic impacts of urbanization

The major impacts of urbanization on integrity of urban streams can be divided into three categories:

I. Hydrologic/hydraulic changes of flow regime and their effect on stream morphology.
II. Water and sediment quality degradation and their effects on composition and survival of aquatic species.
III. Ecological/habitat changes, including modifications of channels and floodplain.

Impervious surface in urban areas dramatically increases surface runoff during storm events. The changes affect both the rate and volume of flow. Schueler (1994) claimed that depending on the degree of imperviousness and soil type, annual volume of runoff of fully developed urban watersheds can increase 2 to 16 times the pre-development rate.

To accommodate the increased high stream flow caused by urbanization, streams themselves respond by increasing their cross sectional area. This is done by stream bed downcutting, stream widening, or a combination of both. Robinson (1976) in a study of eight watersheds in Baltimore, MD found that urban streams have channel cross-sections areas approximately twice those or rural streams and width-to-depth ratios about 1.7 times those of rural streams. Other studies have found that cross-sectional area increases by a factor of 2 to 5, depending on the degree of impervious cover in the watershed and the age of the development (Arnold et al., 1982; Gregory et al., 1992). Stream channels react to increased urban runoff not only by adjusting their widths and depths, but also by changing their gradients and meander pattern (Riley, 1998).

The final modification of urban stream, in the last phase, is again done by man. To constrict the widening stream, control stream bank erosion and contain the flood water in the channel, streams banks and channel are lined with artificial materials such as concrete, stone rip raps and gabions. Such engineering measures downgrade the stream to an open conveyance channel with minimum or no habitat conditions. Table 1 summarizes the hydrological/hydraulic effects of urbanization on urban streams.

RECONCILING THE CONFLICTS OF THE OBJECTIVES OF URBAN STREAM MANAGEMENT

Most of urban watershed management projects in the United States are driven by flood control objectives. On one side, public media pay extraordinary attention to the plight of people affected by flooding that then results in heavy pressure and lobbying of public officials by affected individuals and citizens groups. However, using traditional benefit/cost analysis most urban flood control projects are highly inefficient. In the Milwaukee (Wisconsin) metropolitan area the benefit/cost ratio of flood control drainage projects in which the benefit is the reduction of monetary damages to properties and land within the floodplain, are typically less than 0.2. Consequently, projects that would address flood control only are not feasible. Such projects would represent a massive transfer of benefits from the general taxpayer public to a small number of beneficiaries located in the floodplain. Further more, the *antidegradation rule* of the present regulations in the United States and elsewhere does not allow downgrading the integrity of the receiving water bodies even when the objective is drainage or flood control. Therefore, the sometimes conflicting concurrent objectives of drainage/flood control and restoration of ecological integrity of urban streams of urban stream projects must be reconciled.

Restoration of ecological al integrity of urban streams, on the other hand, benefits much larger segments of population. However, considering the benefits of ecological improvement in the classic economic benefit cost analysis is difficult because such benefits are mostly intangible. On the other hand, such benefits are very desired by the public, especially those living near the water body but in the floodplain. Consequently, another measure of benefits must be defined and substituted. The *Willingness to Pay* of the public for the ecological benefits is a common substitution for strictly monetary flood control benefits in a multi-objective watershed restoration and flood control projects.. In reality, projects that include both flood control benefits and ecological and water quality restoration and improvement may become acceptable to the general public as exemplified in two such projects in the Milwaukee Metropolitan area that are featured in this article.

Table 1 **Summary of impacts of urban stormwater runoff on stream ecosystems**

Potential Stream Ecosystem Change	Disturbance Activity							
	Increased Watershed Imperviousness	Increased Soil Erosion	Vegetative Clearing	Channelization	Streambed Armoring	Woody Debris Removal	Bridges, Culverts and Utility Crossings	Contaminants
Increased peak flood flows	•				•	•		
Increased frequency of bankfull flows	•			•				
Increased duration of flood flows	•							
Increased instream velocities	•		•	•	•			
Increased flood energy	•		•	•	•			
Increased channel bed and bank erosion	•		•	•				
Increased streambed turnover	•				•	•		
Decreased base flow	•							
Embedded streambed sediments	•	•	•					
Loss of fish refuge				•		•	•	
Loss of pool and riffle structure	•	•	•	•	•			
Increased streambed gradient	•		•	•	•			
Changes in meander patterns	•		•	•	•			
Increased stream migration	•		•	•	•			
Channel widening and down-cutting	•		•	•	•			
Loss of riparian vegetation			•	•	•	•	•	
Shift in organic material from external sources (leaves) to internal sources (algae)			•	•	•	•		
Reduction in macroinvertebrate numbers and diversity	•	•		•	•	•		•
Shift in macroinvertebrate community structure	•	•		•	•	•		•
Reduction in fish diversity	•	•	•	•	•	•	•	•
Shift in fishery to more pollutant tolerant species	•	•	•	•	•	•	•	•
Increase in fish disease	•	•						•
Blocked fish passage				•	•		•	
Increased water temperatures	•	•	•	•		•		
Reduced instream oxygen levels	•							•
Reduced gene pool of species for dispersal and colonization	•	•	•	•	•	•	•	•

INVESTIGATED URBAN WATERSHEDS

Oak Creek

The Oak Creek discharges to Lake Michigan in the City of South Milwaukee, WI. About 22 km of the stream is perennial.

TABLE 1. Basic watershed characteristics: Oak Creek watershed.

Area	69.8 km^2 (27.24 mi^2)
Percent urbanized	44.6%
Population (1980)	39,700

The Oak Creek watershed can be characterized as a rural area with a great potential for future development. Agricultural land (cropland and pasture) represents the prevailing type of the land use in the watershed (see Tab. 2). Most of the agricultural land is located in the western and southern portions of the watershed. The soils within the Oak Creek watershed are silty clay loams, loams, and sandy loams, and are developed on gently sloping or rolling morainel topography. Most of the soils are relatively fertile.

TABLE 2. Land use distribution: Oak Creek watershed [GIS].

Land Use	Percent Total
Cropland and Pasture	55.4
Residential	22.8
Other Urban or Built-Up	6.5
Transportation, Commerce, Utilities	6.0
Commercial and Services	5.8
Industrial	3.6

Pollution sources can be categorized as municipal, industrial, agricultural, landfill, and stormwater. A contribution of pollution from the point sources is negligible compared to that from the nonpoint sources. Rural sources dominate among the nonpoint sources (20-50%).

Menomonee River

The Menomonee River discharges into the Milwaukee River about 0.9 mile upstream from where the Milwaukee River enters Lake Michigan.

TABLE 3. Basic watershed characteristics: the Menomonee River watershed.

Area	350.7 km^2 (137 mi^2)
Percent urbanized	52.8%
Population	348,165 (1970)
	964,640 (1990)
	962,570 (1996)

Population density ranges from less than 135 to about 10,000 persons per square kilometer with an average of 980 po./km^2. Channel modifications are concentrated in the urban areas. The 120-km river system contains 42% of minor channelization, 22% of major channelization, and 3% of conduit, accounting for a total of 67% of river length.

Table 4 shows the land use distribution for the Menomonee River watershed. About 46% of the total area is still in rural uses, representing a great potential for nonpoint source pollution. Rural areas prevail in the northern portion of the watershed, while the southern portion of the watershed is mainly urban.

The soils within the Menomonee River watershed are rolling silt loams or gravelly loams. Most of the natural soils are relatively fertile. Where urbanization has occurred, artificial fill materials and paved surfaces have modified the natural character of the soils with regard to drainage and fertility.

TABLE 4. Land use distribution: the Menomonee River watershed [GIS].

Land Use	Percent Total
Commercial and Services	7.6
Confined Feeding Ops	0.1
Cropland and Pasture	42.6
Deciduous Forest Land	2.4
Forested Wetland	0.3
Industrial & Commercial	6.0
Mixed Forest Land	0.2
Mixed Urban or Built-Up	1.1
Silvicultural	0.1
Other Urban or Built-Up	5.2
Reservoirs	0.2
Residential	29.7
Strip Mines (quarries)	0.7
Transportation, Commerce, Utilities	2.4
Transitional Areas	0.1

Ecological Risk Assessment

There are no point sources of pollution discharging in the two investigated water bodies.

The habitat quality and physical parameters were evaluated using Habitat Assessment and Physicochemical Parameters Protocol (Plafkin et al., 1989). The scores at Oak Creek ranged from 45 to 95% of reference score with majority of scores between 53 and 62% (non-supporting). Only one site has habitat conditions comparable to those of the reference site (>90%) and two sites are classified as supporting (75-90%). The scores at Menomonee River ranged from 40 to 97% of reference score. Three sites have conditions comparable to those of the reference site, one site is classified as partially supporting (60-75%) and four sites as non-supporting (<60%).

Biological monitoring was conducted during Summer 1999 in cooperation with Wisconsin Lutheran College. An index of biotic integrity (IBI) based on fish species composition was calculated based on procedures developed by Lyons (1992). A high percentage of tolerant species and low species diversity indicate very poor stream quality. The IBI scores indicate that all three locations do not support a typical fish community for this region.

Macroinvertebrates were collected at 5 sites on Oak Creek and 9 sites on Menomonee River, including 2 sites in headwaters without significant impairment by urbanization (reference sites). Sampling followed protocols for multihabitat using a D-frame dip net. Sampled habitat types included cobble, snags, vegetated banks, submerged macrophytes, sand and other fine sediment.

The chemical integrity monitoring program focused on key locations in the Oak Creek and Menomonee River watersheds. The following parameters were monitored: pH, suspended solids, volatile suspended solids, total solids, hardness, COD, total Kjeldahl nitrogen, nitrate and nitrite nitrogen, total phosphorus, total and dissolved heavy metals (Cd, Cu, Pb, Zn), cyanides (winter sampling only), and PAH (sampled twice). Total of 24 water column samples were analyzed. The sampling covered both low and high flow periods with wide range of flows. Sediment samples were also analyzed.

The data on water quality were used to estimate the ecological risk to aquatic biota by selected heavy metals (Cu, Pb, Zn). The calculation is based on modified methodology summarized in Novotny and Witte, 1997. The ecological risk is estimated as a joint probability of two probability functions: (i) the probability density function of ambient concentration (pdf), and (ii) the probability that an organism will be adversely affected by the exposure to the given concentration (toxic response curve). Ambient concentrations follow log-normal distribution.

Table 5 reports the calculated chemical risks by toxic metals. The risks (both chronic and acute) from copper calculated for the Menomonee River are two orders of magnitude higher than those for the Oak Creek. The risks from lead and zinc are at the same level for both watersheds.

Table 5. Chemical risk to aquatic biota. Oak Creek and Menomonee River.

Station Number	Cu	Pb <1987	Pb >1987	Zn
Oak Creek - acute	1 E-06	1 E-04	7 E-06	9 E-04
Oak Creek - chronic	7 E-05	2 E-02	3 E-03	1 E-03
Menomonee River - acute	1 E-04	2 E-04	2 E-06	6 E-04
Menomonee River - chronic	7 E-04	3 E-02	2 E-03	1 E-03

Flood Risk

The flood risk was defined as a probability at any point of the watershed that a flood will occur in any given year. Flood risks were estimated in the GIS ArcView environment. Two basic approaches were considered. The first is a vector-based approach that employed a custom developed ArcView Avenue scripts program. This approach permits estimation of risks only at specific points rather than for complete areas. The second more general approach works in a grid (raster) environment, and makes use of the Spatial Analyst Extension for ArcView. It permits flood risk to be calculated for the entire watershed, and specified points can be assigned the corresponding value from the underlying polygon. The second approach was selected because of its future applicability in watershed management applications.

RELATION OF THE WILLINGNESS TOP PAY TO THE RISKS OF FLOODING AND ECOLOGICAL DAMAGE TO THE STREAMS

Willingness to pay provides a measure of how much all beneficiaries, not just those living in the flood plain, are willing to spend for flood control and restoration of urban streams. In the research described herein, a hypothesis was advanced that the willingness to pay parameter could be related to the risks of flooding and damage to ecology.

To identify users's (citizen's) preferences for flood control and diffuse pollution control/stream restoration actions a two way survey is being conducted in two watersheds in the Milwaukee metropolitan area. The objectives of the surveys are as follows:

1. Find the extent and nature of physical and emotional connection to the water body;
2. Identify perceptions of the health of the water bodies;
3. Identify perceptions about flooding;
4. Assess understanding of the "Willingness to Pay" questions;
5. Identify salient beliefs about the water bodies and related issues;
6. Identify perceptions about the citizen's capacity to get information on this topic;
7. Identify beliefs about nature and quality of information about this topic from mass media;
8. Find the range of values placed on prevention of flooding and ecological improvement relative to other community issues.

Participants were drawn from a random sample of homeowners and residents of two investigated watersheds ion the Milwaukee metropolitan area.

Findings of the focus groups

Objective 1: There is great variance in people's connection to the river or creek. Some visit the river regularly to enjoy the scenery, walk or bike along the river while others avoid the river because they are too busy, or due to perceptions of pollution or lack of accessibility. Emotionally, some expressed anger at local agencies perceived as responsible for flooding/environmental quality problems.

Objective 2: Most participants felt that the health of the river and creek could be improved and that it had worsened over time. Specific concerns were about fertilizer, chemical runoff and trash and debris left behind by people. Several participants were concerned about the effect that communities upstream may have on the health of the river. A handful felt that some positive changes had taken place to improve the environmental quality. The following were seen as indicators of the health of the river or creek: 1) clarity and quality of water, 2) presence of fish, 3) presence of birds and other wildlife, 4) presence and condition of trees and plants, 5) ability for the water and areas surrounding the river and creek to sustain life, 6) the absence of fertilizers and chemical runoff from farms and homes, 7) the absence of industrial pollution.

Objective 3: Participants from Menomonee River groups perceived a much greater risk of flooding than respondents from Oak Creek. Menomonee River has a recent history of urban flooding. Participants were concerned about a wide range of damage, including flooding of yards and basements, roads and streets, sewer backup, well water contamination, the effects of future development and concern about others living in the flood plain. In general, it was difficult for participants to identify the cause of flooding in their community. Many were unsure whether the flooding they experienced was the result of poor drainage, sewers backing up, heavy rain, or rising water in the river and creek. It was suggested that future research include a set of items that tap into respondent's perceptions about the causes of flooding-- a consideration that is likely to influence WTP estimates.

Objective 4: Oak Creek residents had a hard time providing a WTP dollar amount because they did not believe the river was flooding and was not a problem in their community. Interestingly, flood plain residents gave WTP estimates that were lower than other groups. In fact, 4 out of 9 gave zero bids. Some of the reasons for the lower estimates include: 1) the beliefs that current taxes should be covering these projects; 2) the beliefs that past projects didn't work; 3) anger at and mistrust of public officials and local agencies. Given existing perceptions of minimal to nonexistent flood risks in the Oak Creek watershed, it was concluded that willingness to pay on flooding risk will only be evaluated in the Menomonee River watershed.

Objective 5: A number of salient behavioral beliefs were considered when subjects were formulating a WTP estimate. These appear to be the beliefs that are likely to be positively related to WTP. The most commonly held beliefs:

1. Perception that there is a current risk of flooding
2. Feeling strongly connected to the river/creek.
3. Concern for others in the flood plain.
4. Affordability and personal finances
5. Belief that paying would be making my contribution to solve a community problem
6. Belief that the project would benefit the community.
7. Belief that the project would improve the environmental quality

Some beliefs appear to be negatively related to WTP. These were:

1. Homeowners and developers are responsible for the increased risk and should be held responsible.
2. Belief that the project would be ineffective. General skepticism.
3. Taxes are too high already. Should be paid with current monies.
4. Belief that the project is not a priority for my community
5. Belief that the money would go to administrative costs and studying the problem, not solving the problem.

Objective 6: Participants generated a long list of potential information resources, but a majority of respondents said they would turn to governmental sources for information. (This may have been an artifact of the social context of the focus groups, however.) Some expressed distrust about the accuracy of information coming from government agencies. Many perceived a great difficulty in getting and understanding the information they would need to make a more educated WTP estimate (because of access and interpretability of information). Some felt it was not their responsibility to get information about potential projects.

Objective 7: A majority of participants said they would be unlikely to turn to the mass media for information. Participants varied greatly on the extent to which they held the following beliefs:

Stories with statistics are more believable than those without.
Someone's personal experience is more convincing than statistics.
In-depth features are more informative than single news articles or reports.
In-depth features are more trustworthy.

A number of additional possible items were suggested, designed to tap into people's beliefs about government agencies, experts, environmental groups and elected officials.

Objective 8: Most participants placed the prevention of floods and the environmental improvement of the river/creek as a medium to high priority for their community. Most participants disagreed with the notion that only those who live in the flood plain should be required to pay the cost of flood control. However, results were much more varied when a similar question implied taxation and the participant possibly having to make a contribution ("Taxpayers have a duty to share in the cost of flood control even thought only a minority is affected by floods"). Most participants agreed that we have an obligation to protect nature even if there are not human benefits.

The focus group surveys are being followed by two large surveys of approximately1000 citizems of the two investigated watersheds. Results of the surveys will be available at the end of the year 2000.

CONCLUSIONS

Urban streams are adversely affected by urbanization that increases risk of floods and decreases ecological integrity of urban receiving waters. Reducing both risks may lead to conflicting solutions. In the past emphasis was solely on flood control by using conveyance approaches. Today, efforts are on the way in many communities to restore the ecological integrity and in the same time provide flood control. BY correlating the numeric ecological and flood risks to the citizen's willingness to pay for reduction of the risks it will be possible to find an optimum of the solutions of the dual risks facing today many urban streams.

Focus group surveys by the research team of citizens living in two urban watersheds revealed that citizens value highly ecological integrity of the streams and are willing to support programs that would lead to its restoration. Willingness to pay for flood control may vary depending on the history of the flooding. Education of the public about future flooding potential is crucial because the citizens living in developing watersheds do not anticipate the future increases of the flood risks.

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RISK BASED URBAN WATERSHED MANAGEMENT UNDER CONFLICTING OBJECTIVES

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ABSTRACT

Ecological impairment and flooding caused by urbanization can be expressed numerically by calculating the risks throughout the watershed (floodplain) and along the main stems of the streams. The risks can be evaluated in terms of the present and/or future. This article describes the methodologies for ascertaining the risks in the Geographical Information Systems (GIS) environment. The objectives of urban flood controls and ecological preservation/restoration of urban waters are often conflicting and, in the past, the sole emphasis on flood control led to destruction of habitat and deterioration of water quality.

An optimal solution to these two problems may be achieved by linking the risks to the concepts of risk communication, risk perception, and public *willingness to pay* for projects leading to ecological restoration and ecologically sustainable flood control. This method is appropriate because, in each case, public funds are used and the projects require approval and backing of policy makers and stakeholders. This article briefly describes a research project that attempts to resolve the conflict between the flood protection and stream ecological preservation and restoration and suggests alternative ways of expressing benefits of urban stream flood control and restoration projects.

KEYWORDS

Urban flood control, Ecological integrity, Risk, Risk communication, Risk Perception, Willingness to pay, Contingent valuation, Public opinion surveys, Theory of Planned Behavior.

INTRODUCTION

Urbanization has an irreversible impact on natural drainage patterns and flows in the receiving water bodies impacted by urban development. Uncontrolled development or past development in the flood plain that did not consider the impacts on hydrology, flood plain encroachment, morphology and ecology of the receiving water body system have had detrimental effects on the receiving water body, flood plain development and downstream uses of the water body. However, if development progresses in a planned, ecologically conscious way, the adverse impacts on population and properties can be minimal or minimized.

Management of smaller and medium size urban streams today must today consider several objectives, such as:

1. ***Controlling floods***;
2. ***Preserving and restoring the ecological integrity*** of the receiving water body affected by point and nonpoint discharges and changes in hydrology and hydraulics;
3. ***Providing contact and noncontact recreation*** to urban populations;
4. ***Optimizing other uses***, such as water supply, navigation, or hydropower production.

Some of the objectives conflict and some complement each other. For example, the preservation and restoration of ecological integrity and the provision of habitat for aquatic life complement recreational objectives. In fact, contact recreational uses require a healthy stream ecology. On the other hand, flood control often is in conflict with ecological and recreational objectives. In the context of watershed and water body management, these conflicts must be reconciled and uses must be optimized.

HYDROLOGIC CHANGES BY URBANIZATION

Figure 1 shows a probability-frequency chart of flows in a watershed located in central Wisconsin that underwent rapid urbanization. The flows were calculated by a well known TR-55 hydrologic runoff curve model (U.S. Soil Conservation Service) after entering the watershed characteristics as they are changed by urbanization. The watershed area is 36.7 km^2 (14.2 sq.mi.). The original use of land in the watershed before 1960 was as a rural mix of agri-cultural and forested lands. By the time of the 1985 Federal Emergency Management Administration (FEMA) flood delineation study, the watershed became about 20 to 25 percent urbanized. Soils of the watersheds were predominantly in the U.S. SCS hydrologic categories of B and C (loams and silt loams). As of 1998, the watershed was about 40 percent urbanized and the dominant land use had become residential. The other current, major land uses are transportation (including a freeway and state and local highways) and a large shopping mall. As Figure 1 illustrates, the flow that was a 100-year flood in the 1965 pre-development period is today a high flow occurring on average every three to four years and could become an annual high flow when the watershed is fully developed.

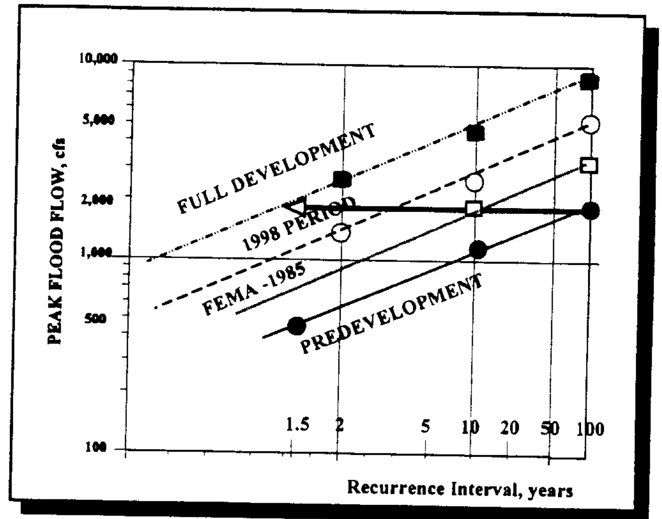

Figure 1 Effect of urbanization on flood flows in a small Midwestern (US) watershed

The increased magnitude and frequency of high flows have several major adverse effects on the community located near the water course, on the floodplain, and on the ecology of the urban stream. Hydrologic effects can be summarized as follows:

1. ***The floodplain enlarges***. In the United States, the *floodplain* is defined as an area that is flooded up to the extent of the 100 year flood. Figure 1 shows that as the magnitude of the 100 year flood increases, areas that were outside the 100 year flood plain would become a part of it.
2. ***The frequency of flooding inside the floodplain increases.*** Under natural conditions, a river channel overtops about once every 1½ to two years (Leopold, Wolman and Miller, 1992). Figure 1 documents that the channel, as a result of urbanization, is overtopped several times each year.
3. ***Peak flows during storm events are increased.*** Since surface flow moves faster, the time of concentration is decreased.
4. ***The magnitude and frequency of all runoff events of all sizes increases.*** This outcome is especially important for rainfalls of smaller and medium magnitudes. Before urbanization these smaller rainfalls mostly infiltrated into soil and the flows in the stream were smaller and could be easily contained in the natural channels of the stream. After urbanization the same medium rainfall could result in a flood.
5. ***Channels become unstable and more erosive*** (degrading) as a result of increased medium floods (Booth and Jackson, 1997). This outcome has an adverse impact on habitat.
6. ***Imperviousness of the watershed impedes recharge of shallow groundwater aquifers.*** This outcome diminishes the base flow contributions. Some streams may become ephemeral or effluent dominated.
7. ***More flow moves on the surface, and with a faster velocity.*** This outcome increases the volume of surface runoff contribution.

Urban engineers in the past had tried to resolve the problem of increased floods by enlarging the flow capacity of urban streams via the processes of lining, covering, and straightening the channels. Los Angeles River in California and the Kinnikinnic River in Milwaukee are examples of the ultimate transformation of urban streams into concrete high flood velocity channels with very little biological habitat. At the same time, flood-plains were being lost to urban development. In general, most urban stream modification projects are driven by the need to control floods. However, economics are not favorable to projects that consider only flood control needs and most urban flood control projects have negative net benefits, *i.e.*, the project costs far exceed the benefits in terms of flood damage reduction. This article briefly describes a research project that (1) makes an attempt to resolve the conflict between flood protection goals and stream ecological preservation and restoration needs, and (2) explores alternative ways of expressing the benefits of urban stream flood control and restoration projects.

RISKS OF FLOODS AND ECOLOGICAL INTEGRITY

In order to compare the risks of increased flooding and the deteriorated ecological integrity of urban streams, the first step is to define a measure for both. Ideally, these measures should be comparable. But that, at this point, seems impossible. The next best solution is to assign weights so they can be compared.

Measure of flood risk. There is a need to express a flood risk relation in the urban flood plain. First, let us define a flood as a flow that is greater than the capacity flow of the channel. A floodplain is a part of the river corridor (Figure 2).

It is also necessary to expand the probabilistic definition of flooding to areas away from the channel. As one moves away from the river's edge (the beginning of the flood plain) the probability of flooding decreases and at some point at a distance X from the river's edge the recurrence interval of flooding becomes 100 years, i.e., the risk of flooding is $\mathbf{r(X) = 0.01}$. This is the extent of the 100 year flood plain that defined and delineated for engineering and flood insurance purposes. The schematic of the risk is then shown on Figure 2. If before urbanization the smallest flow that leaves the channel is about a flow with a recurrence interval of two years (Figure 2) then the annual risk of flooding at the bank of the river is $\mathbf{r_n(0) = ½ = 0.5}$. If, as a result of urbanization, flooding becomes more frequent, for example, if the bankfull capacity flow is exceeded twice a year, the risk of flooding at the river's bank becomes $\mathbf{r_u(0) = 1/0.5 = 2}$ and so forth. The subscripts ***n*** and ***u*** denote natural (pre-development) and urbanized (post development) conditions, respectively.

The monthly probability (risk) can be calculated from a *series* of maximum monthly flows and not just from one, per-year maximum flow. This approach enables us to consider the fact that there may be more then one occasion in a year when the flow leaves the confines of the channel and becomes a flood. Thus, the monthly risk will be slightly different from 1/12 of the annual risk that is based on only one flood per year. To bring the magnitude of the risk on par with the water quality risks that are expressed in terms of the probability of daily grab or four day composite samples exceeding the acute or chronic toxic concentrations or water quality criteria, the risk of monthly flood would be further divided by 30.41.

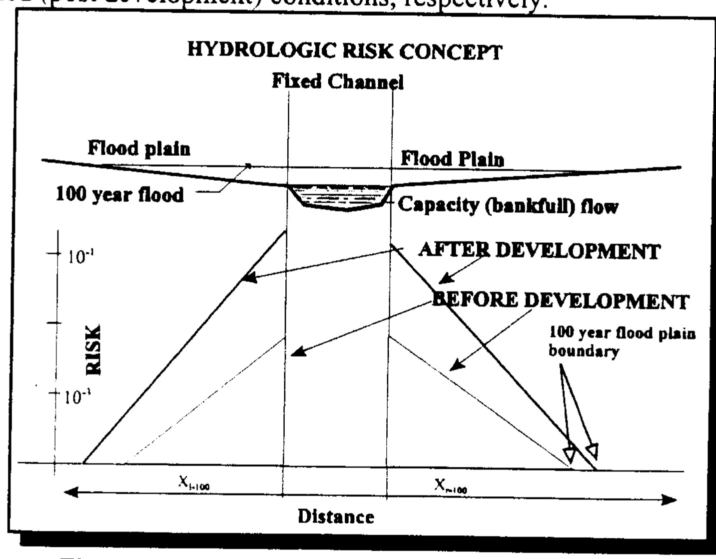

Figure 2 Concept of Urban Flood Risk

The logarithmic mathematical form of the risk function is selected for convenience and simply expresses the fact that floods on rare occasions may extend further than the 100 year flood plain limits. The risk function can be then expressed as

$$r = C\,10^{-K\,x} \qquad (1)$$

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The function parameters can be easily estimated from the knowledge of the risk of exceeding the bankfull capacity flow and from the extent of the 100 year flood plain. C in the above equation is the risk of exceeding the bankfull flow, or, **C = r(0)**. In the Geographical Information Systems (GIS) environment, the risk function can be ascertained from flood flow elevations and contours of the flood plain.

This risk function can be integrated, *i.e.*,

$$\boxed{R = \int_0^{\infty} r_l(x)\,dx + \int_0^{+\infty} r_r(x)\,dx = r(0)\int_0^{\infty}[\,10^{-K_l x_l} + 10^{-K_r x_r}]\,dx} \qquad (2)$$

where subscripts *l* and *r* correspond to left and right bank flood plains.

The flood plain risk parameter, **R**, or function, **r**, can be combined with the flood damage cost information to yield annualized flood damage indicator. If **d** is an uniform flood damage cost expressed in dollars ($) per m^2 of the flood plain ,then the total annualized flood damage function is simply **D = R x d.**
The unit of the annualized flood damage indicator is **$ (meter of length of the stream)$^{-1}$(year)$^{-1}$**. If **d** varies with the distance from the stream then this function is included into the integral (**Equation 2**) and solved. This parameter could be used in flood risk communication. The flood damage cost, **d**, includes a variety of the costs of remedies for flooding, such as pumping water from basements and streets, cleaning up flooded basements, repair of houses damaged by flooding, cleaning roads, loss of property, and loss of time. It represents the total cost of cleanup and repair divided by the flooded area.

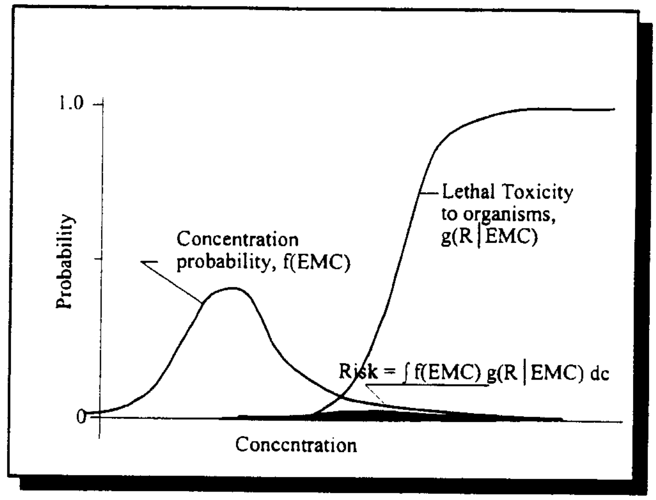

Figure 4 Concept of risk calculation for an individual stressor

The concept of flood risks can be incorporated into a GIS environment. The information and data necessary to develop the flood risk are obtainable from flood insurance maps, U.S. Geological Survey stage-flow rating curves, watershed elevation contours, and conventional hydrologic and hydraulic engineering calculations.

Ecological Risk. Following U.S. Environmental Protection Agency (EPA) (1992) and WERF (Parkhurst *et a.l,* 1996) risk assessment documents, ecological risk for aquatic systems is defined as *"a probability that a genus residing in or potentially indigenous to the receiving water body will be lost or acutely damaged by existing or potential discharges of pollutants."* The term *potentially indigenous* reflects the fact that the representative composition of organisms should be selected from a composition in similar unimpacted water bodies located in the same ecoregions.

The calculations of individual risks for each stressor is demonstrated in Figure 3 . EPA currently evaluates ecological risks in terms of the loss of species or genera that will result from the environmental impact (Parkhurst *et al.,* 1996, US EPA, 1992). This risk is basically a joint probability function of (1) probability density function of concentrations, **f(EMC)**, and (2) probability that species will be lethally or chronically impacted when exposed to a given concentration, **g(R | EMC)**. A simple model and method for calculating ecological risks of contaminants present in storm-water discharges was published by Novotny and Witte (1997). The method assumes that the event mean concentrations of pollutants are log-normally distri-buted. At this point the method estimates only the risk of acute damage to the indigenous population. Both storm-water and base flow discharges are considered. The method considers dilution of storm-water and CSO discharges and Water Effect Ratio. A simple soft-ware package has been developed by the Water

Environment Research Foundation (Parkhurst *et al.*, 1996). The single, dimensionless risk value has numerous advantages over the traditional separate comparison of measured water quality data with criteria because it puts all pollutants on the same basis, *i.e.*, the probability of ecological damage to the resident biota (or poten-tially resident as derived from reference unimpacted water bodies of the same character within the ecoregion). It may also be an additive and comparative number, *i.e.*, risks from several compounds and those from dry weather discharges could be added together to yield an overall risk and approximate synergy and individual risks can be quantitatively compared.

WILLINGNESS TO PAY - A WEIGHTING FACTOR FOR RISKS

As shown above, the ecological and urban flooding risk can be expressed in apparently similar units; however, these risks are not directly comparable and need not be valued the same by local residents. A solution is to assign weights to each risk and use a common denominator to develop the weigths. One technique that has been used by economists to assess the underlying value associated with nonmarket goods such as environmental and flooding risk reduction is the contingent valuation method (CVM). This approach employs a survey of residents to assess their maximum willingness to pay (WTP) to improve, or avoid degradation of a local resource. In the current context, the approach can be used to determine WTP for reduced ecological risk, and the maximum WTP to avoid increasing flooding risks above existing levels as a consequence of continued urbanization. The stated WTP payment should be that dollar value that would make the respondent indifferent between the original level of risk, and the hypothesized change in risk. Hence, the WTP response gives an indication of the true value to the respondent of the hypothetical change being described in the questionnaire. If carefully designed, these surveys can be used to not only gauge the level of public support for a project, but also determine the community benefits associated with public investments in flood control and ecological improvement to urban watersheds.

This technique is being employed in the present analysis of flooding and environmental risks in two watersheds within the Milwaukee metropolitan area. Development scenarios are described to the respondents based on ecological and hydrological simulation. Respondents are then asked to define maximum annual payments to (1) prevent increases in flood risks associated with development scenarios and, (2) improve ecological quality of the river and its environs. Although the economic theory that underlies the CVM has been thoroughly developed by Carson and Mitchell (1989), and others, there are a number of issues outlined below that are relevant to this particular application.

Descriptions of Public Goods. The respondents must understand clearly what is being valued and, equally important, the respondent must understand what is *not* being valued. For example, in the Milwaukee area, there have been consistent problems with sewer backups and basement flooding due to inadequate grading around houses. We are careful to point out that the flooding risks being valued are related to the rivers and streams overtopping their banks, rather than these alternative forms. To assist in the development of accurate and believable descriptions of the flood risk and ecological risk goods, focus groups drawn from residents within the watershed were conducted.

Referendum Format, Fiscal Reference Points and the Payment Vehicle. Since most flood control and environmental improvement projects are financed publicly, we used a referendum format to describe the project. That is, the project was described to the respondent in the form of a public referendum that would be financed with public tax dollars. Residents were then given as reference points average public expenditures on numerous public services provided by their state and local government (e.g., annual expenditures on police, fire, education, ambulance, etc.). We were careful to avoid identifying the property tax as the specific payment vehicle for the referendum. Rather, it was indicated that the payment would be made through a combination of state and local taxes. Given that most local flood control projects are financed over a period of 20-30 years, we indicated a 20 year period for the financing of the project. The respondent was presented with a randomly generated project cost between $0 and $500 (the range was determined from the focus groups) and asked if they would be willing to vote for the project if it were on the next ballot. This permits the determination of median responses to the WTP question. Furthermore, respondents were also asked to state the most they would be willing to pay in annual tax contributions over the next 20 years.

The Embedding Issue. A debate has developed as to whether WTP responses truly reflect the valuation of the good in question, or whether they simply reflect a desire to purchase moral satisfaction that one is actually doing something about an environmental problem (embedding). To test whether embedding is a problem among our respondents, we ask different WTP questions for three distinct groups of respondents. The first set of respondents were asked to place a value on maintaining the status quo on flood control in light of continued urbanization. A second group was asked to value ecological improvements to the watershed, and the third group was asked to value a project that included both ecological risk reduction and flood control. If embedding is not a problem, then the average WTP of the third group would be greater than that of either the first or the second groups. If completely separable, the WTP of the first two groups would sum to that of the third group.

Studying Watershed Residents. A two-wave, panel-design, probability sample survey of more than 1000 adult heads of households residing in two pilot watersheds (Oak Creek and the Menomonee River) located in the Milwaukee Metropolitan area is being conducted by telephone in 1999-2000 to ascertain WTP for flood control and/or ecological restoration of these two degraded watersheds. The interviews also ask most respondents questions that examine carefully various potential predictors of WTP, including a series of socio-demographic, attitudinal, risk perception, and risk communication variables based on a model of risk information seeking and processing developed by Griffin, Dunwoody and Neuwirth (1999) from powerful psychological theories such as the Theory of Planned Behavior (1988) and the Heuristic-Systematic Model of information processing (Eagly and Chaiken, 1993). The panel design of the study (i.e., reinterviewing the same individuals over time, with some new individuals added in the follow-up interview to control for sensitization effects) allows us to assess patterns of likely influence among the variables as well as the stability or volatility of WTP estimates over time.

Prior to the start of the survey, eight focus groups, consisting of citizens recruited in the watersheds, had been conducted in Spring 1999 to help develop survey questionnaire measures, including finding the best lay terminology for posing the WTP questions and describing flooding and ecological risks to survey interviewees. Because focus groups, even those drawn from samples, tend to be unrepresentative of the larger population, results were not used directly for policy or planning guidance

Theory of Planned Behavior. The Theory of Planned Behavior (Ajzen, 1988), which has been successfully tested in prediction of a wide range of human behaviors, is being applied in this study as a means of determining some key predictors of WTP. In this study, WTP is considered to be a form of *Behavioral Intention* (here, an intention to pay a particular amount for the described benefit in terms of flood risks or ecological improvements). Ajzen's theory indicates that behavioral intention (BI) is predicted by a limited set of psychological variables, notably one's sense of control over the behavior (*e.g.*, the amount one could pay), one's social normative beliefs (*e.g.*, one's sense that other people important to the individual would want him or her to pay for the benefit), a set of beliefs about the cost-benefit consequences of performing the behavior (*e.g.*, that paying a given amount would in fact help people who live in the flood plain), and a set of values that the individual holds about those consequences (*e.g.*, that helping people who live in the flood plain in this way is a desirable outcome). The latter two elements (outcome beliefs and outcome evaluations) are considered to be the building blocks of an *attitude* toward performing the behavior, which is the more direct predictor of BI. The theory should serve as a diagnostic tool (e.g., what separates those people who are willing to pay for flood control or environmental improvement from those who are not?) as well as a predictor.

Risk Communication and Perception. One dimension of WTP of key interest to researchers and policy makers is the stability (or volatility) of public WTP over time. Volatile WTP estimates mean that policy makers cannot truly plan on the level of public support voiced in WTP surveys. Thus this study seeks to determine factors that lead to stability in WTP estimates. In general, factors that contribute to stability in the variables that Ajzen (1988) uses as predictors of BI should contribute indirectly to stability in BI (WTP).

To examine these factors, we apply the model of risk information seeking and processing (Griffin et al., 1999).
The model proposes that seven factors -- (1) individual characteristics, (2) perceived risk characteristics, (3) affective responses to the risk, (4) felt social pressures to posses relevant information, (5) information sufficiency, (6) one's personal capacity to learn, and (7) beliefs about the usefulness of information in various channels -- will affect the extent to which a person will seek information about the risk in both routine and nonroutine channels and the extent to which he/she will spend time and effort analyzing the risk information critically (*i.e.*, "processing" it). A key aspect of this model is its reliance on Eagly and Chaiken's (1993) Heuristic-Systematic model, which proposes that information that is analyzed more systematically will produce attitudes more resistant to change over time. Thus, we would expect that factors that lead people to spend more effort gathering and analyzing information about flood risks and about risks to the urban watershed ecosystem will develop more stable beliefs and attitudes toward paying for flood control and ecosystem improvement and, therefore, will provide more stable WTP estimates.

Environmental values are a special form of beliefs about how things should be in the world and about what we should do to make the world a better place. For instance, a basic environmental value could be a belief that restoration of urban watersheds is the right thing to do. Environmental values can be anthropocentric (i.e. human centered) or they can be biocentric (Norton 1995). In the case of anthropocentric values, environmental improvement should be undertaken only for the benefit of people. For biocentric environmental values, ecological improvement should be undertaken both for the benefits humans and for the sake of nature itself. The surveys were designed to find these attitudes.

Synthesis.. Using the model of risk information seeking and processing (Griffin et al., 1999) and the Theory of Planned Behavior (Ajzen, 1988) enables us to predict variance in WTP and helps us explain cognitive, attitudinal, and social normative reasons for WTP. The WTP behavioral intention of respondents, as well as its cognitive and attitudinal precursors, are investigated by considering numerous factors such as upstream (source) vs. downstream (impact) location, living or owning real estate inside or outside the floodplain, other demographic parameters including the standard of living, and finally, the measured and calculated flooding and ecological risks. The estimated WTP functions can then be evaluated across various policy simulations to make derive the benefits associated with risk reductions. These benefit estimates can be compared with project costs to evaluate the economic efficiency of proposed projects.

CONCLUSION

This project represents an interdisciplinary analysis of two degraded urban watersheds. Hydrologic and biological models have been developed to quantify the impact of urbanization on flooding and ecological risks in two urban watersheds. The social scientists on the research team then derive individual and public values for such risk reductions. Although much of the engineering and biological work has been completed, the first wave of the survey was completed in April 2000, and the second wave will follow in the Fall and Winter of 2000/2001. Once the analyses of these surveys are completed, policymakers and stakeholders will be able to address a number of important issues. These include:

1. What are the relative weights placed on WTP for flood control vis a vis risk reductions for environmental quality in urban rivers, and how do these vary with individual and neighborhood circumstances?
2. What role does communication and public education play in determining WTP?
3. What factors lead to political support for flood control and ecological risk reductions?
4. Under what circumstances can officials count on continued public support in monetary terms (i.e., stability of WTP estimates over time)?
5. In light of future urbanization trends, how do the derived benefits associated with flood control and

watershed ecological improvement projects compare with the costs of these projects?

Because the location and other descriptors of respondents to the survey are known, the results will also enable the researchers to assign approximate spatial or neighborhood weights to these two types of risk, thereby reflecting community support for flood control and ecological risks. This outcome will help stakeholders to assign funding priorities. Preliminary results of the focus groups and of the first survey indicate that the WTP estimates in pilot watersheds are generally greater than the cost of the remediation, especially when ecological restoration and preservation are considered. Preliminary results of the survey indicate that 78.6 percent of respondents either strongly agree or agree with the statement that "the health of urban rivers should be improved for the sake of nature itself". This clearly suggests that the public in Milwaukee urban watersheds subscribe to biocentric urban values.

Acknowledgment. The research described in this presentation is sponsored by the Research Grant No. EPA Grant Number: R82-5759 from the US Environmental Protection Agency as a part of the EPA/NSF/USDA STAR Watershed Program. The views expressed in this presentation are those of the authors and not of the sponsoring agencies.

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Plan for California's Nonpoint Source Pollution Control Program

State Water Resources Control Board
California Coastal Commission
January 2000

U.S. Department of Commerce
National Oceanic and Atmospheric Administration

EPA U.S. Environmental Protection Agency

July 17, 2000

Peter Douglas, Executive Director
California Coastal Commission
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Edward Anton, Acting Executive Director
State Water Resources Control Board
901 P Street
Sacramento, California 95814

Dear Messrs. Douglas and Anton:

The National Oceanic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency (EPA) are pleased to inform you of our full approval of the *Plan for California's Nonpoint Source Pollution Control Program* (Program Plan), submitted in accordance with §6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) and §319 of the Clean Water Act (CWA §319). We commend you for developing a nonpoint source pollution control program to address both the requirements of CZARA and the CWA §319. We congratulate you on your efforts to successfully complete development of this comprehensive program, while recognizing the most challenging work awaits us.

Nonpoint source pollution, caused by a wide range of activities including agriculture, mining, urban development and forestry, is the leading cause of water quality impairment in California. The restoration of California's waters will depend on a wide range of regulatory and non-regulatory actions. We fully support the Program Plan's stress on cooperation and local stewardship to resolve nonpoint source problems, but vitally important are your assurances of applicable State regulatory authorities available to protect and restore water quality degraded by nonpoint source discharges. We recognize success will ultimately rely on your ability to use these programs and authorities to foster the widespread implementation of practices that will restore and maintain the chemical, physical and biological integrity of California's waters.

NOAA and EPA find that California has satisfied all conditions of program approval pursuant to CZARA set forth in the *Findings on the California Coastal Nonpoint Program*, transmitted to the State on June 30, 1998. These conditions have been addressed in the Program Plan. Furthermore, EPA finds that the Program Plan successfully incorporates the nine key elements pursuant to CWA §319 that characterize an effective and dynamic state nonpoint source program (EPA, May 1996). Consequently, the California Nonpoint Source Pollution Control Program is now fully approved pursuant to CZARA and CWA §319. As a result, California will receive $10.6 million this year to implement the nonpoint source program. This includes $5.2 million of "new" funds that the Clean Water Action Plan (February 1998) has earmarked for those States that have upgraded their nonpoint source programs.

We greatly appreciate the effort and commitment your agencies and staff have shown in completing development of your nonpoint source program. We look forward to working closely with you to implement fully the management measures by 2013, and will be working with you to monitor your progress in achieving this goal. If you have any questions regarding the enclosed decision documents, please call Jeff Benoit (NOAA) (301-713-3155), Felicia Marcus (EPA Region 9) (415-744-1001), or Alexis Strauss (EPA Region 9) (415-744-1860), or refer staff to Keelin Kuipers (NOAA) (301-713-3121, ext. 175) or Sam Ziegler (EPA Region 9) (415-744-1990).

Yours,

Jeffrey R. Benoit, Director
Office of Ocean and Coastal Resource Management
National Oceanic and Atmospheric Administration

for Felicia Marcus, Regional Administrator
EPA Region 9
U.S. Environmental Protection Agency

Enclosures: NOAA/EPA Decisions on Conditions of Approval (CZARA)
EPA's Review of California's Upgraded NPS Management Program (CWA §319)

cc: Winston H. Hickox, CalEPA
Mary D. Nichols, Resources Agency
Arthur G. Baggett, Jr., SWRCB
Sara Wan, CCC
Executive Officers, RWQCB 1-9
Chairs, RWQCB 1-9

STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 99 - 114

APPROVAL OF A RESOLUTION ADOPTING THE PLAN FOR CALIFORNIA'S NONPOINT SOURCE POLLUTION CONTROL PROGRAM (PROGRAM PLAN) AND AUTHORIZING THE EXECUTIVE DIRECTOR TO SUBMIT THE PROGRAM PLAN TO THE U.S. ENVIRONMENTAL PROTECTION AGENCY AND NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION FOR APPROVAL AND TO IMPLEMENT THE PROGRAM PLAN

WHEREAS:

1. The State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards (RWQCBs) are committed to and are ultimately responsible for nonpoint source (NPS) pollution management to protect and restore water quality in California.

2. In February 1987, the federal Clean Water Act (CWA) was amended to include section 319 which required each state to address NPS pollution by: (a) assessing NPS pollution problems and causes within the state; (b) adopting management programs to control the NPS pollution; and (c) implementing the management programs.

3. In accordance with the requirements of CWA section 319, on November 15, 1988, the SWRCB adopted and, on January 4, 1990, the U. S. Environmental Protection Agency (USEPA) approved *California's Nonpoint Source Management Plan.*

4. On November 5, 1990, the Coastal Zone Act Reauthorization Amendments (CZARA) were enacted to address concerns with NPS pollution of coastal waters not adequately considered in the Coastal Zone Management Act of 1972.

5. Section 6217 of CZARA requires coastal states to develop Coastal Nonpoint Pollution Control Programs (CNPCP) that: (a) identify and adopt management measures to prevent and control NPS pollution; (b) ensure that enforceable mechanisms exist where self-determined efforts are insufficient to restore and protect water quality; (c) enhance cooperation among the states' land and water use agencies; (d) identify land uses which individually or cumulatively may cause or contribute significantly to a degradation of coastal waters; (e) identify "critical coastal areas" and identify and implement additional measures where necessary to achieve and maintain water quality in the such areas; (f) provide technical assistance to local governments and the public to implement the management measures;

(g) provide opportunities for public participation in CNPCP development and implementation; and (h) monitor management measure implementation. The CNPCP must be approved by USEPA and the National Oceanic and Atmospheric Administration (NOAA).

6. The lead agencies designated for upgrading the State's NPS Program to conform to the requirements of the CWA and CZARA are the SWRCB, the RWQCBs, and the California Coastal Commission (CCC).

7. In September 1995, the SWRCB and the CCC submitted to USEPA and NOAA the State's response to the CZARA requirements. In lieu of a separate program for the coastal zone, the SWRCB and the CCC applied the CZARA requirements on a statewide basis.

8. In July 1998, USEPA and NOAA issued their findings and conditional approval of the State's submittal. For final approval of the CNPCP, the State was required, consistent with the August 1997 Action Plan, to (a) adopt management measures; (b) identify back-up and enforceable policies and mechanisms for the management measures; and (c) demonstrate the ability for widespread implementation of the management measures.

9. The Program Plan is the State's final submittal to satisfy the requirements specified by USEPA and NOAA for CNPCP approval and NPS Program Upgrade. The Program Plan is composed of two volumes -- *Volume I: Nonpoint Source Program Strategy and Implementation Plan for 1998-2013* (PROSIP) and *Volume II: California Management Measures for Polluted Runoff (CAMMPR)* (Attachments 1 and 2, respectively).

10. SWRCB and CCC staffs held public workshops to receive comments on the Program Plan, and the Program Plan has been revised to incorporate pertinent comments.

THEREFORE BE IT RESOLVED THAT:

The SWRCB:

1. Adopts the Program Plan;

2. Authorizes the Executive Director to submit the Program Plan to the USEPA and NOAA for approval;

3. Authorizes the Executive Director to execute the Memorandum of Understanding between the SWRCB and CCC;

4. Directs the Executive Director in coordination with CCC to request the Secretaries of the California Environmental Protection Agency and Resources Agency to jointly transmit a memorandum directing all departments and boards within their agencies to use their respective authorities to implement the Program Plan; and

5. Directs the Executive Director in coordination with CCC to request the Secretaries of the California Environmental Protection Agency and Resources Agency to jointly transmit a memorandum asking the California Department of Transportation, Department of Food and Agriculture, and Department Health Services to use their respective authorities to implement the Program Plan;

6. Directs the Executive Director to work with the Executive Officers of each RWQCB and directors of the State agencies to implement the Program Plan; and

7. Directs staff to initiate activities described in the Program Plan.

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on December 14, 1999.

Maureen Marché

Maureen Marché
Administrative Assistant to the Board

R0018594

STATE OF CALIFORNIA—THE RESOURCES AGENCY

GRAY DAVIS, *Governor*

CALIFORNIA COASTAL COMMISSION

45 FREMONT, SUITE 2000
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January 28, 2000

Jeffrey R. Benoit, Director
Office of Ocean and Coastal Resource Management
National Oceanic and Atmospheric Administration
1305 East-West Highway, 11th Floor
Silver Spring, MD 20910

Felicia Marcus, Regional Administrator
U.S. Environmental Protection Agency Region 9
75 Hawthorne Street
San Francisco, CA 94105

Subject: Adoption of the *Plan for California's Nonpoint Source Pollution Control Program*

Dear Mr. Benoit and Ms. Marcus:

On January 11, 2000, by a vote of 9 in favor, 0 opposed, and 1 abstention, the California Coastal Commission adopted the *Plan for California's Nonpoint Source Pollution Control Program* (Plan). The Plan provides a framework to focus, expand, and coordinate actions to prevent and control nonpoint source pollution Statewide.

By a vote of 8 in favor, 0 opposed, and 1 abstention, the Coastal Commission also directed me to enter into a Memorandum of Understanding with the State Water Resources Control Board to promote the continued close collaboration between the two State lead agencies that developed and are implementing the Plan.

Sincerely,

Peter Douglas

Peter M. Douglas
Executive Director

Plan for California's Nonpoint Source Pollution Control Program

Volume I: Nonpoint Source Program Strategy and Implementation Plan
1998-2013

State Water Resources Control Board
California Coastal Commission
January 2000

R0018596

VOLUME I

NONPOINT SOURCE PROGRAM STRATEGY AND IMPLEMENTATION PLAN, 1998-2013 (PROSIP)

State Water Resources Control Board
California Coastal Commission

JANUARY 2000

EXECUTIVE SUMMARY

The *Plan for California's Nonpoint Source Pollution Control Program* (Program Plan) is the first significant upgrade of California's Nonpoint Source (NPS) Pollution Control Program (NPS Program) since its inception in 1988. California is required to have its Program conform to the Clean Water Act (CWA) and section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA). The lead State agencies for upgrading the Program are the State Water Resources Control Board (SWRCB) (designated lead water quality agency), the nine Regional Water Quality Control Boards (RWQCBs), and the California Coastal Commission (CCC) (designated lead coastal zone management agency). The Program Plan will be submitted for approval to the U.S. Environmental Protection Agency (USEPA) and the National Oceanic and Atmospheric Administration (NOAA), the lead federal agencies that administer the CWA and the Coastal Zone Management Act (CZMA) respectively.

Finding solutions to NPS pollution poses unique challenges. Although the SWRCB and CCC have lead roles in developing and coordinating the implementation of the Program, they are not solely responsible for solving the problem. Over 20 other State agencies have authorities, programs, or responsibilities relating to the control of NPS pollution. Coordinating and focusing such a large number of entities to produce an effective NPS program in a state as large and geomorphologically diverse as California poses unique and difficult challenges. While increased use of regulatory authorities can help to address certain categories of NPS pollution (such as the relatively recent effort to issue permits for the most significant municipal storm water discharges), California will need to rely on a wide range of tools, activities, and authorities to address NPS pollution statewide. Initially, implementation will focus significant resources on management measures (MMs) identified as primary and secondary in Table 8, on retooling the Program's infrastructure, and on institutionalizing Program processes and mechanisms to make certain the State meets the commitments made in the Program Plan.

The State is committed to implementing the 61 NPS MMs by 2013 consistent with Federal Administrative Guidance (USEPA and NOAA, 1998), the Three-Tiered Approach adopted in the Nonpoint Source Management Plan, November 1988 (1988 Plan), and priorities identified in the Watershed Management Initiative (WMI) Chapters. The WMI, approved by the SWRCB in 1995, is used to help the SWRCB meet its goal to provide water resource protection, enhancement, and restoration. WMI uses an integrated planning approach to create and implement unique solutions for each watershed. Each RWQCB and the SWRCB revises its WMI Chapter annually to reflect changing priorities and conditions in the State's watersheds. Revisions currently underway will ensure that the WMI chapters and RWQCBs' actions are consistent with the Program Plan's goal of implementing all MMs by 2013.

Total Maximum Daily Loads (TMDLs) are another implementation planning tool that will enhance the State's ability to foster implementation of appropriate NPS MMs. By providing watershed-specific information, TMDLs will help target specific sources and corresponding corrective measures and will provide a framework for using more stringent approaches that may be necessary to achieve water quality goals and maintain beneficial uses.

Approximately 1,500 water body-pollutant combinations requiring TMDL development have been identified in the CWA section 303(d) list. During the Fifteen-Year Strategy, the RWQCBs are committed to the development of 500 to 800 individual TMDLs which will account for <u>all</u> 1,500 water body-pollutant combinations. The commitment of financial and staff resources to this effort will be influential in addressing the State's effectiveness in controlling NPS problems.

NPS pollution, also known as polluted runoff, is the leading cause of water quality impairments in California and in the Nation. NPSs, including natural sources, are the major contributors of pollution to impacted streams, lakes, wetlands, estuaries, marine waters, and ground water basins in California and are important contributors of pollution to harbors and bays (SWRCB, 1998). Unlike pollution from distinct, identifiable point sources (e.g., industrial or waste water treatment plant discharge pipes), NPS pollution comes from many diffuse sources. Rainfall, snowmelt, or irrigation water that moves over and through the ground results in NPS pollution. As the runoff moves, it picks up and carries away natural and human-made pollutants and deposits them into lakes, rivers, wetlands, ground water, and other inland and coastal waters.

The Program's roots were established in 1988 when the SWRCB adopted and the USEPA approved the original plan for the 1988 Plan (SWRCB, 1988) in response to CWA section 319. In 1990 Congress identified NPS pollution as a significant factor contributing to coastal water degradation, noting the link between coastal water quality and land use activities. In response, Congress amended the CZMA by passing CZARA. CZARA requires the lead water quality agency and coastal zone management agencies to jointly develop and submit a coastal nonpoint pollution control program (CNPCP).

In February 1994, the SWRCB initiated a comprehensive review of the Program using technical advisory committees (TACs) for ten categories of NPS pollution. Over 150 people participated in the TACs as public and private representatives for irrigated agriculture, nutrient application, pesticide application, confined animal facilities, grazing, urban runoff, on-site sewage disposal systems, boating and marinas, hydromodification and wetlands, and abandoned mines. The TACs presented their recommendations to the SWRCB in 1995 (SWRCB, 1994 a-i).

In lieu of a separate program for the coastal zone, the State decided to satisfy CZARA requirements on a statewide basis. As required by statute, in September 1995, the SWRCB and CCC submitted California's initial CZARA response to USEPA and NOAA. The response included two documents: *California's Coastal Nonpoint Pollution Control Submittal*, detailing the State's existing programs related to NPS pollution management, and the *Initiatives in Nonpoint Source Management*, based on the recommendations of the TACs.

USEPA and NOAA released draft findings and conditions for the State's September 1995 submittal in October 1996. In August 1997, the SWRCB, CCC, USEPA Region 9, and USEPA and NOAA headquarters staffs negotiated the *Action Plan* which outlined a framework and activities for the State to achieve both an approvable program consistent with CZARA and an *"enhanced status"* Program by addressing the nine key elements in the USEPA's *Nonpoint Source Program and Grants Guidance of 1997 and Future Years*. In July 1998, USEPA and NOAA issued their Final Findings and Conditional Approval for California's submittal. Consistent with the *Action Plan* and final administrative changes to CNPCP guidance issued in October 1998, for final approval the State must: (1) adopt MMs consistent with the *Guidance Specifying Management Measures for*

Sources of Nonpoint Pollution to Coastal Waters (USEPA, 1993); (2) identify back-up and enforceable policies and mechanisms for the MMs; (3) demonstrate the ability for widespread implementation of the MMs; and (4) address the nine key elements.

The Program Plan is the State's final submittal intended to satisfy the CWA section 319(h) requirements for "an upgraded program" and the CZARA requirements for a CNPCP. The Program Plan achieves this goal by providing a single unified, coordinated statewide approach to dealing with NPS pollution structured around 61 MMs. MMs serve as general goals for the control and prevention of polluted runoff. Site-specific management practices (MPs) are then used to achieve the goals of each management measure. Implementation of MMs will occur using a fifteen-year strategy with three nested five-year implementation plans. The fifteen-year strategy and each five-year implementation plan use an iterative program process. The program process includes: (1) assessing Program activities; (2) targeting efforts; (3) planning activities based on Program goals and objectives; (4) coordinating the efforts of federal, State, and local agencies and stakeholders; (5) implementing coordinated actions; (6) tracking and monitoring the results of implemented actions; and (7) reporting on Program results. The Program Plan is designed to be flexible and adaptable over time.

Specifically, the Program Plan:

1. Adopts 61 MMs as goals for six NPS categories (agriculture, forestry, urban areas, marinas and recreational boating, hydromodification, and wetlands/riparian areas/vegetated treatment systems);
2. Provides a fifteen-year strategy for fully implementing the MMs;
3. Continues use of the "Three-Tiered Approach" for addressing NPS pollution problems (Tier 1: Self-Determined Implementation of Management Practices [formerly referred to as "voluntary" implementation]; Tier 2: Regulatory Based Encouragement of Management Practices; and Tier 3: Effluent Limitations and Enforcement Actions). Senate Bill 227 (California Water Code [CWC] section 13369) requires the SWRCB to develop by February 1, 2001, guidance for describing the process by which the SWRCB and RWQCBs will enforce the Program Plan;
4. Provides the first of three five-year implementation plans targeting activities for specific MMs consistent with State and regional priorities in specific watersheds and also establishes mechanisms for: (a) coordination among agencies; (b) participation by the public; (c) assistance technically and financially; (d) adoption of additional MMs as goals, if needed; and; (e) monitoring and reporting of program effectiveness;
5. Promotes long-term interagency coordination among State agencies of the California Environmental Protection Agency and Resources Agency as well as other local, State, and federal agencies;
6. Identifies back-up authorities and enforceable policies and mechanisms for the 61 MMs adopted by the State; and
7. Relies on the use of existing authorities and regulatory processes to achieve implementation but allows for the adoption of the MMs as regulation after each five-year cycle if adequate progress in NPS pollution control has not been demonstrated.

Program accountability is critical to reassure the public of the State's commitment to deal with the NPS pollution problem. The Program Plan contains actions that will result in consistent and timely evaluation and reporting of the Program's progress in effectively dealing with NPS pollution. This includes annual, biennial, and five-year reporting cycles and the use of Internet-based interactive information tools. Also important is greater public participation through: (1) development of the five-year implementation plans; (2) tracking the implementation of and assessing effectiveness of MMs; (3) use of public reports; (4) expanded volunteer monitoring and education programs; (5) use of the Internet; and, (6) expansion of public outreach workshops.

The Program Plan also contains a Memorandum of Understanding (MOU) between the SWRCB and CCC. Although the two agencies have worked side-by-side to complete this document, the MOU commits the agencies to continue implementing the Program Plan after it is adopted by the SWRCB and CCC and approved by the federal agencies. Actions in the first five-year implementation plan require the SWRCB and CCC to review and update existing Management Agency Agreements and MOUs as appropriate and to develop others as needed. This aspect is important because the success of this Program Plan is dependent on the active participation of other government agencies with NPS responsibilities and private partners with significant influences over land use practices.

TABLE ES-1

SUMMARY OF MAJOR TASKS THAT THE NPS PROGRAM LEAD AGENCIES SEEK TO COMPLETE AS OF 2003

	Plan section
A. Assess Program Activities	
• The State will continue use of the State's Water Quality Assessment (WQA) as the primary tool for assessing NPS pollution statewide. **By August 1, 2001**, the SWRCB will provide WQA data prepared pursuant to CWA sections 305(b) and 303(d) on the Internet for public reference and to help monitor and track the effectiveness of the NPS Program. The data, included on the Geographically-based Water Body System (GeoWBS) database, will identify water body size, degree to which beneficial uses are supported, affected beneficial uses, pollutants, and pollution sources.	II-B
• **By August 1, 2001**, the State with the assistance of University of California, Davis's Information Center for the Environment (UCD ICE) will complete development of a database that will enable State agencies to geographically track implementation of MMs and MPs.	II-G
B. Target Efforts	
• **On even-numbered years** or as required by the USEPA, the SWRCB will prepare the CWA section 303(d) and TMDL priority lists that will assist the State in targeting priorities by water body, geographic region, pollutant, etc. • **By December 31, 2000**, the Critical Coastal Area (CCA) Committee will develop an initial list of CCAs where targeted implementation of MMs will occur.	II-C
C. Plan Activities Based on Program Goals and Objectives	
• **By July 1, 2000** and annually thereafter, the SWRCB, CCC, and RWQCBs will prepare joint annual workplans for NPS Program activities to include information on use of funding sources (including bond funds). • **By July 1, 2000**, the CCC will update its in-house Procedural Guidance Manual to reflect newest development of NPS MMs and to provide guidance for updates and amendments to local coastal programs (LCPs) and development of new LCPs. • Pursuant to the **schedules listed in Appendix C**, the RWQCBs will develop TMDLs.	II-D & Apx C
D. Coordinate Efforts of Federal, State, and Local Agencies and Stakeholders	
• **By January 31, 2000**, the SWRCB and CCC will sign an MOU designed to enhance coordination between these agencies. • **By July 1, 2000**, the SWRCB and CCC will convene the initial meeting of the Interagency Coordinating Committee (IACC). **By September 30, 2000** the CCC and SWRCB will convene the initial meeting of the CCA Committee. • **By July 1, 2000**, the SWRCB and CCC will initiate the development of five-year implementation plans for the California Environmental Protection Agency (Cal/EPA), California Resources Agency (Cal/RA), and other agencies with a goal of completing 50 to 100 percent of these plans by December 31, 2000. • **By July 1, 2000**, the SWRCB and CCC will begin the process to update existing Memorandums of Understanding/Management Agency Agreements (MOUs/MAAs) (e.g., agreements with the State Board of Forestry/Department of Forestry, Department of Pesticide Regulation, and Department of Food and Agriculture) and develop new MOUs/MAAs with other agencies as needed. **By December 31, 2001**, the SWRCB and CCC will prepare a schedule for completing any necessary remaining MOUs/MAAs.	II-E

	Plan section
E. Implement Coordinated Actions • **By July 1999 and each year thereafter**, the SWRCB and RWQCBs will support activities using CWA section 319(h) funds to implement the CAMMPR MMs. • **By February 2001**, the SWRCB will develop guidance to be used by the SWRCB and RWQCBs in establishing the process by which the SWRCB and RWQCBs will enforce their authorities as outlined in this Program Plan (CWC §13369). • **By July 1, 2002**, the State will prepare California MM implementation guidance. Links to existing guidance for implementation of MMs and MPs will be provided on the NPS Program website(s) in the interim (examples of existing guidance used in California include Natural Resources Conservation Service (NRCS) technical guides and Storm Water Quality Task Force Manuals). • Pursuant to the **schedules listed in Appendix C**, the RWQCBs will begin implementation of TMDL implementation plans.	II-F
F. Track and Monitor Results of Implemented Actions • By **November 30, 2000**, the SWRCB will assess and report to the Legislature on the SWRCB's and RWQCBs' current surface water quality monitoring programs for the purpose of designing a proposal for a comprehensive surface water quality monitoring program for the State (as provided for in CWC §13192). • By **January 1, 2001**, the SWRCB will prepare and submit to the Legislature a report that proposes the implementation of a comprehensive program to monitor the quality of State coastal watersheds, bays, estuaries, and coastal waters and their marine resources for pollutants (as provided for in CWC §13181[c]).	II-G
G. Report on Program Results • **By August 1, 2000 and annually thereafter**, the SWRCB will submit to the Legislature and make available to the public, copies of and a summary of information in all SWRCB and RWQCB reports that contain information related to NPS pollution and that the SWRCB or RWQCB are required to prepare in the previous fiscal year pursuant to CWA sections 303, 305(b), and 319 and CZARA section 6217. (CWC §13369[b]) • **By August 1, 2001 and August 1, 2003**, the SWRCB and CCC will complete biennial reports, for evaluation by USEPA and NOAA as well as other agencies and the public, regarding the State's progress in implementing the NPS Program.*	

* The reports to be produced in 2001 and 2003 will provide details to address questions such as:

1. Have the activities identified in the five-year plans been completed and have the associated performance measures been achieved?
2. Has an MM implementation tracking system been established? Based on that system, what is the extent of MM implementation for all source categories throughout the State?
3. Has the IACC become active and successful in fostering implementation?
4. Has the SWRCB/RWQCBs published NPS enforcement guidance in 2001 as per CWC section 13369(a)(2)(B)?
5. Has the technical assistance to land owners and managers been improved through the issuance of technical guides, information sharing, "field-level" assistance and/or other activities?
6. Have other State and federal agencies and non-governmental entities become involved in implementing the NPS Program? Where necessary, have formal agreements been established to enhance the effectiveness of these partnerships?
7. Has the planning process for the next five-year plan (2003-2008) been established to achieve more specific plans that include measurable objectives and that involve a wide range of key stakeholders?
8. Have adequate efforts been made to identify funding needs and mechanisms to ensure continuing MM implementation and Program Plan success?

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VOLUME I

NONPOINT SOURCE PROGRAM STRATEGY AND IMPLEMENTATION PLAN, 1998-2013 (PROSIP)

I. NONPOINT SOURCE PROGRAM OVERVIEW

A. Vision and Goals

Since 1991, staffs of the State Water Resources Control Board (SWRCB), California Coastal Commission (CCC), and nine Regional Water Quality Control Boards (RWQCBs), in coordination with other agency staffs and the public, have conducted a comprehensive inquiry into the future direction of California's Nonpoint Source Pollution Control Program (Program). This inquiry shows clearly that Californians have invested significant resources to address nonpoint source (NPS) pollution and improve water quality; however, NPSs continue to be a major contributor of pollution to State waters.

The *Plan for California's Nonpoint Source Pollution Control Program* (Program Plan) is intended to focus and expand the State's efforts over the next 15 years to prevent and control NPS pollution. The vision of the NPS Program is to reduce and prevent NPS pollution so that the waters of California support a diversity of biological, educational, recreational, and other beneficial uses. The NPS Program addresses both surface and ground water quality. The goals of California's NPS Program are the following:

Track, Monitor, Assess, and Report Program Activities

- Improve monitoring and assessment of State water quality and the effectiveness of management practices (MPs) that are implemented to prevent and control NPS pollution.
- Ensure consistent, accurate reporting and dissemination of information related to water quality and related environmental data, sources of NPS pollutants, and pollution control and prevention activities.

Target Program Activities

- Manage NPS pollution, where feasible, at the watershed level—including pristine areas and watersheds that contain water bodies on the Clean Water Act (CWA) section 303(d) list—where local stewardship and site-specific MPs can be implemented through comprehensive watershed protection or restoration plans.
- Apply previous experiences to future decisions (e.g., through the use of pilot projects and the incorporation of "lessons learned").

Coordinate with Public and Private Partners in All Aspects of the Program

- Build the NPS Program upon a foundation of public involvement and support and encourage public participation throughout all stages of the NPS Program.
- Encourage innovative approaches to NPS pollution control and prevention through interagency, interdisciplinary, and volunteer activities.

- Strive to make regulatory, planning, and monitoring processes and programs more effective, efficient, and user-friendly and to coordinate related programs to avoid duplication where possible.

Provide Financial and Technical Assistance and Education

- Enhance the leadership roles of the SWRCB, RWQCBs, CCC, and other agencies in providing local governments and the public with technical and financial assistance and educational programs related to NPS pollution control, land use management, and watershed management.
- Support applied research to expand NPS Program implementation (e.g., development of improved, cost-effective MPs, and environmentally friendly products).

Implement Management Measures

- Ensure the protection and restoration of State's water quality, existing and potential beneficial uses, critical coastal areas (CCAs), and pristine areas by implementing management measures (MMs) to prevent and control NPS pollution. All MMs will be implemented, where needed, by 2013.[1] MMs serve as general goals for the control and prevention of polluted runoff. Site-specific MPs are then used to achieve the goals of each MM.
- Target implementation of MMs using a combination of non-regulatory activities and enforceable policies and mechanisms with self-determined cooperation preferred over prescriptive measures.

To ensure that the NPS Program goals are met, the SWRCB, CCC, and RWQCBs have already taken the following steps: (1) developed MMs that are appropriate for implementation in California and (2) prepared an iterative Fifteen-Year Program Strategy (Strategy) and Five-Year Implementation Plan (1998-2003) (Implementation Plan).

Additional steps in California's long-term strategy and initial short-term plan that are needed are:

- Adoption of NPS MMs by the SWRCB and CCC as goals or through a rulemaking process, as necessary, to ensure that they are implemented statewide by the year 2013;
- Establish and enter into the first five-year plan all relevant information for each process element for primary and secondary MMs by July 1, 2000, with the exception of numeric program performance measures. Numeric program performance measures will be established for each primary and secondary MM in the first five-year plan by October 1, 2000. The revised five-year plan will be distributed to the public by November 1, 2000.

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1 MMs are identified in Volume II of this Program Plan: *California's Management Measures for Polluted Runoff* (CAMMPR). CAMMPR identifies MMs for five land-use categories: (1) agriculture, (2) forestry (silviculture), (3) urban areas, (4) marinas and recreational boating, and (5) hydromodification. MMs specific to wetlands, riparian areas, and vegetated treatment systems are also identified. CAMMPR has been reviewed by other agencies with authorities and programs that are critical to addressing NPS pollution. Additional workshops were held in Southern and Northern California to solicit public input.

- Publication of an MMs Guidance document that includes examples of MPs that achieve the goals of each MM;
- Building a foundation for agencies with authorities related to the NPS Program to coordinate and collaborate in problem solving, implementing MMs, monitoring, and assessing program success (e.g., review and revise existing agency agreements or develop new agency agreements; convene an interagency committee or similar working forum);
- Increased funding and enhanced education to foster implementation of MMs statewide; and
- Conducting a workshop and reporting every two years (biennially) on the status of the NPS Program.

B. History

Nonpoint Source Water Quality Issues in California

California is a geomorphologically diverse state with 1,609 miles of shoreline and more than 200,000 miles of rivers and streams; 1.6 million acres of lakes and reservoirs; 645,000 acres of estuaries, harbors, and bays; and 275,000 acres of wetlands. California also contains more than 100 million acres of land, almost half of which (44.6 percent) is owned and/or overseen by the federal government (e.g., the U.S. Forest Service [USFS] and Bureau of Land Management [BLM]).

NPS pollution, also known as polluted runoff, is the leading cause of water quality impairments in California and nationally. NPSs, including natural sources, are the major contributors of pollution to impacted streams, lakes, wetlands, estuaries, marine waters, and ground water basins in California and are important contributors of pollution to harbors and bays (SWRCB, 1998). Unlike pollution from distinct, identifiable point sources (e.g., a discharge pipe), NPS pollution comes from many diffuse sources. It is caused by rainfall, snowmelt, or irrigation water that moves over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants and deposits them into lakes, rivers, wetlands, ground water, and other inland and coastal waters.

Adverse effects of point sources of pollution (e.g., those subject to National Pollutant Discharge Elimination System [NPDES] or Waste Discharge Permits [WDRs]) and NPSs of pollution on coastal areas include closures of beaches and shellfish harvest areas due to contamination (see Table 1). In 1998, causes of California beach closings or advisories included: (1) elevated bacteria levels—1,395 events; (2) sewage spills—1,607 events; and (3) rain related events—2,222 events (rain events include combined sewer overflows, storm water runoff, storm drains, and floods) (Natural Resources Defense Council [NRDC], 1999). Data from the *National Shellfish Register* reveal that in 1995, the most recent year that data are available, shellfish harvesting was prohibited at 9,000 out of 24,000 acres (38 percent) of harvesting areas in California due to water quality concerns (National Oceanic and Atmospheric Administration [NOAA], 1997). Table 2 contains 1995 pollution source data for harvesting waters in the State of California and in the Nation.

TABLE 1. CALIFORNIA BEACH CLOSING AND ADVISORY (C/A) COMPARISONS: 1991-1998 (NRDC, 1999)

Year	Beach days affected by C/A lasting less than 6 weeks	Number of Extended C/A (lasting 6-12 weeks)	Number of Permanent C/A (lasting more than 12 weeks)
1998	at least 3,273	30	12
1997	at least 1,141	1	37
1996	at least 1,061	7	9
1995	at least 1,305	3	11
1994	at least 910	2	6
1993	at least 1,397	2	2
1992	at least 609	2	1
1991	at least 745	1	5

TABLE 2. PRINCIPAL OR CONTRIBUTING FACTORS IN HARVEST-LIMITED SHELLFISH GROWING AREAS NATIONALLY, 1995 (NOAA, 1997)

Type	% (total is > 100% as areas can be affected by a combination of sources)
Urban runoff	40
Unidentified sources upstream of coastal watersheds	39
Wildlife	38
Individual waste water treatment systems (e.g., septic tanks)	32
Waste water treatment plants	24
Agricultural runoff	17
Marinas	17
Boating	13
Industrial facilities	9
Combined sewer overflows	7
Direct discharges	4
Feedlots	3

The major sources of NPS pollution in California are related to land use activities that occur throughout watersheds and include: (1) agriculture, (2) forestry (silviculture), (3) urban runoff, (e.g., from construction sites, roads and highways, septic systems), (4) marinas and boats, (5) hydromodification activities, and (6) resource extraction (e.g., mining) (see Table 3). Atmospheric deposition is also a source of NPS pollution. Examples of pollutants associated with specific land use activities include:

- Excess pesticides and fertilizers from agricultural lands, urban lawns, and parks;
- Oil, grease, heavy metals, and chemicals from urban streets, parking lots, and industrial sites;
- Sediment from improperly managed construction sites, crop and forest lands, abandoned roads, and eroding streambanks;
- Bacteria and nutrients from livestock, pet wastes, and faulty septic systems; and
- Other pollutants (e.g., salt from irrigation practices, acid from abandoned mines).

Agency Roles in Program Development and Implementation

The NPS Program's roots were established in 1988 when the SWRCB adopted and the U.S. Environmental Protection Agency (USEPA) approved the original plan, the NPS Management Plan, November 1988 (1988 Plan) (SWRCB, 1988), in response to CWA section 319. CWA section 319 required states to develop assessment reports that described the state's NPS problems and to establish an NPS management program to control or prevent the problems. The 1988 Plan identified projected and proposed activities to initiate the NPS Program and both to measurably improve water quality and the implementation of best MPs.

After passage of CWA section 319, Congress determined that additional efforts were needed to protect coastal waters from NPS pollution and subsequently enacted the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA). In passing CZARA, Congress noted the link between coastal water quality and land use activities and directed states to improve state and local efforts to manage land use activities that degrade coastal waters and coastal habitats (USEPA and NOAA, 1993). CZARA section 6217 requires coastal states to: (1) identify land uses which individually or cumulatively may cause or contribute significantly to a degradation of coastal waters; (2) identify "Critical Coastal Areas" and identify and implement additional measures where necessary to achieve and maintain water quality in such areas; (3) identify and adopt MMs to prevent and control NPS pollution; (4) provide technical assistance to local governments and the public to implement the MMs; (5) provide opportunities for public participation in Coastal Nonpoint Source Pollution Control Program (CNPCP) development and implementation; (6) enhance cooperation between the states' land and water use agencies; and (7) identify a program area sufficient to control NPS pollution affecting coastal waters. In addition, CZARA amended section 306 of the Coastal Zone Management Act (CZMA) requiring that " … the management program contains enforceable policies and mechanisms to implement the applicable requirements of the Coastal Nonpoint Pollution Control Program of the State required by section 6217 …." (CZMA section 306[d][16]).

TABLE 3. EXTENT OF CALIFORNIA WATER BODIES AFFECTED BY VARIOUS LAND PRACTICES

	Surface water (SW) bodies (acres)								
	bays/ harbors	estuaries	lakes/ reservoirs	saline lakes	wetlands fresh	wetlands tidal	Total SW bodies	rivers/ streams (miles)	ground water (square miles)*
(Total acres/miles assessed)	(497,000)	(79,000)	(741,000)	(433,000)	(67,000)	(71,000)	(1,889,000)	(17,000)	(64,000)
Agriculture	237,000	59,000	40,000	352,000	51,000	57,000	796,000	4,000	16,875
Forestry	(nd)	(nd)	121,000	(nd)	12,000	(nd)	133,000	1,900	(nd)
Urban Runoff	198,000	58,000	130,000	(nd)	1,300	57,000	444,000	1,800	842
Construction	(nd)	(nd)	149,000	56,000	1,220	(nd)	206,000	800	(nd)
Highways and Roads	(nd)	(nd)	145,000	(nd)	(nd)	(nd)	145,000	300	(nd)
Marinas	(nd)	(nd)	121,000	(nd)	(nd)	(nd)	121,000	(nd)	(nd)
Hydromodification	170,000	56,000	141,000	165,000	27,000	57,000	616,000	1,100	3,418
Resource Extraction	288,000	51,000	109,000	(nd)	(nd)	(nd)	448,000	1,500	8,166
Septage Disposal	(nd)	(nd)	(nd)	(nd)	(nd)	(nd)	(nd)	(nd)	15,436

Source: *1998 California CWA Section 305(b) Report on Water Quality. Extent of SW bodies that are partially or not supporting beneficial uses* (figures rounded to nearest thousand, where appropriate). (nd) = no data or unknown.

*The *1998 CWA Section 305(b) Report* states that 22,053 of 63,581 square miles of ground water (35 percent) are impaired (note: a ground water basin may be polluted by more than one source).

In February 1994, the SWRCB initiated a comprehensive review of the NPS Program using technical advisory committees (TACs) for ten NPS categories. Over 150 people participated in the TACs as public and private representatives for irrigated agriculture, nutrient application, pesticide application, confined animal facilities, grazing, urban runoff, on-site sewage disposal systems (OSDSs), boating and marinas, hydromodification and wetlands, and abandoned mines. The TACs presented their recommendations to the SWRCB in 1995. Common themes expressed in the TAC Reports include the following:

- Self-determined cooperation is preferred over prescriptive measures;
- Public education should be enhanced so that individuals can take responsibility for preventing and controlling NPS pollution;
- NPS pollution should be managed on a watershed scale where local stewardship and problem-responsive measures can be devised through comprehensive watershed protection plans;
- The State should provide for comprehensive and directed technical assistance to local groups and individuals; and
- Activities of resource management agencies should be better coordinated.

In September 1995, the SWRCB and CCC submitted California's initial response to CZARA to USEPA and NOAA—the lead federal agencies that administer the CWA and CZMA, respectively. California's submittal package included two documents: *California's Coastal Nonpoint Pollution Control Submittal* (SWRCB and CCC, 1995) and *Initiatives in Nonpoint Source Management* (Initiatives Document) (SWRCB, 1995).[2] In July 1998, USEPA and NOAA issued their Final Findings and Conditional Approval for California's submittal.

The SWRCB, RWQCBs, and CCC are committed to enhancing the NPS Program to further protect water quality and to address the federal findings and conditions. The revised NPS Program incorporates MMs into the Program Plan to help coordinate agency and individual actions. Volume II of the Program Plan—*California Management Measures for Polluted Runoff* (CAMMPR)—identifies 61 MMs with related State authorities for NPS pollution prevention and control in California (Table 4).[3] Staffs from the SWRCB, CCC, USEPA, and other agencies held initial meetings to review and refine CAMMPR and to identify actions to implement MMs over the next five to 15 years. Staff workshops to solicit public input were also held in Southern and Northern California in December 1998 and July 1999.

The SWRCB and CCC, in coordination with the nine RWQCBs, are the lead State agencies in California for the development and implementation of the Program Plan.

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2 *California's Coastal Nonpoint Pollution Control Submittal* (SWRCB and CCC, 1995) details California's existing programs related to the management of NPS pollution. The *Initiatives in Nonpoint Source Management* (SWRCB, 1995), which is based on the TACs' recommendations, recognizes the need to continue and build upon the collaborative work initiated by the TACs.

3 These MMs are based on the *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (g-Guidance) (USEPA, 1993).

TABLE 4. CALIFORNIA NONPOINT SOURCE MANAGEMENT MEASURES

(1) AGRICULTURE

A. Erosion and Sediment Control
B. Confined Animal Facilities Wastewater and Runoff
C. Nutrient Management
D. Pesticide Management
E. Grazing Management
F. Irrigation Water Management
G. Education/Outreach

(2) FORESTRY (SILVICULTURE)

A. Preharvest Planning
B. Streamside Management Areas
C. Road Construction/Reconstruction
D. Road Management
E. Timber Harvesting
F. Site Preparation and Forest Regeneration
G. Fire Management
H. Revegetation of Disturbed Areas
I. Forest Chemical Management
J. Wetlands Forest
K. Postharvest Evaluation
L. Education/Outreach

(3) URBAN AREAS

3.1 Runoff from Developing Areas
A. Watershed Protection
B. Site Development
C. New Development

3.2 Runoff from Construction Sites
A. Construction Site Erosion and Sediment Control
B. Construction Site Chemical Control

3.3 Runoff from Existing Development
A. Existing Development

3.4 On-site Disposal Systems
A. New On-site Disposal Systems
B. Operating On-site Disposal Systems

3.5 Transportation Development: Roads, Highways, and Bridges
A. Planning, Siting, and Developing Roads and Highways
B. Bridges
C. Construction Projects
D. Construction Site Chemical Control
E. Operation and Maintenance
F. Road, Highway, and Bridge Runoff Systems

3.6 Education/Outreach
A. Pollution Prevention/Education--General Sources

(4) MARINAS & RECREATIONAL BOATING

4.1 Assessment, Siting, and Design
A. Water Quality Assessment
B. Marina Flushing
C. Habitat Assessment
D. Shoreline Stabilization
E. Storm Water Runoff
F. Fuel Station Design
G. Sewage Facilities
H. Waste Management Facilities

4.2 Operation and Maintenance
A. Solid Waste Control
B. Fish Waste Control
C. Liquid Material Control
D. Petroleum Control
E. Boat Cleaning and Maintenance
F. Maintenance of Sewage Facilities
G. Boat Operation

4.3 Education/Outreach
A. Public Education

(5) HYDROMODIFICATION

5.1 Channelization and Channel Modification
A. Physical and Chemical Characteristics of Surface Waters
B. Instream and Riparian Habitat Restoration

5.2 Dams
A. Erosion and Sediment Control
B. Chemical and Pollutant Control
C. Protection of Surface Water Quality and Instream and Riparian Habitat

5.3 Streambank and Shoreline Erosion
A. Eroding Streambanks and Shorelines

5.4 Education/Outreach
A. Educational Programs

(6) WETLANDS, RIPARIAN AREAS, AND VEGETATED TREATMENT SYSTEMS

A. Protection of Wetlands and Riparian Areas
B. Restoration of Wetlands and Riparian Areas
C. Vegetated Treatment Systems
D. Education/Outreach

The roles of the SWRCB and CCC are outlined in the Memorandum of Understanding (MOU) between those two agencies. The role of all of the State and federal partners is to:

- Implement the 61 MMs by 2013. Activities to support implementation will be included by the RWQCBs in the WMI chapters and by the State agencies in their five year implementation plans. Implementation of the MMs will also be incorporated into the NPS updates of the basin plans and other enforceable policy tools.
- Track implementation and effectiveness by MM and source category and provide this information to the SWRCB as part of the monitoring and assessment strategy.
- Actively participate in biennial and five-year program reviews, as well as new goal-setting activities, including the development of five-year implementation plans.
- Coordinate with the SWRCB in developing guidance as required by section 13369 of the California Water Code (CWC) to be used by the SWRCB and the RWQCBs to enforce the Program Plan.
- Coordinate NPS-related planning, assessment, and regulatory activities.
- Support statewide initiatives to implement the MMs.

California must enhance the NPS Program to remain eligible for funding for water quality and coastal protection by USEPA and NOAA. Implementation of the NPS Program is primarily supported by grants from USEPA under CWA section 319(h), approximately $10.6 million in Federal Fiscal Year (FFY) 1999. To continue to receive this level of funding--an increase of about $5.3 million from FFY 1998--the State must continue to protect and restore water quality and develop an effective NPS Program that complies with both the CWA and CZMA. Implementation of the Program Plan will occur through 2013 (within 15 years of the July 1998 federal conditional approval by USEPA and NOAA pursuant to CZARA).

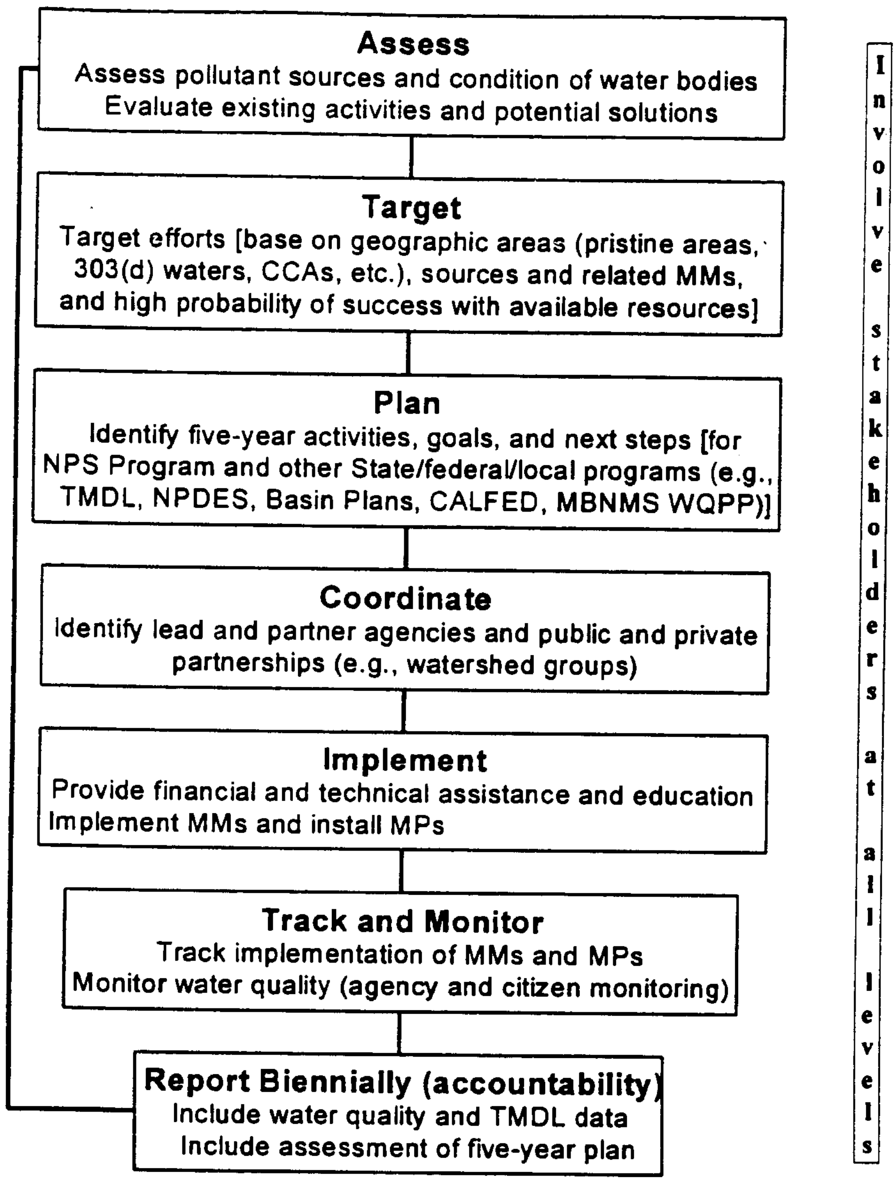
C. Program Infrastructure

Program infrastructure refers to the structure of the program, its components, and how they interact in a systematic process to achieve the program's goals. The Program Plan has three major components: (1) an overall long-term Fifteen-Year Program Strategy (Strategy); (2) three five-year implementation plans nested within the Strategy; and (3) 61 MMs. Running through and connecting these major components is a sequential iterative process that begins with assessing the program, identifying pollutant sources, and determining condition of water bodies and ends with reporting program results. It begins again with assessment activities (see Figure 1). The Program Plan infrastructure is designed to produce a dynamic program that is responsive to changing conditions during its fifteen-year life.

Program Process

For the Program Plan to produce a living, responsive program that is useful throughout its fifteen-year duration, previous experience (e.g., in implementing MMs) must be integrated into present and future planning and implementation efforts. Figure 1 depicts the Program Plan's iterative model. At any time during the fifteen-year life of the

FIGURE 1. NPS PROGRAM PROCESS



Acronyms used above: CCA - Critical Coastal Areas; MMs - Management Measures; MPs-Management Plans; TMDL-Total Maximum Daily Load; NPDES - National Pollution Discharge Elimination System; MBNMS WQPP- Monterey Bay National Marine Sanctuary Water Quality Protection Program

Program Plan, agencies and other stakeholders should be able to: (1) assess the present Program's activities; (2) target efforts; (3) plan future actions based on past and present goals and objectives; (4) coordinate federal, State, and local agencies' and stakeholders' efforts; (5) implement collaborated actions; (6) obtain data on water quality and implementation effectiveness from tracking and assessment documentation, Total Maximum Daily Loads (TMDLs), and other agency and citizen monitoring programs; and (7) return to Step 1 to reassess the NPS Program's progress and effectiveness.

Fifteen-Year Program Strategy

The Strategy, described later in this document, outlines how California will seek to achieve the vision and goals of the NPS Program. Specifically, the State will use the "Three-Tiered Approach" of broad-based local stewardship backed up by regulatory authority under the Porter-Cologne Water Quality Control Act (Porter-Cologne Act) with other local, State, and federal authorities serving as additional enforceable and/or back-up authorities. Recommendations from the TACs and from additional agency and stakeholder meetings convened by the SWRCB and CCC in 1998 and 1999 are a central part of the NPS Program.

The Strategy includes elements prescribed in federal guidance (NOAA and USEPA, 1993 and USEPA, 1996), including:

- A process to implement MMs to help coordinate agency and individual actions rather than focus on individual practices or separate programs;
- Actions related to administrative coordination, technical and financial assistance, public participation, critical coastal areas (CCAs), additional MMs as goals, and monitoring;
- A strategy for and evaluation of back-up authorities;
- A process to track implementing actions to assess Program progress and effectiveness; and
- The "nine key elements" of a dynamic and effective NPS management program. (See Appendix A.)

Five-Year Implementation Plans

Nested within the Strategy are three five-year implementation plans that describe the who, what, where, when and how of Program implementation. In each five-year implementation plan, California will target implementation actions where the NPS Program can make a difference in correcting current and potential problems.

Targeting involves a balance between the need to implement NPS controls broadly and the need to address priority water quality problems in specific watersheds. Targeting also allows the State to use limited resources efficiently and to ensure that actions are tailored to match the diversity of California's climate and land use activities. With climate ranging from rain forest in the north to desert in the south, different approaches are needed to manage NPS pollution in the State. In establishing targets, the State will address both pollution prevention and water quality improvement goals, including the protection of exceptional inland and coastal areas that are threatened by reasonably predictable increases in pollution loadings from new or expanding NPSs.

Each implementation plan will identify a set of MMs on which to target NPS Program efforts during the five-year time period. The implementation plans will also identify a series of actions related to (1) assessing water quality conditions and/or institutional efforts; (2) targeting implementation based on geographic regions or other criteria; (3) performing planning activities; (4) coordinating public and private efforts; (5) implementing the targeted MMs; and (6) obtaining data on water quality and implementation effectiveness. The Plans will also identify agencies responsible for MM implementation and will include actions, performance measures, and milestones.

Phased Approach to Managing Nonpoint Source Pollution

The State is committed to implementing the 61 NPS MMs by 2013, consistent with Federal Administrative Guidance (USEPA and NOAA, 1998) and the Three-Tiered Approach adopted in the 1988 Plan. The implementing agencies will increase the use of regulatory authorities as necessary to ensure implementation is achieved. In accordance with CWC section 13369, the SWRCB will develop on or before February 1, 2001 guidance to be used by the SWRCB and RWQCBs in establishing the process by which the SWRCB and RWQCBs will enforce their authorities as outlined in this Program Plan.

Initially the State is adopting the 61 MMs contained in CAMMPR as goals. MM implementation will be achieved through a set of activities outlined in each five-year implementation plan and will rely on existing local, State, and federal authorities and private efforts. At the end of each five-year implementation cycle, the State will evaluate and report on the effectiveness of the Program Plan to achieve the stated goals. Success will be determined by (1) the degree to which the performance measures have been met; (2) geographic extent of MM implementation; (3) selected evaluation of MPs used to implement MMs; and (4) analysis of available water quality information in those areas where implementation has occurred. Based on this evaluation, the SWRCB and CCC, in coordination with the RWQCBs and other appropriate agencies, will make public their findings and recommendations for the next five-year cycle. Depending on the degree of success, the State may choose to maintain the in-place efforts, modify, or add MMs and/or actions for each target MM. In cases where adequate progress is clearly not being made, the State will consider rulemaking to ensure successful implementation of specific MMs. Implementation of MMs in additional watersheds and water bodies will also take place as new geographic areas with NPS pollution are identified and targeted.

D. Legal Framework

Introduction

This section describes California's legal framework for implementing the NPS Program. The framework is based on two primary federal laws—the CWA and CZMA—and State and local law. In California, the Porter-Cologne Act is the principal State law governing water quality in California, and it provides the primary back-up authority to implement the NPS MMs. However, other State and local authorities are also critical components of the legal framework that address NPS pollution in California. In addition to the Porter-Cologne Act, this section describes the California Coastal Act (Coastal Act), the California Environmental Quality Act (CEQA), and the California Planning, Zoning and Development Law. Additional details on these and other authorities that are part of this framework are identified in Volume II: CAMMPR. Details on the SWRCB's and CCC's statutory authority for addressing NPSs are included in Appendix B—Legal Opinions.

Federal Laws

The Federal Water Pollution Control Act Amendments of 1972 and 1987, known as the CWA (33 United States Code [USC] §§1251 et seq.), are the principal federal statutes for water quality protection. In California, the SWRCB and nine RWQCBs administer many of the CWA's provisions. The CWA requires the State to adopt water quality standards and to submit those standards for approval by the USEPA. For point source discharges to surface water, the CWA authorizes USEPA or approved states to administer the NPDES Program. CWA section 303(d) requires states to list surface waters not attaining (or not expected to attain) water quality standards after the application of technology-based effluent limits, and states must perform a TMDL for all waters on the CWA section 303(d) list. The CWA also establishes a loan program—the State Revolving (SRF)—for the construction of water quality projects, including NPS projects.

In the 1987 CWA Amendments, Congress added CWA section 319 (33 USC §1329) which required states (1) to develop Assessment Reports that described the states' NPS problems, (2) to establish Management Programs to address these problems, and (3) to provide funding to support implementation of the Programs. California's *Nonpoint Source Management Plan* (SWRCB, 1988) outlined a general approach to address persistent NPS problems using education and outreach, financial and technical assistance, and regulatory authorities when necessary. To enhance activities to address NPS water pollution, states are currently encouraged to upgrade their NPS programs. In 1996, USEPA issued CWA section 319 program guidance that identified "nine key elements" that must be addressed to receive USEPA approval for upgraded NPS Plans (See Appendix A). Pursuant to the 1998 Clean Water Action Plan (CWAP), states with upgraded NPS Programs will receive increased funding based on a federal appropriation for State NPS Programs above $100 million. For California to receive additional funding in FFY 2000 and beyond, USEPA must certify that California's NPS Program has been upgraded consistent with the "nine key elements."

The CZMA of 1972 (16 USC §§1451 et seq.) established a national framework for effective management, protection, development, and beneficial use of the coastal zone. Pursuant to the CZMA, California prepared the California Coastal Management Program (CCMP) which was approved by NOAA. The bulk of California's coast is within the jurisdiction of the CCC pursuant to the Coastal Act of 1976 (Public Resources Code [PRC] §§30000 et seq.), while the San Francisco Bay Conservation and Development Commission (SFBCDC) has jurisdiction in San Francisco Bay (SFB) pursuant to the McAteer-Petris Act (MPA) (Government Code §§66600 et seq.). The State Coastal Conservancy (SCC) is a third partner agency in the CCMP.

Recognizing that the CZMA did not specifically mention water quality, in 1990 Congress amended CZMA section 306(d)(16)(16 USC §1455[d][16]) and added section 6217 (16 USC §1455b) to focus on NPS pollution problems and the protection of coastal waters. CZARA section 6217 requires state coastal zone management (CZM) agencies, in coordination with state water quality agencies, to develop and implement MMs to restore and protect coastal waters from adverse impacts of NPS pollution. Similarly, CZMA section 306(d)(16)(16 USC §1455[d][16]) requires that state CZM programs contain enforceable policies and mechanisms to implement applicable requirements of CZARA section 6217. To achieve these goals, states were directed to coordinate and integrate their existing CZM and water quality plans and programs, including the states' NPS management plans.

Porter-Cologne Water Quality Control Act (Porter-Cologne Act)

The Porter-Cologne Act is the principal law governing water quality regulation in California. It establishes a comprehensive program to protect water quality and the beneficial uses of water. The Porter-Cologne Act applies to surface waters, wetlands, and ground water and to both point and NPSs of pollution. Pursuant to the Porter-Cologne Act (CWC section 13000), it is the policy of the State:

- That the quality of all the waters of the State shall be protected,
- That all activities and factors affecting the quality of water shall be regulated to attain the highest water quality within reason, and
- That the State must be prepared to exercise its full power and jurisdiction to protect the quality of water in the State from degradation.

The Porter-Cologne Act established nine RWQCBs and the SWRCB which are charged with implementing its provisions and which have primary responsibility for protecting water quality in California. The SWRCB provides program guidance and oversight, allocates funds, and reviews RWQCB decisions. In addition, the SWRCB allocates rights to the use of surface water. The RWQCBs have responsibility for individual permitting, inspection, and enforcement actions within each of nine hydrologic regions. The SWRCB and RWQCBs have numerous NPS-related activities, including problem monitoring and assessment, planning, financial assistance, and regulatory and non-regulatory management.

The RWQCBs regulate discharges under the Porter-Cologne Act primarily through issuance of NPDES and WDR permits. Anyone discharging or proposing to discharge materials that could affect water quality (other than to a community sanitary sewer system regulated by an NPDES permit) must file a report of waste discharge. The SWRCB and the RWQCBs can make their own investigations or may require dischargers to carry out water quality investigations and report on water quality issues. The Porter-Cologne Act provides several options for enforcing WDRs and other orders, including cease and desist orders, cleanup and abatement orders, administrative civil liability orders, civil court actions, and criminal prosecutions.

The Porter-Cologne Act also implements many provisions of the federal CWA, such as the NPDES permitting program. Section 401 of the CWA gives the SWRCB the authority to review any proposed federally permitted or federally licensed activity which may impact water quality and to certify, condition, or deny the activity if it does not comply with State water quality standards. If the SWRCB imposes a condition on its certification, those conditions must be included in the federal permit or license.

Except for dredge and fill activities, injection wells, and solid waste disposal sites, WDRs may not "specify the design, location, type of construction or particular manner in which compliance may be had" (Porter-Cologne Act section 13360). Thus, WDRs ordinarily specify the allowable discharge concentration or load or the resulting condition of the receiving water, rather than the manner by which those results are to be achieved. However, RWQCBs may impose discharge prohibitions and other limitations on the volume, characteristics, area, or timing of discharges and can set discharge limitations such that the only practical way to comply is to use MPs. RWQCBs can also waive WDRs for a specific discharge or category of discharges on the condition that MMs identified in an SWRCB or RWQCB approved water quality management plan are followed.

The Porter-Cologne Act also requires adoption of water quality control plans (WQCPs) which contain the guiding policies of water pollution management in California. There are a number of statewide WQCPs adopted by the SWRCB. In addition, regional WQCPs, commonly referred to as basin plans, have been adopted by each of the RWQCBs. All basin plans identify the existing and potential beneficial uses of waters of the State and establish water quality objectives to protect these uses. The basin plans also contain implementation, surveillance, and monitoring plans. WQCPs include enforceable prohibitions against certain types of discharges, including those that may pertain to NPSs. Basin plans have been adopted for each of the nine RWQCBs as delineated in Table 5.

Table 5. RWQCB Numerical Designations

1	North Coast
2	San Francisco Bay
3	Central Coast
4	Los Angeles
5	Central Valley
6	Lahontan
7	Colorado River Basin
8	Santa Ana
9	San Diego

Portions of WQCPs are also subject to review by USEPA. When approved by USEPA, the water quality objectives and beneficial use designations become water quality standards under the CWA. In most cases, water quality objectives contained in a WQCP are not directly enforceable unless implemented through WDRs or water right permits.

California Coastal Act

The State Legislature enacted the California Coastal Act (PRC §30000 et seq.) (Coastal Act) to provide for the conservation and planned development of the State's coastline. The Coastal Act mandates the protection and restoration of coastal waters pursuant to several sections in the PRC. Mandated activities include:

- To carry out a public education program to promote coastal conservation.
- To maintain, enhance, and, where feasible, restore marine resources.
- To maintain and, where feasible, restore biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes through, among other means, minimizing adverse effects of wastewater discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface water flow, encouraging wastewater reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.
- To protect against spillage of crude oil, gas, petroleum products, or hazardous wastes.
- To limit the alteration of wetlands, coastal waters, and estuaries and provide for feasible mitigation measures to minimize adverse environmental effects.
- To phase out or upgrade, where feasible, existing marine structures causing water stagnation contributing to pollution problems and fish kills.
- To limit hydromodification of rivers and streams. Channelization, dams, and other substantial alterations of rivers and streams shall incorporate best mitigation measures feasible.
- To protect environmentally sensitive habitat areas (ESHAs). Site and design new development in areas adjacent to ESHAs to prevent significant adverse impacts.
- To protect long-term productivity of soils and timberlands.
- To site and design new development so as to not have significant adverse impacts either individually or cumulatively on coastal resources.
- To minimize alteration of natural landforms.
- To assure that new development is stable, has structural integrity, and does not contribute significantly to erosion.
- To control impacts of dredging in specified port areas.
- To minimize harmful effects to coastal waters, including water quality, from fill within ports.
- To locate, design, and construct port-related development to minimize substantial environmental impacts and protect beneficial uses.

In carrying out the mandates of the Coastal Act, the CCC certifies local coastal programs (LCPs) prepared by local governments (§30500). The CCC also certifies plans prepared by port districts (§30711 et seq.), colleges and universities (§30605), and proponents of public works projects (§30605). In addition, the CCC approves coastal development permits (CDPs), energy projects, and federal (federally approved, conducted, or funded) projects consistent with the Coastal Act policies. The Coastal Act also contains several means to deter and discipline violators of its provisions. In order to prevent imminent or further damage of coastal resources, the Executive Director of the SWRCB or the CCC can issue a cease and desist order to any party that is undertaking a development without a permit or in a manner inconsistent with the terms of a previously issued permit (§§ 30809 and 30810). The CCC can also order the restoration of a site (§ 30811). Civil liability fines for violations of the Coastal Act are specified in sections 30820, 30821.6, and 30822. In practice, the CCC protects water quality primarily through: (1) managing coastal development that generates runoff or creates spills; (2) assisting local coastal governments and other agencies to address land-use and development activities that may produce NPS pollution; and (3) implementing educational and technical assistance programs.

California Environmental Quality Act (CEQA)

California is one of 20 states with an environmental impact assessment law modeled after the National Environmental Policy Act (NEPA). The SWRCB, RWQCBs, and all State and local government agencies must comply with CEQA. CEQA applies to discretionary activities proposed to be carried out by government agencies, including approval of permits and other entitlements. CEQA has six objectives: (1) to disclose to decision-makers and the public the significant environmental effects of proposed activities; (2) to identify ways to avoid or reduce environmental damage; (3) to prevent environmental damage by requiring implementation of feasible alternatives or mitigation measures; (4) to disclose to the public reasons for agency approvals of projects with significant environmental effects; (5) to foster interagency coordination; and 6) to enhance public participation.

CEQA sets forth procedural requirements to ensure that the objectives are accomplished and also contains substantive provisions requiring agencies to avoid or mitigate, when feasible, impacts disclosed in an Environmental Impact Report (EIR). In addition, CEQA sets forth a series of sweeping policy statements encouraging environmental protection. These policies have led the courts to interpret CEQA "so as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language." (*Friends of Mammoth v. Board of Supervisors [1972] 8 Cal 3d 247, 259, 104 Cal. Rptr. 761.*)

Planning, Zoning, and Development Laws

The legal framework within which California cities and counties exercise local planning and land use functions that can play a critical role in addressing NPS pollution is provided in the California Planning and Zoning Law (Government Code §§65000 et seq.) and the Subdivision Map Act (SbMA) (Government Code §§66410 et seq.), as well as in the Coastal Act.

Under State planning law, each city or county must adopt a comprehensive, long-term general plan for the physical development of the city or county and any land outside its jurisdiction which bears relation to its planning. Pursuant to Government Code section 65302, general plans must contain seven elements: (1) land use, (2) circulation,

(3) housing, (4) conservation, (5) open space, (6) noise, and (7) safety. The following elements are the most relevant to NPS pollution prevention and control:

- Land Use. Designates categories such as housing, industry, and natural resources, including density and intensity of use.
- Conservation. Applies to conservation, development, and use of natural resources (e.g., soils, forests, rivers and other water bodies, and harbors). May also cover watershed protection, land or water reclamation, prevention or control of the pollution of streams and other coastal waters, regulation of land uses along stream channels and in other areas required to implement the conservation plan (e.g., buffer areas), to control or correct soil erosion, and for flood control.
- Open Space. Applies to preservation of natural resources, including fish and wildlife habitat, rivers, streams, bays and estuaries, and open space.
- Circulation. Plans infrastructure, including water, sewage, and storm drainage.

While the general plan is a long-range look at the future of a community, a zoning ordinance spells out the immediate allowable uses for each property in the community. Each property in the community is assigned a "zone" listing the kinds of uses that will be allowed on that land (e.g., single family residential, multi-family residential, neighborhood commercial, light industrial, agricultural, etc.) and setting development standards (e.g., minimum lot size, maximum building height, minimum front-yard depth). The distribution of residential, commercial, industrial, and other zones is based on the pattern of land uses established in the community's general plan. Zoning is adopted by ordinance and carries the weight of local law. All local governments use some form of a permitting process whereby a permit is issued for a specific project and can be conditioned based on conformance with the zoning ordinance.

Subdivision regulation, like zoning, is an exercise of police power and is a principal instrument for implementing a general plan. The SbMA (Government Code §§66410 et seq.) sets forth other mandates that must be followed for subdivision processing.

The local government's corporate and police powers and zoning and subdivision ordinances are tools commonly used to implement general plans. Preferential assessment of real property can also offer landowners an economic incentive for keeping their land in agricultural, timber, or open space uses. This can serve to implement the land use, open space, and conservation elements of a general plan by reserving areas designated for agriculture, timber, open space, scenic resources, and natural resource use.

The Coastal Act also requires cities and counties that are located wholly or partially in the coastal zone to have an "eighth element" (the LCP) for that portion of the local government's jurisdiction in the coastal zone. When an LCP is certified by the CCC as being consistent with the goals and policies of the Coastal Act, coastal permit authority for that area is delegated to the local government. However, development in State tidelands, submerged lands, and public trust lands continues to require a permit from the CCC, and certain types of local government decisions on coastal permits made under certified LCPs may be appealed to the CCC.

SWRCB Antidegradation Policy

A key policy of California's water quality program is the State's Antidegradation Policy. This policy, formally known as the *Statement of Policy with Respect to Maintaining High Quality Waters in California* (SWRCB Resolution No. 68-16), restricts degradation of surface and ground waters. In particular, this policy protects water bodies where existing quality is higher than necessary for the protection of beneficial uses.

Under the Antidegradation Policy, any actions that can adversely affect water quality in all surface and ground waters must: (1) be consistent with maximum benefit to the people of the State; (2) not unreasonably affect present and anticipated beneficial use of the water; and (3) not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect surface waters are also subject to the Federal Antidegradation Policy (40 Code of Federal Regulations [CFR], § 131.12) developed under the CWA.

E. Stakeholder Roles in Program Development and Implementation

NPS pollution control is the shared responsibility of both public and private interests. Ultimately all of us—agencies, landowners and land operators, and the general public—contribute to and must help to control NPS pollution.

The CWA and CZARA are the legal foundation for California's current strategy to prevent and control NPS pollution. Therefore, the SWRCB, RWQCBs, and the CCC are the lead agencies for developing the program and coordinating its implementation.

However, the management of land and water uses in California is conducted by numerous local, State, and federal agencies with independent or, in some cases, overlapping authorities and programs. These agencies may be broadly categorized as management agencies, regulatory agencies, land use agencies, or assistance agencies (Table 6). Some agencies' authorities and programs are limited to specific NPS categories (e.g., Department of Boating and Waterways [DBW], Board of Forestry [BOF]); other agencies have broad authority to protect resources (Table 7).

F. Scope and Schedule

California intends to implement a comprehensive statewide program under the CWA and CZMA rather than develop a separate new program for the coastal zone. This will allow the State (1) to protect water quality through a single upgraded NPS program, (2) to use resources more effectively, (3) to eliminate the potential for regulatory inequities that might occur if special zones are created, and (4) to enhance agency coordination. The Strategy is based on implementation of MMs through regulatory and non-regulatory activities including education and outreach, public participation, and technical and financial assistance and the use and coordination of enforceable authorities and programs where self-determined efforts are insufficient to restore and protect State waters.

TABLE 6. CATEGORIES OF IMPLEMENTING AGENCIES

Federal and State Land Management and Regulatory Agencies	This category comprises federal and State agencies that have the authority to implement MPs statewide. Such authority derives either from the agency's management responsibility for publicly owned or controlled land or its regulatory authority. For example, large portions of the State are managed by federal regulators or land and water managers (e.g., USEPA, NOAA, BLM, National Park Service, U.S. Army Corps of Engineers [USACOE], U.S. Fish and Wildlife Service [USFWS], U.S. Forest Service [USFS], and Federal Energy Regulatory Commission[FERC]). When such agencies have the capability to act effectively in their areas of jurisdiction as a lead NPS management agency, the SWRCB may seek formal agreements—e.g., Management Agency Agreements, Memoranda of Agreement (MAA), or MOU—that contain NPS controls.
Federal and State Assistance Agencies	This category comprises agencies that can provide technical or financial assistance to support implementation of MPs. These agencies include the Natural Resources Conservation Service (NRCS), SCC, and University of California Cooperative Extension (UCCE). They assist landowners and land managers to voluntarily implement MPs and help identify appropriate MPs for RWQCB or management agency enforcement. For example, SCC programs are directed at preserving coastal agriculture, resolving coastal land use issues, restoring and enhancing natural resources, developing urban water fronts, acquiring significant coastal sites, providing public access to and along the shoreline, and assisting local governments and nonprofit organizations. One action of the Program is for the SWRCB to seek agreement with these agencies so that they could target technical and financial resources to high priority NPS problems. Currently, the CCC works with the SCC to ensure that the watershed protection work reflects priorities of the Program Plan.
Local Land Use Agencies	This category comprises agencies (e.g., counties, cities, and some special districts) that have the authority to enforce implementation of MPs locally. Local government is the principal land use planning authority in the State. County and city government and special districts often institute the first tier of management requirements for a specific parcel of land. When such agencies have the capability of acting effectively in their jurisdictional areas as lead NPS management agencies, RWQCBs may seek formal agreements that provide for NPS control.
Local Assistance Agencies	This category comprises local agencies and special districts that provide technical or financial assistance to support implementation of MPs. These agencies assist landowners and land managers to voluntarily implement MPs and to help identify appropriate MPs for RWQCB or management agency enforcement. One action of the Program is for the RWQCBs to seek agreements with these agencies so that they can target technical and financial resources to high priority NPS problems.

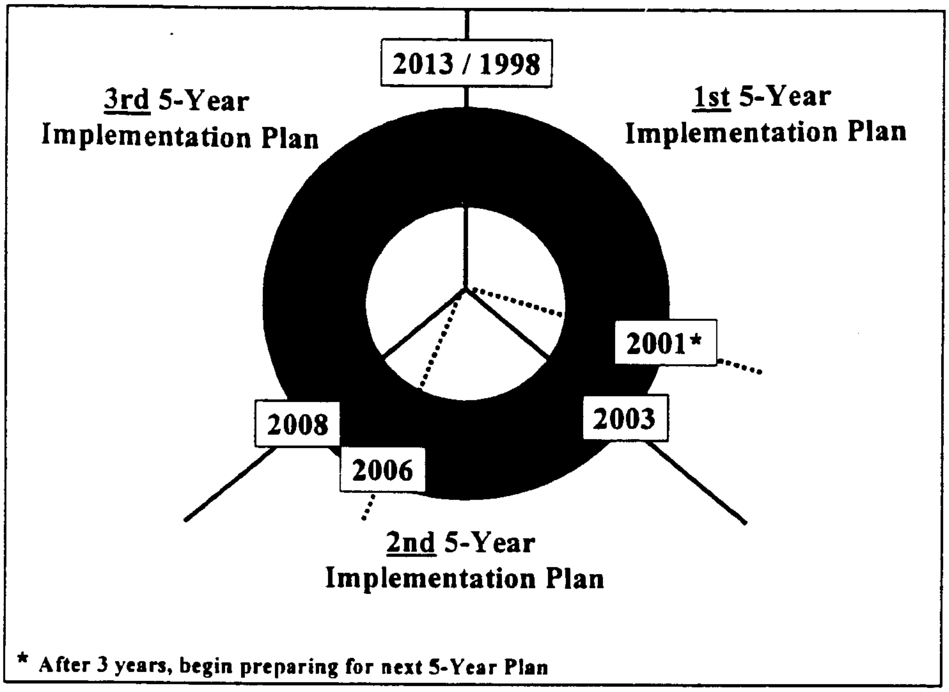
TABLE 7. IMPLEMENTING AGENCIES FOR CALIFORNIA'S NONPOINT SOURCE MANAGEMENT MEASURES

Agencies	Management Measures*					
	AGR	FOR	URB	MA	HYD	WET
California Environmental Protection Agency (Cal/EPA)						
1. State Water Resources Control Board (SWRCB)	✓	✓	✓	✓	✓	✓
2. Regional Water Quality Control Boards (9) (RWQCB)	✓	✓	✓	✓	✓	✓
3. California Integrated Waste Management Board (CIWMB)			✓	✓		
4. Department of Pesticide Regulation (CDPR)	✓	✓	✓			
5. Department of Toxic Substances Control (DTSC)			✓	✓		
California Resources Agency (Cal/RA)						
6. California Coastal Commission (CCC)	✓	✓	✓	✓	✓	✓
7. Delta Protection Commission	✓					
8. Department of Boating and Waterways (DBW)				✓		
9. Department of Conservation (DOC)	✓					
10. Department of Fish and Game (DFG)	✓	✓	✓	✓	✓	✓
11. Department of Forestry and Fire Protection (CDF)		✓				
12. Board of Forestry(BOF)		✓				
13. Department of Parks and Recreation (DPR)	✓	✓	✓	✓	✓	✓
14. Department of Water Resources (DWR)	✓		✓		✓	✓
15. San Francisco Bay Conservation and Development Commission (SFBCDC)			✓	✓	✓	✓
16. Santa Monica Mountains Conservancy			✓			✓
17. State Coastal Conservancy (SCC)					✓	✓
18. State Lands Commission (SLC)	✓	✓		✓		✓
19. Wildlife Conservation Board (WCB)					✓	✓
Other State, Regional and Local						
20. Department of Food and Agriculture (DFA)	✓					
21. Department of Health Services (DHS)	✓	✓	✓	✓	✓	✓
22. Department of Transportation (Cal/Trans)			✓			
23. University of California Cooperative Extension (UCCE)	✓	✓	✓	✓	✓	✓
Local Governments	✓	✓	✓	✓	✓	✓
Resource Conservation Districts (RCDs)	✓	✓	✓		✓	✓
Federal						
Bureau of Land Management (BLM)	✓					
National Oceanic and Atmospheric Administration (NOAA)	✓	✓	✓	✓	✓	✓
• Monterey Bay National Marine Sanctuary (MBNMS)	✓		✓	✓	✓	✓
Natural Resources Conservation Service (NRCS)	✓					
U.S. Army Corps of Engineers (USACOE)				✓	✓	✓
U.S. Coast Guard (USCG)				✓		
U.S. Environmental Protection Agency (USEPA)	✓	✓	✓	✓	✓	✓
• San Francisco Bay (SFB), Santa Monica Bay (SMB), and Morro Bay National Estuary Programs (NEPs)	✓		✓	✓	✓	✓
U.S. Forest Service		✓				

* In this table, AGR = Agriculture; FOR = Forestry; URB = Urban; MAR = Marinas and Recreational Boating; HYD = Hydromodification; WET = Wetlands and Riparian Areas.

The assessment of implementation efforts conducted pursuant to each five-year implementation plan will occur on a regular basis in three distinct stages, with the SWRCB and CCC reporting on these efforts every two years (biennially). This process is detailed below and shown in Figure 2.

FIGURE 2. CALIFORNIA NPS POLLUTION CONTROL PROGRAM: A FIFTEEN-YEAR STRATEGY WITH THREE FIVE-YEAR IMPLEMENTATION PLANS



First Five-Year Implementation Plan (1998 - 2003) (Implementation Plan)

This document contains the first implementation plan which identifies an initial set of targeted MMs and describes NPS Program activities through June 2003 (five years after the July 1998 USEPA and NOAA Conditional Approval of the State's submittal pursuant to CZARA). In this Implementation Plan, the SWRCB and CCC have developed a plan to implement the MMs and achieve Program goals. In 2001, the SWRCB, RWQCBs, and CCC, in coordination with other agencies and the public, will begin reviewing implementation actions to assess the State's progress and effectiveness. At this time, the State will also start developing the next five-year implementation plan. Achieving designated milestones and meeting identified objectives will serve as a basis for evaluating progress. In 2003, California will report on the State's progress in meeting its milestones and objectives for the first five-year period.

Second Five-Year Implementation Plan (2003 – 2008)

Implementation of the second five-year implementation plan will occur from July 2003 through June 2008. The second five-year implementation plan will: (1) provide for the continued implementation of the initial set of actions and MMs, including increasing use

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of regulatory actions if necessary; (2) outline steps to improve and expedite program implementation determined to be appropriate in light of the review and evaluation; (3) target approximately half of the remaining NPS MMs, plus any additional MMs deemed necessary; and (4) include actions and milestones to ensure implementation of these MMs. In 2006, the State will again review and evaluate implementation to assess progress and effectiveness.

Third Five-Year Implementation Plan (2008 – 2013)

Implementation of the third five-year implementation plan is expected to begin in July 2008 and continue through June 2013. The third five-year implementation plan will: (1) provide for continued implementation of actions and NPS MMs as necessary; (2) target the remaining NPS MMs for implementation, plus any additional MMs deemed necessary; and (3) include actions and milestones to ensure implementation of these MMs.

II. FIFTEEN YEAR PROGRAM STRATEGY

A. Introduction

The Strategy describes how the vision and goals of NPS pollution prevention and control will be realized by utilizing the components of the Program process. The Program process begins with "assessing" the impact of NPS pollution on water quality. NPS issues are identified for waters across the State either individually or collectively. A thorough assessment allows the State to proceed to the second component, "targeting" appropriate human, financial, and technical resources into geographic areas and NPS MMs requiring immediate attention.

The State will fully address the NPS issues from multiple fronts. The "planning" component will take advantage of the numerous programs and tools already in place. Use of existing programs reduces duplicative efforts and benefits from the expertise already accumulated at different institutional levels. Based on previous success stories and lessons learned, the State can begin to identify and plan to use new approaches to address remaining NPS problems.

The complexity of the issues makes effective "coordination" of the various activities imperative. The State will therefore foster interagency cooperation and facilitate public participation through the establishment of formal agreements and formation of an Interagency Coordinating Committee (IACC).

Effective "implementation" of NPS MMs will rely on a "three-tiered approach," with an emphasis on self-determined cooperation of the stakeholders. Applicable regulatory programs and authorities will be invoked in the case of persistent NPS water quality problems and/or stakeholder resistance to self-determined implementation of MMs.

The final element of the Program process consists of "tracking" implementation of MMs, "monitoring" MP effectiveness, "assessing" program success, and "reporting" program progress. Again, participation of the stakeholders at this step will ensure the dissemination of lessons learned and will continue program success. These lessons learned will become the backbone of future decisions both within the Strategy and the subsequent five-year implementation plan.

These components make up an evolving and iterative process repeated in each of the three five-year implementation plan cycles. It is expected that by the end of the fifteen year duration of the Program Plan all the identified MMs for the prevention and control of NPS pollution will have been implemented in the appropriate watersheds and will have improved the quality of the State's waters.

B. Assessing the Problem

California will continue to use the State's Water Quality Assessment (WQA) as the primary tool for assessing NPS pollution statewide.[4] Pursuant to CWA section 305(b), this information is reported to USEPA every two years and is used to develop the CWA section 303(d) list of waters that do not meet water quality standards with technology-based pollution controls.[5] Assessment of waters used as drinking water will also be enhanced by the DHS's new Drinking Water Source Assessment and Protection (DWSAP) Program.[6]

These assessment systems support the NPS Program by identifying, individually and collectively, which waters are impacted by NPS pollution. This assists the NPS Program in targeting future actions and determining their effectiveness. To improve the usefulness of these assessment systems, the NPS Program will:

- Ensure that monitoring data from the Program is incorporated into the WQA,
- Support the development and improvement of a geographically-based assessment system, Geo Water Body System (GeoWBS) [7],
- Support efforts to provide consistency in listing impairments,
- Improve consistency in the definitions of specific sources of pollution,
- Promote public access to the WQA and its underlying data, and
- Seek funding to increase the quality and quantity of water quality monitoring.

These assessment systems also will be utilized to monitor and track the effectiveness of the NPS Program and are discussed in that context in subsequent sections of the Strategy (see Part II, Section G—*Track, Monitor, Assess, and Report*).

C. Targeting Efforts

Introduction

High quality water resources are of significant economic, social, and ecological value in California; however, the amount of available public funds is inadequate to address all the

[4] This compilation of water quality information, provided by the RWQCBs, synthesizes the results of monitoring programs conducted by dischargers, landowners, community members, and local, State, and federal agencies. The WQA reports on the degree to which these waters support their beneficial uses, such as municipal drinking water supply, recreational activities, or cold water fisheries.

[5] A total of 1,700 water bodies was assessed in the 1998 CWA section 305(b) Report. Of these, 509 surface waters did not meet water quality standards. The RWQCBs specified 392 water bodies (77 percent) as directly impacted by NPS pollution. The categorical sources (e.g., agriculture, urban, forestry, marinas) of the NPS pollution were identified for 173 surface water bodies. The categorical sources were not identified by the Los Angeles and San Diego RWQCBs. The identification of sources is not required by the CWA when listing waters as impaired.

[6] DHS, as required by the Safe Drinking Water Act Amendment of 1996, recently submitted to USEPA and received approval (April 1999) for the DWSAP Program. DHS will identify and assess all potential sources of contaminants, including NPS pollutants, for public drinking water systems in California. A report outlining the findings will be provided to customers of each system.

[7] The information in the WQA is stored in the SWRCB's GeoWBS database. The GeoWBS database identifies the water body size, the degree to which beneficial uses are supported, the affected beneficial uses, the pollutants, and the pollution sources.

existing water pollution sources all at once at every location in the State. The concept of targeting focuses State resources on specific actions or pollutants within limited geographic regions and improves the likelihood of achieving measurable water quality improvements. Actions that lead to water quality benefits can in turn increase public support of NPS pollution control programs and ensure that the public is more closely attuned to overall water quality goals. Such a change in attitude with a corresponding increase in pollution control knowledge and skill is a primary ingredient of lasting water resource protection.

In order to make the Strategy most effective, efforts must be targeted from both a water resources (e.g., water quality, geographic, or watershed area) and economic resources perspective. To achieve the overall objective to improve water quality, the Program Plan will target efforts towards accomplishing the following goals:

- Coordinate NPS pollution control implementation efforts to target both:
  1. MMs for agriculture, forestry, urban areas, marinas and recreational boating, and hydromodification in riparian corridors and wetlands, and
  2. Geographic regions, with a focus on the most impaired areas, areas most in need of protection, and areas where significant existing efforts or increased stakeholder participation are underway to prevent and control NPS pollution.
- Apply project resources to clearly specified, realistic goals and objectives (e.g., to efforts that will result in a high probability of success with available resources and funding).
- Protect and restore valuable resources from increased NPS pollution associated with changes in land use.

All targeting efforts will coordinate with existing State and federal programs that focus on water resources in general and NPS problems in particular. To increase stakeholder support of the prioritized efforts, public involvement needs to be directly incorporated into the targeting process. The following sources of information were used for targeting resources and priorities within the first five-year plan:

- Stakeholder interpretation of NPS priorities;
- Impaired waters as identified on the CWA section 303(d) list and TMDL priority lists; and
- Delineation of critical coastal areas and identification of additional MMs.

Stakeholder Involvement in Prioritization

In order to receive direct input from stakeholders concerning current and future efforts of the NPS Program, staffs of the SWRCB and the CCC held workshops in December 1998 and July 1999 (each series consisting of one workshop in the northern and southern parts of the State). In addition, a questionnaire was sent to over 200 stakeholders (including the RWQCBs and 17 other State agencies) requesting identification of "priority" MMs and program categories (e.g., administrative coordination, public participation, monitoring, and technical assistance) that need to be addressed during the first five-year implementation plan. The questionnaire results and comments from these opportunities for stakeholder involvement were used to target the initial activities outlined in the first five-year implementation plan.

The targeting efforts were also supplemented through the use of the reports developed by the NPS TACs (SWRCB, 1994a-i; SWRCB, 1995 a-b). The active involvement of the different representatives in the TACs ensured that priorities were given to the MMs and geographic areas with which those most intimately familiar with the NPS pollution issues, the stakeholders, expressed the most concern. For example, all the identified MMs for agriculture, the single most significant contributor of NPS pollution to the Nation's water bodies, have been targeted for implementation during the first five years. On the other hand, the recommendation for installation of pumpout facilities, during the first implementation cycle, at marinas on the Tomales Bay, an important shellfish production location, demonstrates the Program's focus on protecting areas with critical coastal-dependent industries.

Target Impaired Waters

CWA section 303(d)(1)(A) requires states to identify surface waters within their boundaries where numeric or narrative water quality objectives are not being maintained and/or beneficial uses are not fully protected after application of technology-based controls. Each state is also required to establish a priority ranking for such waters, taking into account the severity of the pollution and the beneficial uses to be made of the waters.

For those surface water bodies identified and prioritized above, section 303(d)(1)(C) requires that each state establish TMDLs for those pollutants identified under CWA section 304(a)(2) as suitable for TMDL development correlated with the achievement of water quality objectives. A TMDL is a numeric target which when achieved will result in attainment of water quality standards. The TMDL includes allocations (e.g., allowable pollutant loading) for both point and NPSs. The loadings are established with consideration given to seasonal variations of pollutant loadings and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

The CWA section 303(d) and TMDL priority lists are developed biennially on even-numbered years. The RWQCBs first assess available data to develop the list. The assessment includes: (1) re-examining the water bodies previously listed under CWA section 303(d); (2) reviewing existing monitoring information; (3) soliciting additional information from other State and federal agencies; and (4) encouraging public participation. The CWA section 303(d) and TMDL priority lists are approved through a public noticing and hearing process at each RWQCB and the SWRCB. USEPA reviews the State's CWA section 303(d) and TMDL priority lists and either approves or disapproves them. If the lists are disapproved, USEPA proposes a modified list with a 30-day comment period. The USEPA's final list then becomes the State's list for the next two years.

The first five-year implementation plan made extensive use of the CWA section 303(d) list to prioritize its tasks. Several impaired water bodies have been targeted for TMDL development. Examples are abundant in the agriculture and forestry categories. Specifically, 33 water bodies have been targeted for nutrient (agriculture – nutrient management) TMDL development by 2003. The load allocations determined for NPSs at the end of the TMDL development process will help guide the selection of best management practices (BMPs) for implementation in the future to ensure NPS pollution prevention and control.

Critical Coastal Area Designation

Special coastal habitats (e.g., wetlands, tide pools, creeks, and lagoons) continue to be threatened from the impacts to water quality that accompany new and existing development. California recognizes that special coastal resources require special care and attention. The intent of CCA designation, therefore, is to direct needed attention to coastal areas of special biological, social, and environmental significance and to provide an impetus for these areas to receive special support and resources.

Pursuant to federal guidance (NOAA and USEPA, 1993), factors in identifying CCAs include:

- The nature and proximity of contaminant sources to the coastal area;
- Physical and biological characteristics of adjacent lands that will cause NPS problems;
- Important biological features;
- Characteristics of land use changes; and
- Extent to which the above effects can be prevented or reduced by implementation of additional MMs.

Federal guidance provides the states with flexibility in their approach to identifying CCAs.[8] California will use a combination of approaches in delineating CCAs. First, the State will designate special sections within the California coastal zone as CCAs. These include ESHAs currently designated in California's CZM program, as well as areas adjacent to Areas of Special Biological Significance (ASBS), California's National Estuarine Research Reserves (NERRs), NEPs, and National Marine Sanctuaries. Within these areas the CCC will use its existing authority under the CCMP to ensure that all appropriate MMs are implemented and, where appropriate, that additional MMs are

[8] A state can take one or both of the following approaches:

1. A state can establish the CCA as a strip of land along the portion(s) of the shoreline adjacent to threatened or impaired coastal waters. Within this area, special controls such as setbacks and low-density zoning can be employed to protect coastal waters.
2. A state can rely on site specific evaluations to determine the extent of a CCA. Under this approach, states may include broader geographic areas in the CCA designation, starting with shoreline segments adjacent to threatened or impaired coastal waters and extending inland to encompass significant coastal features or resources further inland. These broader areas may include entire watersheds or portions of watersheds adjacent to coastal waters and may encompass significant biological features such as wetlands.

developed to protect these coastal waters. Second, agency and public actions will be coordinated to protect the adjacent portions of the inland watersheds that impact the environmental processes within the coastal zone.

To coordinate the actions within the CCAs, the Program Plan will establish an interagency committee (CCA Committee)--led by the CCC in coordination with the SCC, SWRCB, six coastal RWQCBs, and the public--to identify CCAs and develop additional MMs necessary to protect these areas. The CCC and SWRCB have identified several initial goals for CCA designation and implementation.

First, the CCA Committee will evaluate the need for and the implementation of additional MMs to protect and restore coastal waters within CCAs. The Committee will work closely with appropriate agencies and researchers to develop additional MMs that address the issues that threaten or impact the designated CCAs. For the portions of CCAs within the coastal zone, the CCC will include additional MMs, when appropriate, in future coastal development permits and future Local Coastal Program (LCP) amendments associated with these areas. Further discussion of the development of additional MMs for CCAs is provided in Part II, Section H: *Overall Program Assessment—Refining the Program.*

Second, the CCA Committee will seek to channel appropriate NPS Program and agency resources to areas of special concern that may not fall within the initial stages of the Program Plan's other NPS activities. The Committee will act as an advocate for the prioritization, funding, and implementation of projects that can achieve measurable water quality improvements within and in watershed areas adjacent to CCAs. For example, the CCC will support and coordinate the implementation of additional MMs in the watersheds impacting CCAs by: (1) working directly with the appropriate agencies; (2) identifying and targeting resources for implementation in sensitive coastal habitats that can achieve prescribed water quality goals and in sensitive coastal habitats that are of regional concern but not a priority under other water quality designations (threatened or impaired); and (3) expanding participation in education and restoration programs.

This designation will help the State to protect pristine, threatened, and impaired waters that may be degraded by new or substantially expanding land use near the coastal zone by coordinating additional agencies and initiating special programs. Because CCA designation is a continuing process, sensitive coastal habitats that may become threatened by new or expanding development can be targeted as a priority in the future.

Finally, CCA designation will provide resources to special coastal areas which do not achieve priority ranking within other sections of this plan and will therefore provide solutions to program deficits rather than create an additional designation using the same review criteria.

Results of Targeting Efforts

One of the goals of the Program is to implement all of the MMs over the next fifteen years. Although the Strategy targets specific MMs during each five-year implementation plan, in any given year efforts will be ongoing for each MM throughout the State. Some of the MMs implemented during the first implementation cycle will undoubtedly require continued attention long past the initial five years. Similarly, sustained NPS pollution prevention and control efforts may be needed for certain geographic areas beyond the first five years. During the assessment processes in 2001 and 2006, these MMs and areas will be identified and incorporated into the subsequent implementation cycle.

In targeting MMs and geographic areas during the first five-year implementation cycle, special consideration was also given to dovetailing with existing programs. For example, in providing technical support to cities in the development of urban runoff plans, the State will build upon and expand upon the use of the Model Urban Runoff Program (MURP). MURP was originally developed for the Cities of Monterey and Santa Cruz. Taking advantage of existing NPS programs such as MURP will avoid duplicative efforts.

Depending on its relative priority, each MM for each five-year implementation cycle was targeted as either primary, secondary, or tertiary. In designating the targeting level for each MM, consideration was given also to the extent that specific actions are currently being implemented to address the NPS source. For example, urban runoff poses a considerable problem in California but was designated at the secondary and tertiary targeting level because of the existing NPDES Stormwater Program. At the conclusion of each five-year implementation cycle, the MMs targeted at the primary level will be evaluated using the following criteria: (1) the degree to which performance measures have been met; (2) geographic extent of MM implementation; (3) selected evaluation of MPs to implement the MMs; and (4) analysis of available water quality information in those areas where implementation has occurred. Depending on the degree of success, the State will determine whether to: (1) maintain the in-place efforts; (2) modify or add MMs and/or actions for each primary level MM; or (3) consider whether rulemaking is necessary to ensure successful implementation. The targeted MMs for the Strategy and each five-year implementation plan are presented in Table 8.

D. Planning

Introduction

To maintain the Program Plan as a working document, it will be continually updated, decisions will be re-evaluated, and priorities will be re-targeted based on updated information, pilot projects, and lessons learned. An important part of the updating process is integrating the Program Plan with existing federal and State plans and programs that impact NPS pollution control. The following sections provide a brief description of these plans and programs and how the Program Plan will integrate with them.

1988 NPS Plan

The CWA was amended in 1987 to include a new section 319 titled "Nonpoint Source Management Program." CWA section 319 required states to develop a management program describing the measures the State will take to address NPS pollution. Pursuant

TABLE 8 – SUMMARY OF TARGETED MANAGEMENT MEASURES FOR FIFTEEN-YEAR STRATEGY AND FIVE-YEAR IMPLEMENTATION PLANS

Management Measures	Targeting Level for Each Five Year Implementation Plan		
	1998-2003	2003-2008	2008-2013
1. Agriculture			
A. Erosion and Sediment Control	P	P	P
B. Confined Animal Facilities Wastewater and Runoff	P	P	P
C. Nutrient Management	P	P	P
D. Pesticide Management	P	P	P
E. Grazing Management	P	P	P
F. Irrigation Water Management	S	P	P
G. Education/Outreach	P	P	P
2. Forestry (Silviculture)			
A. Preharvest	P	P	P
B. Streamside Management Areas	P	P	P
C. Road Construction/Reconstruction	P	P	P
D. Road Management	P	P	P
E. Timber Harvesting	P	P	P
F. Site Preparation and Forest Regeneration	P	P	P
G. Fire Management	S	P	P
H. Revegetation of Disturbed Areas	P	P	P
I. Forest Chemical Management	S	S	P
J. Wetlands Forest	T	P	P
K. Postharvest Evaluation	P	P	P
L. Education/Outreach	P	P	P
3. Urban Areas			
3.1 Runoff from Developing Areas			
A. Watershed Protection	S*	P	P
B. Site Development	S*	P	P
C. New Development	S*	P	P
3.2 Runoff from Construction Sites			
A. Construction Site Erosion/Sediment Control	T*	S*	P
B. Construction Site Chemical Control	T*	S*	P
3.3 Runoff from Existing Development			
A. Existing Development	S*	P	P
3.4 On-site Disposal Systems			
A. New On-site Disposal	S*	P	P
B. Operating On-site Disposal Systems	S*	P	P
3.5 Transportation Development: Roads, Highways, and Bridges			
A. Planning, Siting, and Developing Roads and Highways	T*	S*	P
B. Bridges	T*	S*	P
C. Construction Projects	T*	S*	P
D. Construction Site Chemical Control	T*	S*	P
E. Operation and Maintenance	T*	S*	P
F. Road, Highway, and Bridge Runoff Systems	T*	S*	P
3.6 Education/Outreach			
A. Pollution Prevention/Education: General Sources	P	P	P

Management Measures	Targeting Level for Each Five Year Implementation Plan		
	1998-2003	2003-2008	2008-2013
4. Marinas and Recreational Boating*			
4.1 Assessment, Siting, and Design			
A. Water Quality Assessment	P	P	P
B. Marina Flushing	T	S	P
C. Habitat Assessment	S	P	P
D. Shoreline Stabilization	S	P	P
E. Storm Water Runoff	S	P	P
F. Fuel Station Design	S	P	P
G. Sewage Facilities	P	P	P
H. Waste Management Facilities	P	P	P
4.2 Operations and Maintenance			
A. Solid Waste Control	P	P	P
B. Fish Waste Control	T	S	P
C. Liquid Material Control	S	P	P
D. Petroleum Control	P	P	P
E. Boat Cleaning and Maintenance	P	P	P
F. Maintenance of Sewage Facilities	P	P	P
G. Boat Operation	T	S	P
4.3 Education/Outreach			
A. Public Education	P	P	P
5. Hydromodification			
5.1 Channelization and Channel Modification			
A. Physical and Chemical Characteristics of Surface Waters	S	P	P
B. Instream and Riparian Habitat Restoration	S	P	P
5.2 Dams			
A. Erosion and Sediment Control	T	S	P
B. Chemical and Pollutant Control	T	S	P
C. Protection of Surface Water Quality and Instream and Riparian Habitat	T	S	P
5.3 Streambank and Shoreline Erosion			
A. Eroding Streambanks and Shorelines	S	P	
5.4 Education/Outreach			
A. Educational Programs	P	P	P
6. Wetlands, Riparian Areas, and Vegetated Treatment Systems			
A. Protection of Wetlands and Riparian Areas	S	P	P
B. Restoration of Wetlands and Riparian Areas	S	P	P
C. Vegetated Treatment Systems	T	S	P
D. Education/Outreach	P	P	P

Legend:
- P – primary
- S – secondary
- T – tertiary

* The Program Plan will implement the Urban MMs through the coordination and expansion of in-place activities including the Phase I and Phase II Storm Water Programs, the Cal/Trans Stormwater Permit, LCP amendments, CDPs and/or MURP.

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to these requirements, the SWRCB developed the 1988 Plan which outlined the steps to initiate systematic management of NPS pollution in California. The 1988 Plan emphasized the following characteristics of an effective management program: (1) developing an explicit long-term commitment by the SWRCB and RWQCBs; (2) coordinating existing SWRCB and RWQCB NPS related programs; (3) using more effectively RWQCB regulatory authorities coupled with non-regulatory programs; (4) improving the linkages among local, State, and federal agencies that have authorities to address NPS pollution; and (5) enhancing funding sources. Key elements of the 1988 Plan were the: (1) development of management options to address NPS pollution (the three-tiered approach); (2) establishment of the NPS Management Information System (NPSMIS); and (3) phased implementation of the 1988 Plan.

The Strategy builds on the lessons learned in the implementation of the 1988 Plan by maintaining and/or expanding those elements that were successful and deleting or altering those that did not achieve the goals of the 1988 Plan. The Strategy maintains the "three-tiered approach" and commits to expanding application of the "tiers" pursuant to the requirements of section 13369(a)(2)(B) of the CWC. The NPSMIS will be expanded through contracts with the University of California at Davis-Information Center for the Environment (UCD-ICE) to develop relational databases and geography-based information systems. The phased implementation program in the 1988 Plan was expanded to include a commitment from the SWRCB to consider adopting the MMs as regulation if clear progress is not being made in their implementation.

Water Quality Control Plans

In California, the RWQCBs and SWRCB are responsible for the development of statewide and regional WQCPs, respectively. Pursuant to section 13240 of the Porter-Cologne Act, each of the State's nine RWQCBs must formulate and adopt regional WQCPs (basin plans) for all surface and ground waters within their respective regions. Porter-Cologne Act section 13170 allows the SWRCB to adopt statewide WQCPs for waters for which water quality standards are required by the CWA. The statewide plans, when adopted, supersede any basin plan requirements for the same waters to the extent of any conflict.

Basin Plans

Section 13241 of the Porter-Cologne Act requires that each basin plan: (1) designate beneficial uses; (2) establish water quality objectives that protect the designated beneficial uses; and (3) provide an implementation plan for achieving the water quality objectives. The implementation plan for achieving water quality objectives must include, but is not limited to: (1) a description of the nature of the actions which are necessary to achieve the water quality objectives; (2) a time schedule for the actions to be taken; and (3) a description of the monitoring and surveillance to be undertaken to determine compliance with objectives.

As part of the "continuing planning process," components of the basin plan are reviewed as new information and data become available or as specific needs arise. Comprehensive updates of the basin plan occur in response to State and federal legislative requirements and as funding becomes available. All of the RWQCB basin plans were completely updated in 1995. In addition, the basin plan provides consistent long term standards and program guidance for the RWQCB.

Section 13240 of the Porter-Cologne Act directs the SWRCB and the RWQCBs to periodically review and update basin plans. Furthermore, CWA section 303(c) directs states to review water quality standards every three years (triennial review) and, as appropriate, modify and adopt new standards. In the triennial review process, basin planning issues are formally identified and ranked during the public hearing process. These and other modifications to the basin plan are implemented through basin plan amendments which must be reviewed by the RWQCB and the SWRCB in a public review process specified. Following adoption by the RWQCB, basin plan amendments and supporting documents are submitted to the SWRCB for review and approval. All basin plan amendments approved by the SWRCB after June 1, 1992 must also be reviewed by the State Office of Administrative Law (OAL). In addition, the USEPA must review and approve those basin plan amendments that involve changes in State standards for surface water quality to ensure such changes do not conflict with federal regulations.

The basin plans will be one of the most effective instruments for integrating the Program Plan. Many of the critical elements for implementing the NPS Program are required by statute to be incorporated into the basin plan. The SWRCB and RWQCBs can use their planning authority to prevent NPS pollution and implement MMs. Implementation programs within the basin plan can implement MMs through several approaches. The implementation plans can recommend that NPS dischargers carry out specific BMPs in order to achieve water quality standards. The implementation programs can also waive regulation of categories of NPS pollution discharges on condition that the dischargers implement specific MMs or BMPs. Alternatively, an implementation program can prohibit NPS discharges either entirely or partially, in certain areas or under certain conditions. The conditions can include compliance with appropriate MMs and applicable BMPs.

Inland Surface Waters Plan/Enclosed Bays and Estuaries Plan

The SWRCB is in the process of developing a new Inland Surface Waters Plan (ISWP) and Enclosed Bays and Estuaries Plan (EBEP) to reinstate the two plans it rescinded in response to an adverse court ruling in 1994. The SWRCB is generally authorized to adopt WQCPs under the Porter-Cologne Act (§13170) and is specifically mandated to adopt the EBEP (CWC §13391). Once adopted and in effect, the ISWP and EBEP will complement the California Ocean Plan (Ocean Plan) by establishing statewide water quality standards and implementation measures for controlling discharges of toxic pollutants to non-ocean surface waters of the State.

The SWRCB is developing the ISWP and EBEP in two phases. In Phase 1, the SWRCB will adopt the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (Policy). The Policy (adopted pursuant to CWC §13140) will establish statewide toxicity requirements and provisions to implement water quality standards for priority toxic pollutants in waste discharges. The adoption of water quality standards for priority toxic pollutants for all waters of the United States is mandated by federal CWA section 303(c)(2)(B) in accordance with implementing regulations (40 CFR 131). The vast majority of these standards will be promulgated for the State in the USEPA California Toxics Rule (CTR). Together, the CTR and the Policy will be the basis for establishing water quality-based effluent limitations and other permit requirements for priority pollutants and whole effluent toxicity in NPDES permits and other WDRs. Thus, the standards and implementation provisions established by the CTR and the Policy will function as replacements for the ISWP and EBEP until they are established in their entirety in Phase 2. In Phase 2, the SWRCB will combine the Policy provisions with State-adopted water quality standards for priority pollutants and other pollutants of concern to produce a new ISWP and EBEP. Other issues, such as toxicity testing and the evaluation of standards for effluent-dependent and agricultural drainage-dominated water bodies, will also be addressed in the future.

Currently, the USEPA expects to promulgate the CTR in December 1999. In November 1999, the SWRCB released a revised draft of the Policy and supporting documents for a second public review prior to an SWRCB workshop in December 1999. The Policy will be considered for adoption at a SWRCB meeting in early 2000. The Policy will become effective upon approval by the OAL in the spring of 2000. After the ISWP and EBEP are adopted, the plans will be periodically reviewed and, as appropriate, revised (generally every three years) in accordance with CWC section 13240 and CWA section 303(c)(1). These triennial reviews involve public hearings prior to adoption of amendments by the SWRCB.

California Ocean Plan

The 1997 Ocean Plan states that the SWRCB "finds and declares that protection of the quality of the ocean waters for use and enjoyment by the people of the State requires control of the discharge of waste to ocean waters in accordance with the provisions contained" in the Ocean Plan. State law (CWC §13170.2) requires that the Ocean Plan be reviewed at least every three years to guarantee that current standards are adequate and are not allowing degradation to marine species or posing a threat to public health. As defined by the Ocean Plan, "waste includes a discharger's total discharge, of whatever origin, i.e., gross, not net, discharge." Section 13170.2 of the CWC requires the SWRCB to adopt and review the Ocean Plan.

The Ocean Plan applies in its entirety to point source discharges to the ocean. NPS discharges are subject to the sections of the Ocean Plan covering beneficial uses, water quality objectives, general requirements, and discharge prohibitions. For NPSs of waste discharge to the ocean, "compliance with water quality objectives, in all cases, shall be determined by direct measurements in the receiving waters." The Ocean Plan is not applicable to discharges to enclosed bays and estuaries, inland waters, vessel wastes, or control of dredging materials. The SWRCB may make exceptions to the Ocean Plan in compliance with CEQA and a public hearing and in concurrence with the USEPA, provided that two conditions are met: (1) the exception will not compromise protection of ocean waters for beneficial uses and (2) the public interest will be served.

The Ocean Plan was established in 1972 and has been amended in 1978, 1983, 1988, 1990, and 1997. Draft amendments were made public in October 1998, public hearings on the draft were held in December 1998, and staff is currently responding to comments made during the hearings. It is anticipated that revised draft amendments will be submitted for SWRCB approval in May 2000. As part of the required review of current standards, a triennial review of the Ocean Plan, public hearings were held in September and October 1998. The public identified 35 specific issues that needed review. Staff subsequently prepared a Triennial Review Workplan, describing 22 high priority issues that the SWRCB approved on July 15, 1999 and submitted to the USEPA. The issue "Regulatory Control of Nonpoint Source Control" was reviewed by staff of the Division of Water Quality's NPS Section prior to SWRCB approval of the Workplan.

Bays and Estuaries Toxic Hot Spot Cleanup Plan

The purpose of this program was to implement the Bay Protection and Toxic Cleanup Program (BPTCP), which was established by the State Legislature in 1989. The BPTCP had four major goals: (1) to provide protection of present and future beneficial uses of the bays and estuarine waters of California; (2) to identify and characterize toxic hot spots; (3) to plan for toxic hot spot cleanup or other remedial or mitigation actions; and (4) to develop prevention and control strategies for toxic pollutants that will prevent creation of new toxic hot spots or the perpetuation of existing toxic hot spots in the bays and estuaries of the State.

The six coastal RWQCBs involved in the BPTCP conducted extensive water and sediment quality monitoring in the enclosed bays and estuaries of the State over a period of eight years. The monitoring data provided information on the chemistry (types and amounts of toxicants), toxicity, and benthic integrity of sediments. An assessment of monitoring data using a weight-of-evidence approach resulted in the designation of 48 toxic hot spots, 22 of which were ranked as high priority based on the guidance developed by the SWRCB. The RWQCBs developed regional toxic hot spot cleanup plans for the high priority hot spots.

The BPTCP concluded in June 1999 with the adoption of the statewide Toxic Hot Spot Cleanup Plan by the SWRCB. The Cleanup Plan includes: (1) a priority listing of all toxic hot spots; (2) description of each toxic hot spot including a characterization of the pollutants present at the site; (3) assessment of the most likely source or sources of pollutants; (4) estimate of the total costs to implement the cleanup plan; (5) estimate of the costs that can be recovered from parties responsible for the discharge of pollutants that have accumulated in sediments; (6) preliminary assessment of the actions required to remedy or restore a toxic hot spot; (7) a two-year expenditure schedule plan; and (8) findings on the need to establish a toxic hot spot cleanup program.

Depending on the source and areal extent of the known hot spot, the actions to remediate the sites include: (1) better characterization of the sites and problem, (2) institutional controls/education, (3) dredging, capping, a combination of dredging and capping, (4) source control watershed management, and (5) implementation of a no-action alternative. In order to prevent the further pollution or creation of known toxic hot spots, the cleanup plan requires RWQCBs to reevaluate WDRs in compliance with CWC section 13395. The re-evaluation consists of: (1) an assessment of whether the discharge may influence the creation or further pollution of the known toxic hot spot, (2) an assessment of which WDRs need to be modified to improve environmental conditions at the known toxic hot spot, and (3) a schedule for completion of any WDR modifications deemed appropriate.

Development of Total Maximum Daily Loads

Section 303(d)(1)(C) of the CWA requires the State to establish TMDLs for "303(d) listed water bodies" for those pollutants determined by USEPA to be suitable for TMDL measurement. The TMDL program provides an assessment and planning framework for identifying load reductions or other actions needed to attain water quality standards. The planning process for TMDL development is divided into two parts. Part 1 establishes and apportions the allowable level(s) of pollution in the water body (or watershed) necessary to achieve water quality standards. The recommended methods for achieving the necessary reductions in pollutant loadings are detailed in the second part of this process--the TMDL implementation plan.

Part 1 – Developing the TMDL

This process establishes the maximum allowable amount of pollution (for parameters of concern) and allocates this among the existing and potential sources. The allocation of pollutants is distributed among both point source and NPS discharges. This quantitative assessment includes determining the following components:

- Loading capacity--The greatest amount of loading that a water body can receive without violating water quality standards.
- Load allocation--The portion of a receiving water's loading capacity that is attributed either to one of its existing or future NPSs of pollution or to natural background sources.
- Wasteload allocation--The portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution.
- Margin of safety--The portion of a receiving water's loading capacity that accounts for the uncertainty of the relationship between the pollutant loads and the quality of the receiving water.
- Seasonal variation--The influence of seasonally-dependent factors (e.g., flow volume) on the receiving water's loading capacity.
- TMDL--The sum of the individual wasteload allocations for point sources, load allocations for NPSs and natural background, and the margin of safety. The TMDL can be expressed in terms of either mass per time, toxicity, or other appropriate measures that relate to the State's water quality standard. In practice, allocations are not typically assigned on a daily basis but instead are

monthly, seasonal, or annual. In most cases mass load is utilized as the metric for the allocations. In some cases (e.g., pathogen problems), other measurable features are used to express the allowable amount of pollution.

Load allocations for NPS and/or natural background may range from reasonably accurate estimates to gross allotments, depending on the availability of data and the techniques used for predicting the loading. As such, a phased approach to TMDL development is often used where estimates are based on limited information. Using the phased approach provides a TMDL that includes monitoring requirements and a schedule for reassessing TMDL allocations to ensure attainment of water quality standards.

Part 2 – Developing the TMDL Implementation Plan

Once a TMDL or phased TMDL has been established, an implementation plan must be developed. The State (acting through the RWQCB) must implement the TMDL and must incorporate the TMDL into the appropriate basin plan. Section 13242 of the Porter-Cologne Act requires that a plan of implementation be incorporated into the basin plan. The implementation plan must include: (1) a description of the nature of the actions necessary to achieve the water quality objectives, including recommendations for appropriate action by any entity, public or private; (2) a time schedule for the actions to be taken; and (3) a description of the monitoring and surveillance to be undertaken to determine compliance with the objectives. Incorporating the TMDL into the basin plan requires approval by the SWRCB and approval of any regulatory provisions by OAL.

The RWQCBs make use of the NPDES permitting process to limit effluent from point source discharges consistent with the wasteload allocations. In the case of NPSs, the RWQCBs rely on the implementation of NPS controls, such as the MMs and associated MPs, and the application of a wide range of State programs and enforcement authorities.

During the Strategy, the RWQCBs have committed to the development of 500 to 800 TMDLs and their associated implementation plans. Appendix C provides a detailed summary of the TMDLs which the RWQCBs have identified for initial development or completion within the first five years of the Strategy. The commitment of financial and staff resources to this effort will be influential in addressing the State's effectiveness in controlling NPS problems.

In summary, TMDLs are planning tools that will enhance the State's ability to foster implementation of appropriate NPS MMs. By providing watershed-specific information, TMDLs will help target specific sources and corresponding corrective measures and will provide a framework for using more stringent approaches that may be necessary to achieve water quality goals and maintain beneficial uses.

Watershed Management Initiative

The watershed Management Initiative (WMI) was approved in 1995 by the SWRCB as part of its Strategic Plan. It was developed to help the SWRCB meet its goal to provide water resource protection, enhancement, and restoration while balancing economic and environmental impacts. The WMI uses an integrated planning approach to create and implement unique solutions for each watershed that consider all local conditions and pollution sources and rely on the input and involvement of local stakeholders. It is not a regulatory program and has no statutory mandate.

Watersheds are identified and prioritized primarily on the basis of water quality. Watershed management strategies have been developed for over 40 watersheds at the nine RWQCBs. These strategies are contained in the Integrated Plan for implementation of the WMI. This Integrated Plan is updated annually in November to reflect changing priorities and conditions in the State's watersheds. The 1998-99 State budget bill included funding for ten WMI coordinators to carry out the WMI. There is one coordinator at each of the nine RWQCBs and one at the SWRCB. The WMI relies on the existing authority of the SWRCB and RWQCBs, including the Porter-Cologne Act and the Federal CWA.

The WMI is consistent with the overall scheme of the Program Plan. Similar to the CWA section 303(d) list described above, prioritization of the watersheds helps the Program Plan in targeting areas with serious water quality issues. Moreover, the watershed management strategies were developed with considerations for local environmental and economic conditions. Consequently, in accordance with the NPS Plan's emphasis on self-determination and the voluntary approach, stakeholder involvement in the implementation of the management strategies is not only critical but feasible. Future annual updating of the management strategies will incorporate RWQCBs' activities identified in the five year implementation plans to support implementation of the Program Plan and make use of the MMs contained in the CAMMPR document of this Program Plan. Implementation of these strategies in targeted watershed will complement the NPS work being performed under other parts of the Program Plan and ensure the full implementation of all MMs in 15 years.

Community-Based Watershed Plans

Community-based watershed plans refer to a wide range of plans and activities that are being undertaken throughout California. These plans and activities are focused on specific geographic areas and involve strong local leadership and diverse stakeholders. Community-based watershed plans have as their premise that many water quality and ecosystem problems are best solved at the watershed level rather than at a statewide or individual discharger level.

Community-based watershed plans are a key component to implementing the MMs. Many of the community-based watershed plans and activities that are underway address NPS pollution. The SWRCB and RWQCBs have supported these plans through financial and technical assistance. Currently, several State agencies, in conjunction with the California Biodiversity Council (CBC) and the Cal/RA, are considering how to establish a statewide framework to more fully support community-based watershed plans and activities.

The SWRCB and the RWQCBs will continue to support watershed plans to foster implementation of the MMs. This is consistent with the federal CWAP that directs new CWA section 319(h) funding to supporting watershed restoration action strategies (WRASs). The intent of this requirement is to ensure that the activities supported by these funds are part of a comprehensive effort that has the community and technical support necessary to achieve significant environmental results. A wide range of community-based watershed plans will be considered to qualify as WRASs. For example, a local watershed stewardship plan, a Coordinated Resource Management and Planning Program (CRMP), or a Comprehensive Conservation and Management Plan prepared under section 320 of the CWA will all be considered to qualify as a WRAS.

Coastal CPR Plan

The CCC's *Plan for Controlling Polluted Runoff* (Coastal CPR Plan) outlines the CCC's authorities to address polluted runoff and identifies actions with timelines and milestones to achieve the CCC's objective to reduce polluted runoff. The Coastal CPR Plan specifies the CCC's role in addressing polluted runoff within the confines of existing budgets, staffing, and statutory authority. The four program enhancements that comprise the Coastal CPR Plan are developed from the CCC's existing and newly developed tools and programs related to the management of polluted runoff. They include: (1) implementation of MMs through planning, regulation, and technical assistance; (2) administrative coordination; (3) public participation and education; and (4) funding. Implementation of the Coastal CPR Plan helps to direct CCC staff efforts to prevent and control polluted runoff, thus leading to improved coastal water quality and enhanced coastal resources and uses.

Many of the actions identified in the Coastal CPR Plan are incorporated into the Program Plan. These actions are expected to help facilitate implementation of the NPS Program, as well as to improve the coastal program's overall treatment of water quality-related issues.

General Plans

The general plan is a local government's basic planning document. Under State planning law, each city or county must adopt a comprehensive, long-term general plan for the physical development of the city or county and any land outside its jurisdiction that bears relation to its planning. General plans must contain seven elements: (1) land use, (2) circulation, (3) housing, (4) conservation, (5) open space, (6) noise, and (7) safety. The following elements are the most relevant to NPS pollution prevention and control:

1. Land Use--Designates categories such as housing, industry, and natural resources, including density and intensity of use.
2. Conservation--Applies to conservation, development, and use of natural resources (e.g., soils, forests, rivers and other water bodies, and harbors). May also cover watershed protection, land or water reclamation, prevention or control of the

pollution of streams and other coastal waters, regulation of land uses along stream channels and in other areas required to implement the conservation plan (e.g., buffer areas), control or correction of soil erosion, and flood control.

3. Open Space--Applies to preservation of natural resources, including fish and wildlife habitat, rivers, streams, bays and estuaries, and open space.
4. Circulation--Plans infrastructure, including water, sewage, and storm drainage.

Local Coastal Programs

In carrying out its objectives and policies, the Coastal Act (PRC §§30000 et seq.) delegates to local governments specified authority to regulate coastal development.[9] The Coastal Act directs each of the 73 cities and counties lying wholly or partly within the coastal zone to prepare for review and certification by the CCC an LCP for the local government's portion of the coastal zone. Through LCP development, the Coastal Act provides a means to manage coastal resources of State, regional, and national significance in ways that respect special circumstances in each locality. The CCC works with local governments to tailor LCPs to reflect local issues and concerns while simultaneously meeting the statewide goals and policies of the Coastal Act.

An LCP consists of a local government's land use plans (LUPs), zoning ordinances, zoning district maps, and, within sensitive coastal resource areas, other implementing actions which, when taken together, meet the requirements of and implement the provisions and policies of the Coastal Act at the local level (PRC §30108.6). The LUP is the relevant portion of a local government's general plan or local coastal element which is sufficiently detailed to indicate the kinds, location, and intensity of land uses, the applicable resource protection and development policies, and, where necessary, a listing of implementing actions (PRC §30108.5). Most key land use and policy decisions are made in the LUP stage. The standard of review of the LCP Implementation Plan is that it conforms with and is adequate to carry out the certified LUP.

Upon LCP certification, a local government can issue permits for such development in the coastal zone as is consistent with LCP policies; alternatively, a local government conditionally approves or denies a coastal development permit application if the proposed development is inconsistent with the LCP. However, certain actions taken by a local government on a CDP application may be appealed to the CCC. The CCC hears appeals, and the standard of review is the certified LCP and the public access policies of the Coastal Act. And, because a CDP is either approved or denied depending on its conformity to a certified LCP, it is imperative that all appropriate NPS MMs are identified and included in the certification process.

The CCC water quality staff will update the in-house *Procedural Guidance Manual: Addressing Polluted Runoff in the California Coastal Zone* to reflect the newest development in NPS MMs. This manual is extensively utilized by the CCC staff in

9 The Coastal Act declares that "to achieve maximum responsiveness to local conditions, accountability, and public accessibility, it is necessary to rely heavily on local government and local land use planning procedures and enforcement" (PRC §30004).

reviewing LCPs and CDP applications. The CCC's water quality staff will also conduct training of its planners in use of the manual and in screening for NPS components in LCPs, Local Coastal Program Amendments (LCPAs), and CDPs. The initial training will be conducted by December 2000, with a refresher training every year thereafter. Currently, the CCC staff are routinely requesting applicants of development permits not already subject to NPDES permit requirements to submit Erosion & Sediment and Chemical Control Plans for the construction phase when appropriate. In addition, a polluted runoff control plan with regular BMP maintenance and inspection is required of most development proposals as well. These efforts will achieve tangible water quality benefits in the field.

Coastal Act section 30519.5 requires the CCC to conduct periodic reviews of certified LCPs to evaluate whether or not the LCPs are being implemented by the local governments in a manner that conforms to the Coastal Act. The periodic reviews also provide a means to ensure that the LCPs reflect new information (such as new MMs) and changing conditions regarding NPS pollution prevention and control and help local governments respond to post-certification NPS issues that develop over time in targeted areas.

Lastly, the CCC can also effect implementation of the NPS Program through either:
(1) the regular LCP amendment process initiated by the local governments or
(2) providing grant incentives to encourage appropriate NPS-related amendments to LCPs.

In short, the CCC will review all new LCPs, LCPAs, and CDP applications brought before it for appropriate NPS pollution prevention and control activities.

Annual Workplans

Each year since 1990, the SWRCB and RWQCBs have developed detailed annual workplans as part of the grant application to USEPA for CWA section 319(h) funding. In addition to satisfying federal funding requirements, the plans served as short-term planning and budgeting tools for the SWRCB and RWQCBs. Annual workplans are detailed, tasked-oriented documents. This Program Plan is not intended to replace annual workplans. In fact, good annual workplans are more important than ever if California is to achieve the goals and objectives set forth in the Program Plan. Annual workplans will continue to be used to plan, coordinate, budget, track, and report on each year's NPS-related work.

Beginning with Fiscal Year 2000 (July 1, 2000), the SWRCB, RWQCBs, and CCC will begin jointly developing a single annual workplan that focuses on implementing MMs. The workplan will detail all major tasks proposed for the coming year including those that support activities outlined in the State NPS Plan. Annual workplans will cover all federal and State (including bond funds) funding sources, fees, and any other sources including private commitments. Other State agencies and private entities will be encouraged to join in the process. This widespread participation is crucial if the State is to accurately evaluate and report the large number of efforts underway dealing with NPS pollution.

The State is faced with mounting annual, biennial, and five-year State and federal reporting requirements. To simplify reporting efforts, the SWRCB and CCC will develop a single, standardized report format (Figure 3) for use by all participants. The form will need to satisfy federal grant program requirements, be consistent with the five-year plans, and provide sufficient information so that information is usable in a program tracking database such as the one currently under development at UCD ICE. Another consideration is that it has an Internet-compatible file format to ensure electronic sharing over and posting on the Internet. One of the most important functions of the standardized report format is to simplify the task and thereby improve the State's ability to document and report its yearly progress in managing NPS pollution.

Regulatory Plans (National Pollution Discharge Elimination System)

While different legal authorities may apply to different situations, the goals of the NPS Program are complementary to the goals of the storm water regulatory programs that address urban runoff.[10] The two-phased program under CWA section 402(p) requires NPDES permits for storm water discharges. In California, the federal NPDES Program is administered by the SWRCB and the RWQCBs. Since 1990, Phase I regulations have required NPDES permits for storm water discharges from:

1. Municipal separate storm sewer systems serving populations greater than 100,000,
2. Specific industrial activities, and
3. Construction activities disturbing land of five or more acres.

Phase I requires that individual NPDES permits be issued for municipalities greater than 100,000ff In practice, the RWQCBs include many municipalities in urbanized areas with populations less than 100,000 in the Phase I programs. Individual municipal NPDES permits require implementation of structural and nonstructural control measures to reduce pollutant loads from industrial, commercial, and residential areas. The SWRCB elected to adopt a statewide NPDES General Permit requiring the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP) for all construction and certain industry-related discharges.

Implementation of the NPDES Phase II Program will expand the existing program to include all municipalities within urbanized areas and small municipalities outside of urbanized areas with a population of at least 10,000 and a population density of at least 1,000 persons per square mile. The program will also expand to include construction sites that disturb between one and five acres. All activities under Phase I and II of the NPDES permit regulations will be required to prepare a SWPPP to demonstrate how MMs will be used to protect water quality degradation.

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[10] The 1987 CWA Amendments, which added section 319 related to NPS programs, also expanded the application of regulatory authority under CWA section 402 to prevent and control NPS pollution from certain urban areas and industrial activities. CZARA section 6217 also requires states to implement MMs to control NPS pollution, including urban runoff, to coastal waters.

DRAFT SAMPLE

California Nonpoint Source Pollution Control Program
Annual Workplan for FY 1999

Agency: *Cal/EPA* **Department/Board:** *SWRCB*

Division/Program: *DWQ/NPS*

Contact:

Management Measure Category: *3.5 Transportation Development*

Management Measure Title: *3.5A Planning, Siting, and Developing Roads and Highways*

Process Element: *Assess Problem*

Actions/Statements: *Conduct a consistency analysis of Cal/Trans' statewide storm water permit.*

Geographic Area: *Statewide*

Funding Sources and Amount: *CWA 319(h) and General Fund*

Performance Measures: *Upgrade NPDES permit.*

Annual Progress Report: *The SWRCB approved a statewide storm water permit for CalTrans in August 1999 that includes management measures consistent with the Program Plan.*

Involve Stakeholders in Planning Process (Public Participation)

The Program Plan identifies numerous mechanisms for stakeholder participation in the planning and implementation of Tier 1 activities. To ensure that stakeholders have both the representation and buy-in necessary for Tier 1 to truly be effective, the State recognizes the need for public participation in every step of the planning and implementation process. Public input will be included in plan development, targeting resources, planning five-year activities, coordinating partnerships, implementing MMs, and monitoring success. This coordination will be achieved from direct comments provided by the public during the decision making and planning process. The most effective first step will be to establish the IACC and include a public representative on the Assessment TAC to participate in problem solving activities. In addition, the Program Plan has to establish a role for public participation in, among others, the State WQA (statewide citizen monitoring network), CCAs designation and implementation, specific work groups (e.g., CRMP), tracking MM implementation and effectiveness, and in developing additional MMs.

The first five-year review period will be a critical point for stakeholder involvement and public comments. The public will be invited to participate in the review of the first five-year plan assessment and in the development of future priorities and objectives. This process will be obtained best through the establishment of review committees (identified by the TACs) to review the Program Plan's effectiveness as outlined in the five-year report. From these comments, the State hopes to increase MM implementation and streamline Tier 1 activities.

E. Coordinating with Agencies and Key Stakeholders

Building cooperative partnerships among agencies at every institutional level, as well as with stakeholders, is essential to the success of a sustainable effort to protect and restore the quality and environment of the State's waters. In order for the NPS Program to be successful, we need to ensure that the roles and responsibilities of stakeholders and agencies with authorities to implement the MMs are clarified and executed. Specific objectives include:

- Establishing coordination mechanisms to enhance implementation of the five-year implementation plans,
- Fostering effective partnerships and collaboration among State, regional, and local agencies and non-governmental organizations (NGOs)—including CRMPs, officials responsible for habitat protection, land use programs and permitting, water quality permitting and enforcement, and public health and safety—to implement all appropriate MMs, and
- Making available for public review and comment by January 1, 2001, a draft of the enforcement guidance required pursuant to Porter-Cologne Act section 13369.

We will use the example of marina and boating activities to illustrate the complex partnerships required in implementing the appropriate MMs. In addition to the CCC and SWRCB, numerous agencies have regulatory jurisdiction and non-regulatory oversight of California's water quality management efforts related to marina and boating activities (Table 9). Although agency jurisdiction overlaps in many cases, the goal of these agencies is to prevent NPS pollution before it happens. (For a more complete list of agency authorities related to the various NPS categories, the reader is referred to Volume II-CAMMPR of the Program Plan.)

For example, the RWQCBs, DFG, DHS, DTSC, and USCG all play an important role in regulating both the amount and type of wastes that enter California's waterways. The RWQCBs are the primary State agencies with water quality authority, which ranges from water quality planning to issuing permits for discharges of pollutants to State waters. Most RWQCBs use voluntary/cooperative management efforts for marina and boater NPS pollution control, although boat yards are regulated under a permit system. The DFG also has broad water quality authority and in addition to the USCG is the

TABLE 9 AGENCY PARTICIPATION IN MARINA AND BOATING ACTIVITIES

	Sewage	Bottom Paints/ Cleaning Material	Hazardous Waste	Oil/Fuel	Debris/ Solid Waste	Storm Water Runoff	Education
RWQCBs	X	X	X	X	X	X	
CCC				X	X		X
CIWMB				X	X		
DBW	X						X
DFG	X	X	X	X	X		
DHS	X		X	X	X	X	
DTSC		X	X	X			
UCCE		X	X	X			X
MBNMS (NOAA)	X	X	X	X	X	X	X
NEPs (USEPA)	X	X	X	X	X	X	X
USCG	X		X	X	X		X

agency most likely to be on site at a marina. Its focus is on preventing pollution that harms fish and wildlife resources, especially discharges of oil and petroleum products. The DFG Office of Spill Prevention and Response (OSPR) is charged with oil spill prevention and response. The DHS also regulates the discharge of sewage, other waste, or effluent, while the DTSC regulates the storage, transport, and disposal of all hazardous wastes. The USCG implements federal laws related to garbage and sewage disposal.

In addition to the agencies listed above, DPR, SLC, SFBCDC, and CCC have leasing or permitting authority over many marinas. CCC, DBW, CIWMB, UCCE, MBNMS, and San Francisco Bay and Santa Monica Bay NEPs provide various levels of technical, financial, and/or educational assistance.

Many efforts related to marinas and recreational boating are coordinated through interagency and public committees, such as the California Clean Boating Network (CCBN) for Northern and Southern California (except San Diego County) and the Boating Safety and Environment Education Committee in San Diego. In 1995, a number of pollution educators, including agency, industry, and environmental representatives, came together to create the CCBN as a result of a recommendation by the Marina and Recreational Boating TAC (SWRCB, 1994e) and to assist boaters and marina managers. The purpose of the CCBN is to promote environmentally sound boating education efforts and to improve communication and coordination between marina and boating pollution educators in California. Examples of CCBN activities to support this purpose include, but are not limited to:

- Sharing information and developing expertise on current environmentally sound boating issues;
- Identifying funding sources for marina and boater pollution education projects;
- Providing a forum to allow cooperation on funding source proposals;
- Assisting in the dissemination of materials;
- Providing feedback on draft materials;
- Providing a forum for feedback on the impact that education is having on the identified audience;
- Sharing methodology for education, outreach, and the evaluation of materials;
- Reviewing existing programs and identifying where additional effort is needed; and
- Developing a strategy to implement the additional efforts.

While the CCBN supports the efforts of its member organizations by sharing information, networking, and providing expertise, the CCBN has lost its program funding to conduct education regarding environmentally sound boating practices. In fact, educational efforts in the State regarding environmentally sound boating are largely funded by short-term grants. No State agency has assumed programmatic responsibility for a permanent education and outreach effort akin to the boating safety education program of the DBW.

As the CCC is now completing a three-year statewide grant, funded by the CIWMB, to promote environmentally sound boating, the CCC acknowledges the need for a permanent boater education program to be implemented by an appropriate State agency. The CCC will work with the DBW, SWRCB, and RWQCBs to identify the appropriate agency for implementing a permanent education program as outlined in the Implementation Plan. Once an appropriate agency is identified, the State will work to develop a long-term funding structure and implementation strategies.

Formal Coordination through Memoranda of Understanding and Management Agency Agreements[11]

The State will formalize connections between the lead and enforcing agencies through the letter from Cal/EPA and Cal/RA, asking each agency, department, State boards, and RWQCBs to prepare a five-year implementation plan (see Appendix D). The State will

[11] Under the CWA and the State's Porter-Cologne Act, the SWRCB is given the authority and responsibility to develop and certify water quality management plans (including BMPs, implementation procedures, and management agency implementation responsibilities), to designate management agencies for plan implementation, and to execute MAAs setting forth management agency commitments to its implementation responsibilities. SWRCB encourages this management agency approach where it offers a viable alternative to direct SWRCB/RWQCB regulation in controlling NPS pollution and achieving compliance with the State's water quality standards. Where reasonably implemented by the management agency, the SWRCB will typically waive direct regulation under its own authority.

also enhance coordination by developing a formal agreement (MOU) between the lead agencies (SWRCB and CCC) responsible for the Program Plan's implementation. While the key elements of the NPS Program have been developed through a cooperative partnership without a formal agreement, an MOU would serve to clarify roles and responsibilities of each agency over the next 15 years. This MOU will be submitted with the Program Plan for approval by the SWRCB and CCC (see Appendix E).

The State will ensure that agencies with the ability to implement aspects of the Program Plan are effectively linked with the lead agencies by developing (or revising) MOUs or MAAs. MOUs and MAAs between the lead agencies and several implementing agencies already exist (Table 10). Additional MOUs/MAAs will be encouraged as a mechanism for officially designating other agencies with the responsibility and authority to implement aspects of the Program Plan. The State will revise existing or add additional MOUs/MAAs that support the implementation of MMs in accordance with the MMs' priorities. This approach is consistent with the Program Plan's phased approach and recognizes resource limitations.

TABLE 10. SUMMARY OF EXISTING MAAs AND MOUs

TYPE OF DOCUMENT	SIGNATORY AGENCY	GENERAL PURPOSE	DATE SIGNED
MOU	California Association of Resource Conservation Districts (CARCD)	Coordination of erosion control and water quality protection	1984
	Soil Conservation Service (SCS) (renamed NRCS)	Planning/technical assistance for water quality policies and activities	1990
	U.S. Bureau of Reclamation (USBR), USFWS, SCS (renamed NRCS), USGS, DWR, DFG, DFA	Implementation of San Joaquin Valley Drain Program	1991
	NOAA, USEPA, Association of Monterey Bay Area Governments (AMBAG), Cal/EPA, SWRCB, CCC, RWQCB 2 and 3	Develop and implement the MBNMS WQPP	1992
	BLM	Coordination of NPS policies and activities	1993
	DFA	Regulation of fertilizer and soil amendments	1998
Water Quality Management Plan (WQMP)/MAA	USFS	Control of NPS activities and pollution on National Forest System Lands	1981
	BOF, CDF	Control of NPS pollution from timber operations on nonfederal lands	1988
	CDPR	Control of pesticide pollution	1997
WQMP	None; cooperative program with technical assistance by UCCE and NRCS, support by CARCD, industry/professional associations	NPS control on private rangeland	1995
"Partnership Agreement" of CA Dairy Quality Assurance Program	14 dairy industry organizations, and state and federal agencies	Coordinated environmental stewardship for dairy waste management	1998

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The SWRCB and CCC are committed to formalizing interagency agreements. In 2000-2001, the SWRCB and CCC will initiate reviews of existing MOUs/MAAs and will work with other agencies to identify opportunities for new agreements. The review will address such issues as existing limitations related to Program implementation and will determine the appropriate mechanisms for correcting concerns. The SWRCB and CCC will subsequently develop those MOUs/MAAs that are identified as being feasible and necessary to ensure the implementation of the priority measures identified in the first five-year plan. Specifically, the SWRCB and CCC will update existing or develop new MOUs/MAAs with the BLM, CDPR, and NRCS by December 31, 2001. In addition, by December 31, 2001, the SWRCB and CCC will develop a schedule for updating or developing additional MOUs/MAAs that are necessary to fulfill the goals and objectives of the Program Plan.

For example, beginning in 2000, the SWRCB will work with the USFS to revise the USFS WQMP called for under the MAA between the SWRCB and the USFS[12]. The USFS has recently undertaken a significant review of its BMPs. These new BMPs adequately implement the MMs of the Program Plan. The USFS has initiated a collaborative effort to incorporate new information into national forest management of the Sierra Nevada National Forests. This effort, known as the Sierra Nevada Framework for Conservation and Collaboration, includes updates to forest plans to address problems in aquatic, riparian, and meadow systems, among other ecosystems. An Aquatic Conservation Strategy has been proposed to maintain and restore the ecological integrity of these systems. The WQMP for National Forest System Lands and the MAA between the USFS and the SWRCB should be modified to: (1) include the Aquatic Conservation Strategy; (2) improve the coordination and collaboration of restoration projects in these systems; and (3) include performance measures that can be used to track project/program effectiveness.

The SWRCB and the CDPR will revise their MAA so that the WQMP includes commitments to implement MMs for which CDPR has regulatory authority.

The SWRCB and the BLM are working to finalize a WQMP and MAA. In 1992, the SWRCB and BLM entered into an MOU (SWRCB Resolution No. 92-26) and agreed to pursue development of an MAA for NPS pollution control program on BLM lands. While that MAA is not yet in place, during the last year, BLM has shown renewed interest in completing the work. This effort should be completed prior to the year 2003. The WQMP with BLM should focus on (1) implementation and adaptive management of the rangeland standards and guidelines; (2) development and certification of BMPs and implementation measures for other NPSs of pollution on BLM lands; (3) evaluation and review of rangeland MPs; and (4) an annual assessment process with environmental and operational measures of success.

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[12] Currently, the only federal agency with management agency status in California is the USFS. In 1981, the SWRCB certified a WQMP for National Forest System Lands, designated USFS as management agency for plan implementation, and executed an MAA with USFS. The WQMP and MAA currently provide for: (1) development and implementation of SWRCB-certified BMPs; (2) early State involvement in review of USFS projects; (3) monitoring and adaptive management of BMP effectiveness and implementation; and (4) annual meetings to maintain coordination and communication.

BLM and the SWRCB have worked together to avoid and reduce NPS pollution from BLM–owned land. BLM controls domestic livestock grazing on public lands through designated grazing allotments. In 1998 BLM developed standards for rangeland health and guidelines for livestock management. SWRCB worked with BLM to ensure that these rangeland standards and guidelines would (1) comprise BMPs; (2) conform with the (g) guidance MMs and the BMPs set forth in the SWRCB's 1995 Rangeland WQMP for private rangelands; and (3) achieve compliance with California's water quality standards. Implementation of the BLM standards and guidelines began earlier in 1999.

Strong stewardship by landowners is a critical mechanism for implementing MMs, and the NRCS is a key agency providing financial and technical assistance to those landowners. The SWRCB and NRCS staffs have agreed that an MOU between the agencies would greatly improve the technical assistance aspects of the NPS Program. NRCS (formerly the Soil Conservation Service) and the SWRCB have an existing MOU dated July 31, 1990, outlining planning and technical assistance related to water quality policies and activities. This MOU will be updated to address NRCS's role in the Program Plan (e.g., assisting landowners in voluntarily implementing Resource Management Systems [RMS] or MMs) and to affirm the SWRCB's commitment to work through a self-determined approach (Tier 1) as a valuable step in achieving clean water goals. The new MOU will also address the use of NRCS technical guidance materials (e.g., Field Office Technical Guide[FOTG]) in planning and installing resource MMs.

The SWRCB and the CCC are leading an effort to develop MOUs/MAAs among the agencies in Cal/EPA and Cal/RA. The purpose of these formal agreements is to develop commitments to implement MMs (e.g., develop five-year implementation plans for their agencies or establish NPS pollution control elements to existing workplans). The SWRCB has contracted with the CCC to facilitate the completion of these agency-specific five-year implementation plans. The SWRCB has authority to require agencies to provide technical reports (Porter-Cologne Act §13165), and this authority could be used if cooperative approaches are ineffectual. The five-year implementation plans would contain components such as:

1. Implementation of all identified NPS MMs for which they have authorities and are targeted in the Program Plan by 2013;
2. Tracking of implementation and effectiveness by MM and source category and providing this information to the SWRCB as part of the monitoring and assessment strategy; and
3. Participation in regular program reviews as well as new goal-setting activities, including development of the five-year implementation plans and coordination of planning, assessment, and regulation activities with the SWRCB, CCC, and RWQCBs.

Coordination Through Interagency Forums

In addition to using formal agreements to establish coordination, the SWRCB and CCC will establish an IACC to provide a regular working forum to collaborate in implementation and problem solving. We currently envision several roles for the IACC. First, where programmatic or policy conditions present problems for watershed management, the SWRCB and CCC, through the IACC, will act as a conduit for addressing and resolving those problems. The IACC will also be asked to evaluate agency functions and to recommend improvements that can benefit water quality on a statewide basis for various categories of activities. The IACC will be the primary forum for coordinating program activities of the lead and implementing agencies. Second, SWRCB and CCC staffs will work with the IACC to identify those agencies willing to become partners in interagency technical assistance teams. For these teams to function optimally, they must have broad-based support. Allowing agencies to assist with and utilize the functions of the teams will provide a powerful mechanism for improving coordination. Third, the SWRCB and CCC staffs will request the IACC to establish TACs in four major issue areas--assessment, technical assistance, education, and regulation. The role of these committees will be to identify opportunities for improved coordination and instances where impediments to effective management occur and to devise responses to move toward enhanced performance and management. Staff will work with the committees to ensure that the problems facing watershed groups are clearly understood and to provide a vehicle for implementing changes in State activities.

The lead agencies will work with the CBC to define the appropriate complementary roles of the CBC and the IACC. The CBC is comprised of 15 State agencies, the University of California (UC), CARCDs, and nine regional associations of county supervisors. The CBC was formed to improve coordination and cooperation among the various resource management and environmental protection agencies at federal, State, and local levels.

Interagency Initiatives and Public/Private Partnerships

Because stewardship is a fundamental principle upon which the NPS Program is based, we need to encourage collaborative relationships that include a broad range of groups. SWRCB, RWQCB, and CCC staffs will work with watershed groups and CRMPs to promote coordinated resource management and planning through the active participation of all stakeholders in a given watershed. The lead agencies encourage the participation of all relevant agencies and stakeholders in watershed management. There are a number of collaborative efforts in which the lead agencies are either currently active or will become active. As part of the effort to improve coordination, staff will work with the following efforts:

- Federal CWAP.
- CBC—Watersheds and Resource Assessment Initiatives.
- Implementation of Farm Bill Conservation Programs (including USDA, NRCS Locally-Led Conservation, Stream Corridor Restoration, Conservation Buffers, Salmon Restoration, and Air Quality Initiatives).
- The Environmental Stewardship component of the California Dairy Quality Assurance Program. This partnership among 14 entities including various State and federal agencies, UC, and representatives of the California dairy industry develops a voluntary, cooperative government and industry education and certification program. The program core components include: (1) education workshops for producers; (2) the creation of Environmental Stewardship Farm Management Plans specific to each dairy; and (3) on-site evaluation by a third party.
- The Range Management Advisory Committee of the BOF.

- Cal/RA's effort to inventory wetland and riparian areas statewide and to maintain data on projects subject to CWA section 401 certification.
- Cal/RA's efforts to establish a definition for riparian areas in consultation with other affected agencies.
- The California Aquatic Bioassessment Workgroup, chaired by staff from the DFG. SWRCB and RWQCB staffs have: (1) trained community members in bioassessment; (2) designed regional bioassessment monitoring programs; and (3) participated in the development and review of bioassessment methods and metrics.
- The California Watershed Project Inventory (Project Inventory) at UCD ICE. The SWRCB has provided significant financial support to this database of watershed projects. Currently, the SWRCB and UCD ICE are expanding the database to link MMs, agencies, and authorities to the Project Inventory.
- Certified Crop Advisor Program.
- CRMP groups throughout California.
- CALWATER watershed mapping initiative.
- CALFED Bay Delta Initiative/Program.
- Lake Tahoe Initiative.
- MBNMS WQPP.
- Southern California Beach Water Quality Workgroup.
- Southern California Coastal Water Research Project.

Review of Federal Projects and Programs

CWA section 319 authorizes and requires each state to review federal activities to ensure consistency with the state's NPS management program. The CWA also directs federal agencies to accommodate the concerns of each state.[13] While the 1988 Plan noted that federal consistency[14] would focus on the actions of three federal agencies (USACOE, USBR, and FERC), the SWRCB, and RWQCBs routinely review: (1) financial and technical assistance programs; (2) development activities; (3) environmental impact statements; and (4) monitoring programs from numerous federal agencies. The CCC has a similar federal consistency process under the CZMA (see Appendix B). The State Clearinghouse acts as the coordinating and notification agency for routing projects to appropriate State agencies. Many federal agencies directly notify State agencies of appropriate federal projects and programs through periodic NEPA reporting procedures or regional collaborative efforts.

The federal programs requiring review for NPS issues are listed in Table 11. The primary lead agency that reviews projects with statewide impact will be the SWRCB.

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[13] This requirement is spelled out in Executive Order 12372 of July 14, 1982 (Federal Register Vol. 47, No. 137).

[14] The general process for review of federal projects, as outlined in this Executive Order, is: (1) State develops a list of federal assistance programs and development projects it will review; (2) State clearinghouse routes federal project information to appropriate State agency for review; (3) State agency reviews projects and provides timely comments to the federal agency; (4) federal agency reviews comments and accommodates concerns where possible; and (5) if concerns cannot be addressed, a timely explanation will be provided. Where the State cannot resolve federal consistency issues to its satisfaction, it requests USEPA assistance to help resolve the issues.

TABLE 11. LIST OF FEDERAL AGENCIES' PROGRAMS AND PROJECTS SUBJECT TO STATE REVIEW

U.S. BUREAU OF LAND MANAGEMENT
Watershed Projects
Mineral Exploration and Development
Oil and Gas Leasing
ORV Activities
Timber Activities
Grazing Allotment/Grazing Management/Permits Issuance
Chemicals/Pesticides
Area Analysis/Cumulative Impacts
Wetlands Protection
Riparian Management Plans
Hydrologic Modifications
Transportation Plans
U.S. DEPARTMENT OF DEFENSE
Natural Resource Management Plans and Projects
Military Construction Projects
Facilities Development Plans and Projects
Land and Water-Based Military Training Plans and Exercises
Environmental Restoration Projects
Spoil Disposal
Open Water Disposal Sites
FEDERAL ENERGY REGULATORY COMMISSION
Dam Relicensing
U.S. FOREST SERVICE
Forest Management Plans
Timber Sales
Grazing Allotments
NATIONAL MARINE FISHERIES SERVICE
Fisheries Management Plan
Habitat Conservation Plans
NATURAL RESOURCE CONSERVATION SERVICE
Environmental Quality Incentives Program (EQIP)
Wetland Reserves Program
Wetland Conservation
Forestry Incentives Program
NATIONAL PARK SERVICE
National Park Seashore Management and Proposed Acquisitions
Wildlife Management
Grazing Management
Abandoned Mines Management
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Coastal Management Programs
U.S. BUREAU OF RECLAMATION
Irrigation Development
U.S. ARMY CORPS OF ENGINEERS
Permits for Dredged or Fill Material
U.S. FISH AND WILDLIFE SERVICE
Management of National Wildlife Refuges and Proposed Acquisitions
Habitat Conservation Plans

The appropriate RWQCBs will review local and regional projects. The CCC will also review programs in the coastal zone as defined in the Coastal Act. These State agencies will work with USEPA staffs who are liaisons with these federal agencies to ensure compliance with the CWA.

When project-by-project review and intervention by USEPA staff are insufficient to abate NPS pollution, the lead agencies will negotiate revisions to existing formal agreements or develop new agreements. If formal agreements are ineffectual, the SWRCB or RWQCBs can require federal agencies to provide NPS pollution prevention reports under their authority (Porter-Cologne Act §13267).

F. Implement Actions

The Three-Tiered Approach Overview

Originally adopted in the 1988 Plan , the "three-tiered approach" remains a cornerstone of the NPS Program. The "three-tiered approach" utilizes three different options of enforceable policies and mechanisms under the Porter-Cologne Act to ensure water quality objectives are achieved. The options are presented in order of increasing stringency. Through the "three-tiered approach," the NPS Program recognizes that many NPS problems are best addressed through the self-determined cooperation of stakeholders (Tier 1). However, persistent NPS water quality problems not effectively resolved through self-determined actions will be addressed through applicable regulatory programs and authorities (Tier 2 and Tier 3).

In general, which option is used depends on factors such as:

- Persistence of water quality impairments;
- Whether timely implementation of MMs and MPs is being achieved; or
- Whether the Tier 1 approach is being utilized effectively.

In practice, the RWQCBs will determine which or what combination of the three options will be used to address any given NPS problem. Sequential movement through the tiers (e.g., Tier 1 to Tier 2 to Tier 3) is not required of the RWQCBs. Depending on the water quality impacts and severity of the NPS problem, the RWQCBs may move directly to the enforcement actions specified in Tier 3. Pursuant to CWC section 13369(a)(2)(B), the SWRCB will develop, by February 1, 2001, guidance to be used by the SWRCB and RWQCBs for moving through the "three-tiered" process.

All three options implement BMPs. BMPs include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. BMPs can be applied before, during, and after pollution producing activities to reduce or eliminate the introduction of pollutants into receiving waters. BMPs are means of achieving certain MMs. For example, seeding and mulching of steep slopes at a construction site would be structural BMPs for achieving the MM of erosion control.

Tier One: Self-Determined Implementation of Management Practices

Since its inception in 1988, the "self-determined" or "voluntary approach" to the implementation of BMPs has been central to discussions of the NPS Program. The terms "voluntary" and the "voluntary approach" have been a popular concept grounded in the historic notions of autonomy and self-determination. The definition

of "autonomy" also refers to the concept of "moral independence," implying that autonomy also carries with it responsibility and accountability. This is especially critical in situations where individual actions may conflict with the public good.

As a concept the term "voluntary approach" is as important for what it does not mean as for what it does. Compliance with the CWA, CZARA, CWC, and the Porter-Cologne Act is not a voluntary choice. It is the responsibility of the SWRCB and the RWQCBs to see that these laws are enforced. The concept of "self-determined implementation" of NPS control measures was developed to acknowledge the potential capability of landowners and resource managers to develop and implement workable solutions to NPS pollution control and to afford them the opportunity to solve their own problems before more stringent regulatory actions are taken.

Property owners and/or managers may implement BMPs through their own initiative or self-determination. Implementation could occur for economic reasons and/or through awareness of environmental benefits. Self-determined implementation can be encouraged through education, training, financial assistance, technical assistance, and demonstration projects. A self-determined approach would take advantage of the expertise and incentives offered by a variety of existing local, State, and federal programs that are geared to promoting private actions which could have water quality benefits. Lead agencies for these programs include the DOC NRCS, Farm Services Agency (FSA), RCDs, and the UCCE.

Tier Two: Regulatory-Based Encouragement of Management Practices

In general, the Porter-Cologne Act constrains RWQCBs from specifying the manner of compliance with water quality standards. However, RWQCBs have two ways to use their regulatory authorities to encourage implementation of BMPs.

First, RWQCBs may encourage the use of BMPs by waiving adoption of WDRs on condition that dischargers comply with this requirement. Alternatively, the SWRCB and the RWQCBs may enforce BMPs indirectly by entering into MAAs with other agencies that have the authority to enforce BMPs. Such authority derives either from the agency's regulatory authority or its management responsibility for publicly owned or controlled land. MAAs will include (or reference) specific, acceptable BMPs and their means of implementation. Both the SWRCB and the RWQCBs may enter into MAAs. The SWRCB will develop MAAs, where appropriate, with State and federal agencies having statewide jurisdiction, such as the BLM or Cal/Trans. For example, the SWRCB has existing MAAs with the USFS and with the BOF and CDF. SWRCB MAAs will specify acceptable BMPs and how they will be implemented. Formal agreements between the SWRCB and other agencies pertaining to the prevention and abatement of NPS pollution will be referenced in RWQCB basin plans and will become the primary basis for RWQCB determination of compliance with State requirements. RWQCBs will seek agreements, where appropriate, with local agencies, such as cities and counties. For example, RWQCBs have existing MAAs with counties concerning regulation of on-site wastewater disposal systems. RWQCB MAAs may also reference BMPs that have been adopted into basin plans.

RWQCBs will generally refrain from imposing effluent requirements on dischargers who are implementing BMPs in accordance with a waiver of WDRs, an approved MAA, or other SWRCB or RWQCB formal action. Once the SWRCB or RWQCB has formally approved BMPs, they will become the primary mechanism for meeting water quality standards. While compliance with BMP requirements cannot excuse a violation of water quality standards, the RWQCBs may rely on their implementation of BMPs to demonstrate compliance with standards.

Implementation of BMPs will normally include: (1) specific site conditions; (2) monitoring to assure that practices are properly applied and are effective; (3) immediate mitigation of a problem where the practices are not effective (including regulatory action, if necessary); and (4) improvement of an approved BMP or implementation of additional BMPs when needed to resolve a deficiency.

RWQCBs have discretion in deciding what BMPs to encourage through conditional waiver of WDRs or inclusion in RWQCB MAAs. RWQCBs need not adopt BMPs into basin plans for these purposes but may do so to facilitate regionwide application. The SWRCB will encourage reasonable consistency among the RWQCBs in choosing BMPs by: (1) transferring information among RWQCBs on effective (or ineffective) practices; (2) reviewing amendments to basin plans; and (3) making determinations as the appeal agency for RWQCB decisions.

Tier Three: Effluent Limitations and Enforcement

RWQCBs can enforce requirements on any proposed or existing waste discharge, including NPS discharges. Although RWQCBs cannot specify the manner of compliance with waste discharge limitations (with certain exceptions), in appropriate cases the RWQCBs can set limitations at a level that, in practice, requires implementation of BMPs.

While many of the NPS Program activities support and promote self-determined implementation, the SWRCB and RWQCBs have a wide array of enforcement mechanisms at their disposal that also will be utilized. Enforcement actions may be considered to address many circumstances including, but not limited to, the following: (1) violation of an effluent limit, receiving water limit, or discharge prohibition contained in an order or basin plan adopted by the SWRCB or an RWQCB; (2) an

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unauthorized spill, leak, fill, or other discharge; and (3) failure to perform an action required by the SWRCB or an RWQCB, such as submittal of a self-monitoring or technical report or completion of a clean-up task by a specified deadline.

It is important to note that enforcement of State water quality statutes is not solely the purview of the SWRCB and RWQCBs and their staffs. State law allows members of the public to petition the SWRCB to review permitting and enforcement actions or inactions by the RWQCB. In addition, the CWC provides for public participation in the issuance of orders, policies, and WQCPs.

The SWRCB and RWQCBs have a variety of enforcement tools to use in response to noncompliance by dischargers. An enforcement action is any formal or informal action taken to address an incidence of actual or threatened noncompliance with existing regulations or provisions designed to protect water quality.

Formal Enforcement: Formal enforcement actions fall into two basic categories: those that direct future actions by dischargers and those that address past violations. Actions that generally direct future action include notices to comply, imposition of time schedules, and issuance of cease and desist orders (CDOs) and cleanup and abatement orders (CAOs). Actions taken to address past violations can also include CAOs, rescission of WDRs, administrative civil liability (ACL), and referral to the attorney general (AG) or district attorney (DA). In some instances, both types are used concurrently to deal with a specific violation (e.g., discharger has had past violations but has not yet corrected the problem).

Any person adversely affected by an action or failure to act by an RWQCB may petition the SWRCB to review the decision. The petition must be received by the SWRCB within 30 days of the RWQCB action or refusal to act or 60 days after a request has been made to the RWQCB to act. In addition, the SWRCB may review, at any time and on its own motion, any action or failure to act by an RWQCB, including planning actions.

Informal Enforcement: For minor violations, the first step is usually informal enforcement action. The discharger is informed of the specific violations and is provided information as to how and why the violations occurred and how and when the discharge must come back into compliance. This step can be deleted for significant violations, such as repeated or intentional illegal discharges and falsified reports.

The notice of violation (NOV) letter is also an informal enforcement action. The purpose of a NOV letter is to bring a violation to the discharger's attention and to give the discharger an opportunity to correct the violation before formal enforcement actions are taken. Continued noncompliance should trigger formal enforcement action. An NOV letter is signed by the RWQCB Executive Officer and covers the following points: (1) description of specific violations; (2) summary of applicable enforcement options (including maximum ACL); and (3) a request for a written response.

Time Schedule Order: Pursuant to CWC section 13300, actual or threatened discharges of waste in violation of requirements can result in imposition of a time schedule which sets forth the actions a discharger shall take to correct or prevent the violation.

Cease and Desist Orders: CDOs are adopted pursuant to CWC sections 13301-13303. They are normally issued to dischargers regulated by WDRs and often remain in force for years. CDOs are typically issued to regulate dischargers with chronic non-compliance problems. These problems are rarely amenable to a short-term solution. Often, compliance involves extensive capital improvements or operational changes. The CDO will usually set a compliance schedule, including interim deadlines (if appropriate), interim effluent limits (if appropriate), and a final compliance date. CDOs may also include restrictions on additional service connections (referred to as a "connection ban") to community sewer systems. These have been applied to sanitary sewer systems but can be applied to storm sewer systems as well. Violations of CDOs should trigger further enforcement in the form of an ACL or referral to the AG for injunctive relief or monetary remedies.

Cleanup and Abatement Orders (CAO): CAOs are adopted pursuant to CWC section 13304. They are generally issued to dischargers that are not being regulated by WDRs. With the exception of ground water cleanup, CAOs are typically short-lived enforcement orders. CAOs are issued through an RWQCB action or by the Executive Officer under delegation from the RWQCB Members pursuant to CWC section 13223. Executive Officer-issued CAOs should be used when speed is important, such as when a major spill or treatment plant upset has occurred and waiting until the RWQCB can meet to approve a CAO would be inappropriate. Violations of CAOs should trigger further enforcement in the form of an ACL or referral to the AG for injunctive relief or monetary remedies.

Prohibitions: Basin plans may set forth appropriate prohibitions for various categories of NPS pollution. In some cases, these prohibitions are written to allow application of the prohibition to be waived during planning and permitting of projects or activities covered by a water quality management plan. A prohibition allows an RWQCB to take direct and immediate enforcement action through issuance of CAOs, even in the absence of WDRs. Therefore, it allows RWQCBs to respond in a timely manner where NPS pollution generated by certain activities is creating an emergency or a problem which is not otherwise being remedied in an adequate or timely manner.

Modification or Rescission of Waste Discharge Requirements: In accordance with the provisions of the CWC, and in the case of NPDES permits, the RWQCB may modify or rescind WDRs in response to violations. Rescission of WDRs generally is not an appropriate enforcement response where the discharger is unable to prevent the discharge as in the case of a wastewater treatment plant.

Referrals to the Attorney General or District Attorney: The RWQCB can refer violations to the AG or ask the appropriate county DA to seek civil or criminal penalties. In either case, a Superior Court judge will be asked to impose civil or criminal penalties. In some cases, the RWQCB may find it appropriate to request the U.S. Attorney's Office to review potential violations of federal environmental statutes, including the CWA, Migratory Bird Treaty Act, or the Resource Conservation and Recovery Act (RCRA). Enforcement actions taken by the RWQCB are civil actions. In cases where there is reason to believe that specific individuals or entities have engaged in criminal conduct, the RWQCB or Executive Officer may request that the DA pursue criminal actions. Under criminal law, individual persons, as well as responsible parties in public agencies and business entities, may be subject to fines or imprisonment.

Administrative Civil Liability

ACL means monetary assessments imposed by an RWQCB. These actions are intended to address past violations. If the underlying problem has not been corrected, the ACL action should be accompanied by an RWQCB order to compel future work by the discharger (e.g., CAO or CDO). The CWC authorizes ACLs in several circumstances, summarized in Table 12:

TABLE 12. POTENTIAL MONETARY ASSESSMENTS IMPOSED BY AN RWQCB

CWC Section	Type of Violation
13261	Failure to furnish report of waste discharge or to pay required fees.
13265	Unauthorized discharge of waste.
13268	Failure to furnish technical report.
13308	Failure to comply with time schedule.
13350	Intentional or negligent violation of CDO or CAO; violation of WDRs; or RWQCB prohibition which results in pollution or unauthorized release of any petroleum product.
13385	Violation of NPDES Permit, Basin Plan Prohibition, etc.

A summary of the "three-tiered approach," including practical examples of its application in California, is presented in Table 13.

Implement TMDLs

The development and implementation of TMDLs for NPS impaired water bodies are expected to enhance our ability to address NPS problems, consistent with the three-tiered approach described above. Along with the TMDL, the State will develop implementation plans that describe specific measures needed to achieve the point and nonpoint allocations established by the TMDL. For point sources, the allocations will be implemented through NPDES permits while NPS allocations are implemented through a wider range of authorities and programs, including the use of applicable State enforcement authorities. Therefore, TMDLs are expected to promote the implementation of the appropriate MMs that will achieve timely water quality improvements that have not been achieved through the other approaches.

TMDLs will provide a more detailed approach to ensuring the implementation of the appropriate NPS MMs and will provide a better framework for "triggering" more stringent implementation. For example, TMDLs will (1) establish goals to judge the performance of management programs; (2) create the ability to better assess the effectiveness and appropriateness of MPs individually and collectively; (3) provide a basis for determining when to use more stringent management options (e.g., WDRs or other enforcement authorities); and (4) assist in prioritizing State's staff and financial resources when pursuing corrective actions.

Implement MMs in Regulation

NPDES – Storm Water

The two-phased program under CWA section 402(p) requires NPDES permits for storm water discharges. In California, the federal NPDES Program is administered by the SWRCB through the nine RWQCBs. Since 1990, Phase I regulations have required NPDES permits for storm water discharges for:

- Municipal separate storm sewer systems serving populations greater than 100,000,
- Specific industrial activities, and
- Construction activities disturbing land of five or more acres.

Phase I requires that individual NPDES permits be issued for municipalities greater than 100,000 (in practice, the RWQCBs include many municipalities in urbanized areas with populations less than 100,000 in the Phase I programs). Individual municipal NPDES permits require implementation of structural and nonstructural control measures to reduce pollutant loads from industrial, commercial, and residential areas. Implementation of the NPDES Phase II Program will expand the existing program to include all municipalities within urbanized areas and small municipalities outside of urbanized areas with a population of at least 10,000 and a population density of at least 1,000 persons per square mile. The program will also expand to include construction sites that disturb between one and five acres.

California's current and developing approaches to addressing urban runoff are and will be consistent with both the NPDES and NPS Programs. In the interest of consistency and comprehensiveness, the SWRCB and RWQCBs will ensure the implementation of urban MMs in areas and activities currently regulated by the NPDES Phase I Permit Program by incorporating the MMs into existing NPDES permits as the permits are renewed (at five-year intervals). Similarly, the SWRCB and RWQCBs will ensure that the NPDES Phase II permits will serve as the enforceable authorities to implement the urban MMs in areas and activities covered under Phase II. As lead agencies for the NPS Program, the SWRCB, RWQCBs, and CCC will ensure that all NPS MMs not covered by the NPDES Phase I or Phase II permits are implemented through other mechanisms identified within the NPS Program Plan.

TABLE 13. DESCRIPTION AND USE OF THE THREE-TIERED APPROACH

Tier	Description of Approach	Examples of the Three-Tiered Approach in Action
<u>Tier One</u>: Self-determined Implementation of Best Management Practices	Landowners and resource managers implement MMs/BMPs to achieve water quality standards. The RWQCBs may rely on implementation of MMs and BMPs to demonstrate compliance with, but cannot excuse violation of, water quality standards. Self-determined implementation is encouraged through incentives and technical assistance offered by State and federal programs that promote resource stewardship to achieve water quality benefits and to comply with statutory requirements. Agencies that provide such programs include the SWRCB, RWQCBs, DOC, NRCS, FSA, RCDs, and UCCE. Self-determined implementation is encouraged through the recognition by landowners and resource managers that this tier allows the discharger more "self-determination" in complying with statutory requirements than the more-stringent Tiers Two and Three.	• Financial support for local watershed stewardship projects (CWA §319) • EQIP cost-share for implementation • Sacramento Watershed Program fostering stewardship • Urban pesticide committee education efforts • Workshops promoting the Rangeland WQMP
<u>Tier Two</u>: Regulatory- Based Encouragement of Management Practices	There are two ways that RWQCBs can use their regulatory authorities provided by the Porter-Cologne Act to encourage implementation of MMs/MPs. First, RWQCBs may work with landowners and resource managers to waive the adoption of WDRs or a waste discharge prohibition on the condition that MMs and BMPs will be implemented to correct or prevent NPS pollutant(s) of concern. Second, the SWRCB and RWQCBs may enforce MMs and BMPs by entering into MAAs with other agencies that have authority to enforce the implementation of appropriate MMs and BMPs.	• MAAs with BOF/CDF, USFS, and CDPR • Marin County Stormwater Program (RWQCB-2) • Channel Islands National Park – improved grazing practices (RWQCB-3) • Required submittal of agricultural drainage operation plans (RWQCB-5) • Agricultural Nutrient Management Plans-Newport Bay (RWQCB-8)
<u>Tier Three</u> Effluent Limitations and Enforcement	RWQCBs can adopt and enforce requirements on any proposed or existing waste discharge, including discharges from NPSs. Although RWQCBs are generally precluded from specifying the manner of compliance with waste discharge limitations, in appropriate cases limitations may be set at a level which, in practice, requires implementation of MMs and BMPs. In addition, the SWRCB and RWQCBs have a variety of enforcement tools—such as CDOs and ACLs—that can be used in response to noncompliance.	• WDRs for commercial nurseries – Newport Bay (RWQCB-8) • WDR for selenium for San Joaquin River (RWQCB-5) • Permitted storm water programs • Erosion Control – Lake Tahoe (RWQCB-6) • WDRs for dairies

Provide Financial and Technical Assistance

Introduction

Strong stewardship by local stakeholders is critical to ensuring the successful implementation of the MMs identified in the five-year plans. Self-determined implementation can be encouraged through technical assistance provided by both State and local entities. A priority in the Implementation Plan is for the SWRCB and CCC to provide comprehensive technical assistance to local groups and landowners. The State will identify additional agencies and develop agreements (MOUs) to significantly increase the ease of acquiring and disseminating the most accurate and current information possible. A goal of the SWRCB and CCC is to provide each stakeholder with the information they require by coordinating efforts throughout the State.

Funding (Financial Assistance)

The Program will depend largely on funding received through the CWA section 319(h), State appropriations, and the contributions of other entities, including local governments, nongovernmental organizations, and private individuals. Unless additional funds are made available, it is possible that some of the activities contained within this Program Plan will not be completed as proposed. It is anticipated that implementation difficulties related to funding limitations will be identified and addressed as provided for through periodic program reviews.

Available Program funding will be directed at supporting activities that implement the MMs as identified in CAMMPR. Projects and staff positions at the SWRCB and RWQCBs funded under the CWA section 319(h) must support the implementation of MMs. This change will be included in the next CWA section 319(h) grant cycle (FFY 2000).

Federal Funding

USEPA provides annual funding to the SWRCB for implementation of the NPS program, pursuant to the CWA section 319. Since section 319 was established by the reauthorization of the CWA in 1987, California has received over $40 million to support the State's NPS program. In 1999, the federal allocation to support State NPS programs under CWA section 319(h) was significantly increased in recognition that many of the most serious remaining water quality problems are associated with NPS pollution. California's CWA section 319(h) funding level was increased from $5.7 million in 1998 to $10.3 million in 1999.

In California, the CWA section 319(h) funds have generally been divided between supporting State staff activities at the RWQCBs and the SWRCB and funding NPS implementation projects. As the lead water quality agency in California, the SWRCB receives the CWA section 319(h) funding from USEPA through a cooperative agreement. The SWRCB and the RWQCBs prepare annual workplans for USEPA approval to specify the activities that will be supported through these CWA section 319(h) funds. CWA section 319(h) funding is primarily for implementation activities; therefore, at least 80 percent of all CWA section 319(h) funds must be spent on implementation, while no more than 20 percent may be allocated to planning and program development activities.

NPS projects have been selected based on a competitive process administered by the SWRCB and RWQCBs. Generally, an annual Request for Proposals (RFP) is issued for projects that will reduce or prevent NPS pollution to ground and surface waters. Eligible projects include the implementation of MPs, TMDL implementation, technology transfer, demonstration projects, pollution prevention, technical assistance, volunteer monitoring, and public education. Nonprofit organizations, local government agencies, including special districts (e.g., RCDs or water districts), and educational institutions are the recipients of these funds.

Another important source of funding for NPS projects is the SRF. The SRF is a low interest loan program established by the CWA to fund a wide range of water quality projects, including the same types of projects that are eligible for section 319(h) funding. Traditionally, the SRF and its predecessor, the Clean Water Grant Program, have been used to fund publicly-owned treatment works (POTWs) for sanitary sewer systems. However, the amendments to the CWA that established the SRF allowed for expanded uses of the SRF beyond the traditional POTW project. Capitalization for the SRF comes from an annual federal appropriation, 20 percent of State matching funds and loan repayments that revolve back into the SRF. Current assets (loans and cash) in California exceed $1 billion. The utilization of these assets offers one of the best avenues for funding the implementation of NPS MMs and related watershed implementation efforts.

To date, California has been a national leader in using the SRF to fund a wide variety of expanded use projects. Examples of types of expanded use projects that have been funded include:

- Stream restoration,
- Irrigated agricultural BMPs (improved methods of irrigation to reduce salt and selenium loads to the receiving water),
- Animal feeding operation BMPs (on-site improvements at small dairies that do not meet the USEPA definition of a point source),
- A vineyard to demonstrate BMPs and sustainable viticulture,
- Forestry BMPs (removal of dead and dying trees in the Lake Tahoe Basin),
- On-site septic system rehabilitation,
- Storm water treatment (including wetlands treatment),
- Wetlands preservation,

- Marina education and improvements,
- Water quality enhancements to flood control, and
- Estuary enhancement.

Using the fund to address all types of water quality issues regardless of whether it is a POTW, NPS, etc., is beneficial. In so doing, the SRF will help to foster the watershed approach. The SWRCB (who administers the SRF) is currently developing a formal policy regarding the funding of expanded use projects, including NPS projects. Once this policy is adopted, the expanded use projects will be given appropriate consideration in comparison to the traditional POTW projects.

State Funding

State funds have been earmarked for NPS Program development and implementation. These funds support SWRCB staff to develop MMs, the Strategy, and the Implementation Plan; develop and oversee formal agreements and informal partnerships; provide technical assistance; and provide public participation, education, and outreach. Additional funds are earmarked to develop and implement a program to track the effectiveness of MMs.

Currently, State monies fund NPS pollution prevention and reduction efforts at the SWRCB and RWQCBs in four of the six management categories: agriculture, forestry, hydromodification, and wetlands/riparian areas. Through State General Funds, the SWRCB and the RWQCBs update and revise basin plans regarding the effects of subsurface agricultural drainage on the State's waters. Staff also review forestry activities to ensure control of NPS pollution. Primary activities include: (1) the review of timber harvest plans, (2) consultation with federal agencies on silviculture, mining and grazing on forest lands, (3) evaluation of corrective actions, (4) development of water quality criteria and guidelines for treatment and disposal, (5) regulatory actions, (6) laboratory quality assurance, and (7) coordination of data management. The SWRCB and the RWQCBs administer the water quality certification program authorized through the CWA section 401. CWA section 401 requires that any applicant for a federal license or permit to conduct any activity which may result in a discharge to navigable waters obtain a certification from the State that the discharge will comply with the applicable provisions of CWA sections 1311, 1312, 1313, 1316, and 1317 (essentially State water quality standards). Generally speaking, CWA section 401 applies to dredge and/or fill permits issued by the USACOE, pursuant to CWA section 404 or hydropower generation facility licenses issued by the FERC.

Starting in 1999, the baseline allocation of the SWRCB has been augmented by $3.9 million to develop TMDLs, a necessary first step in reducing NPS pollution in impaired watersheds. While these funds will not support implementation of TMDLs, SWRCB and RWQCB staffs will participate in stewardship groups and assist community-based watershed monitoring programs.

Funds are also provided to on-the-ground pollution prevention and reduction activities through two funding sources: the Delta Tributary Watershed Program and the Agricultural Drainage Management Program (ADMP) authorized under Proposition 204. The Delta Tributary Watershed Program was awarded, on a one-time basis, $14.5 million for rehabilitation projects in the watersheds tributary to the Sacramento-San Joaquin Rivers Delta or the Trinity River. Most of these projects will begin in 1999 or early 2000. Of the $30 million set aside for the ADMP, $27.5 million was for low interest loans and $2.5 million was for the nonfederal share of a project specific to the Salton Sea. The loan fund can be used for the treatment, storage, conveyance, reduction, or disposal of agricultural drainage water that if discharged untreated would pollute California's waters.

Request for Proposals

Each year the SWRCB and USEPA release RFPs for watershed planning and implementation projects to reduce, eliminate, or prevent water pollution and to enhance water quality. The RFP contains information concerning project requirements, anticipated funding levels, the review process, and selection criteria, and an application form is included that serves as the proposal. Funds made available are typically offered under the authority of Federal CWA section 205(j) Water Quality Planning and Assessment or CWA section 319(h) NPS Implementation Programs. However, in 1997 and 1998, the SWRCB offered $15 million made available through Proposition 204, the 1996 Bond Act.

The SWRCB and RWQCBs view the funding of projects consistent with priorities identified in the RFPs as an important tool in managing NPS pollution. Beginning with the calendar year 2000, RFP projects must implement actions that achieve NPS MMs goals and objectives to receive funding.

The funds contracted out under the RFPs represent half of the federal NPS funds California receives. The Program recognized several years ago the need to better track and evaluate the effectiveness of these projects. Working with UCD ICE, the State is working (1) to promote information exchange and coordination among watershed groups; (2) to geographically track the implementation of MMs; and (3) to determine the effectiveness of CWA section 205(j) and 319(h) projects in protecting beneficial uses and improving water quality. Effective with the 1999 RFP, all selected projects' contractors must complete a one page contract summary (format provided by SWRCB) within three months of the contract execution. The SWRCB will make the summaries available to the public, including posting them on the SWRCB's

NPS web site. At the completion of each funded project prior to final payment, all projects must complete a project survey form supplied by the SWRCB. At the same time, SWRCB and RWQCB staffs may survey project location and aerial extent using global position equipment. The information gathered will be entered into an internet-accessible geographic information system (GIS) and be provided as part of the required annual, biennial, and five-year cycle reports. In addition, information concerning each CWA section 319(h) funded project is being entered into a USEPA mandated tracking system known as the Grants Reporting and Tracking System (GRTS) to further aid in fiscal management, accountability, and the exchange of information.

Through these RFPs, the SWRCB, RWQCBs, and USEPA, Region 9, are encouraging watershed management as a means to ensure high quality waters, maximize the use of limited resources, and develop partnerships among all stakeholders of watersheds to address water quality issues. In this respect, grants offered through RFPs are being integrated under the SWRCB's and RWQCB's WMI to ensure the most efficient use of the funds. Local stewardship and partnerships among governmental agencies and private interests are vital parts of the type of watershed management envisioned. Involvement of stakeholders throughout a watershed is a critical feature of watershed management that will provide for sustained, long-term improvements in the beneficial uses of water and water quality. Implementation activities identified in a watershed management plan or similar comprehensive efforts to achieve sustained improvements in water quality and natural resources are a priority. CWA section 205(j) provides water quality planning funds, and CWA section 319(h) provides NPS implementation funds. The funds provided via RFPs are not intended to be used as the sole or principal source of support for local resource management.

Other Agencies Sources

Collaboration with the MBNMS

The CCC and MBNMS WQPP are working to develop coordinated grants among numerous nonprofit organizations improving water quality and restoration. This coordination of funding is intended to help nonprofit organizations obtain grant assistance, coordinate the expertise of the numerous groups working on NPS pollution, and identify a regional framework to guide future projects.

Technical Assistance

Introduction

The SWRCB, RWQCBs, and CCC recognize that individuals, watershed groups, and communities have varying levels of technical and financial capabilities related to water quality protection and restoration and the protection of beneficial uses. In particular, the level of expertise available at the local and/or watershed level during project planning, design, and implementation can have a significant effect on the time and effort needed to implement practices to address NPS pollution. Technical and financial assistance is needed for those who plan and manage resources (e.g., planners, forest managers, public works staff, harbor masters, watershed groups) and those whose activities alter the landscape or affect the water column (e.g., farmers, road builders, boat hull cleaners).

Types of technical assistance include MP manuals, training, assistance in developing ordinances and regulations, modeling to predict and assess the effectiveness of any additional NPS MMs, and the development and management of databases to track implementation of MMs, monitoring data, and land use changes. Technical assistance also includes demonstration projects and other innovations to protect water quality and designated uses. Financial assistance includes both grants and low-interest loans.

Goals

A priority goal of the NPS Program is to provide technical and financial assistance to local governments and the public in assessing watershed conditions and implementing applicable MMs to address identified problems. The NPS management agencies will also work with other federal, State, and local agencies, as well as other private experts where feasible, and will encourage them to use their expertise. Specific objectives include:

- Conducting an ongoing assessment of training and technical and financial assistance needs;
- Providing for the transfer of information on technical and financial assistance including available tools, training courses, grant and loan opportunities, and contact information;
- Improving technical tools;
- Providing technical training for resource managers, landowners and land operators, and the public; and
- Providing financial assistance for on-the-ground implementation of MMs and MPs for each land use sector (i.e., agriculture, forestry, urban, marinas, hydromodification, and wetlands).

The NPS Program will also support technical and financial assistance efforts within other agencies. Examples of existing technical assistance efforts include:

- UCCE and NRCS currently provide technical assistance to the livestock industry and rangeland owners and managers through the California Rangeland Water Quality Management Program (CRWQMP);
- The California Stormwater Quality Task Force (SWQTF) provides assistance to municipal agencies and other dischargers subject to existing storm water permits, while the MURP has been developed to help smaller

municipalities (less than 100,000 in population) develop runoff control programs to protect water quality and prepare for pending storm water permits;

- The MURP has been developed to help smaller municipalities (less than 100,000 in population) develop runoff control programs to protect water quality and prepare for pending storm water permits;
- The CCBN and San Diego Safe Boating and Environment Coalition are devoted to identifying education and technical assistance needs regarding environmentally sound boating and to providing networking opportunities;
- The SWRCB TMDL Program is focusing technical assistance efforts on assessing water conditions and, to the maximum extent practicable, on working with local interests on the collaborative identification of: (1) watershed problems, (2) desired future conditions, (3) numeric targets, (4) allocations of allowable pollution, and (5) implementation.
- The CCC is committed to make available and provide training for use of its Watershed Analysis Tool for Environmental Review (WATER). WATER is a GIS-based analysis tool that connects land use information to water quality in watersheds of the Monterey Bay area, and thus enabling selection of the appropriate MMs for implementation in those particular watersheds. The CCC's permit tracking system also provides a valuable tool for tracking land use activities.
- The NPS Program's future efforts in identifying and mapping CCAs will allow the implementing agencies to direct their resources to coastal areas faced with water quality threats that accompany new and existing development.

Actions

The SWRCB, RWQCBs, and CCC are committed to providing technical and financial assistance through 2013. New and changing needs and opportunities will be identified annually and outlined in each five-year implementation plan. Beginning in State FY 1999-2000, the SWRCB and RWQCBs will provide CWA section 319(h) grants for projects that implement NPS MMs and/or provide for watershed restoration. In State FY 1999-2000, the CCC approved $500,000 in local assistance grants to LCP work programs for eight coastal cities and counties, all of which include NPS requirements or guidelines.

In the short term, the SWRCB has identified the provision of technical assistance as a priority objective in the 1999 CWA section 319(h) RFP. The CCC identified technical and financial assistance as a priority for the State FY 1999-2000 CZMA grants workplan (the CCC is providing funding for projects that develop technical assistance tools, such as technical guidance and model ordinances). The SWRCB and USEPA are also investigating using the Clean Water SRF—a permanent source of low-interest funding for high-priority water quality projects—for addressing a variety of other NPS and estuary water quality issues. Other actions are identified in the Implementation Plan.

G. Track, Monitor, Assess, and Report

The NPS Program must establish mechanisms to determine success in achieving short- and long-term goals. We must:

- Track MM implementation,
- Monitor the program's effectiveness in controlling pollution,
- Assess success in achieving our objectives and milestones, and
- Report on program effectiveness.

Our efforts to demonstrate program effectiveness are guided by existing federal and State requirements. Section 319(b) of the CWA specifies the minimum contents of State NPS management programs including "*(viii) A description of the monitoring and other evaluation programs that the State will conduct to help determine short- and long-term program effectiveness.*" Federal guidance also requires the states to periodically review and evaluate NPS management programs using environmental and functional measures of success and to revise NPS assessment and management programs at least every five years[15]. Section 6217 of CZARA requires monitoring techniques to evaluate the success of the MMs in reducing pollution loads and improving water quality.[16] A monitoring program will also help fulfill the legislative mandate of the Comprehensive Coastal Monitoring Strategy required by Assembly Bill (AB) 1429. It stated, in part: "Sound water quality management decisions require a solid base of information collected from a variety of sources … improved monitoring, or in some cases improved coordination of existing programs, will be necessary for the State of California to achieve a systematic understanding of NPS pollution and to measure the effect of efforts to reduce this water pollution source."

A comprehensive monitoring strategy for the NPS program will soon be complete. This strategy will be designed to provide objective, quantified answers to broad management questions. These questions are then refined into more discrete monitoring objectives that will shape the design of specific monitoring programs. The monitoring strategy will focus primarily on answering the first two questions posed below while coordinating with other monitoring programs to effectively answer all questions.

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[15] In 1996, USEPA released a CWA section 319(h) guidance document requiring states to upgrade their NPS programs consistent with nine key elements in order to achieve "*Enhanced Benefit Status.*" In a January 1999 memorandum, J. Charles Fox, USEPA Assistant Administrator, reiterated the requirement and outlined the process for approval of upgraded NPS Programs.

[16] NOAA and USEPA in accordance with these statutory mandates provide additional specifics for the monitoring and tracking of MMs in their January 1993 Coastal Nonpoint Pollution Control Program – Program Development and Approval Guidance.

1. *Are MPs to reduce polluted runoff being implemented (Tracking or Implementation Monitoring[17])?* Our efforts will focus on tracking MM implementation and determine whether practices are implemented in accordance with relevant standards and specifications.

2. *Are the MPs effective in avoiding or minimizing pollution generation (Effectiveness Monitoring[18], Compliance Monitoring[19])?* We will develop a monitoring strategy that measures the effectiveness of MPs for agriculture, forestry, urban sources, and marinas.

3. *Is water quality being protected and are narrative and numerical water quality criteria being achieved (Baseline Monitoring[20], Compliance Monitoring)?* We will coordinate with ongoing regional monitoring efforts and point-source compliance monitoring to identify impairments and determine the extent, causes, and sources of impairment.

4. *Is reasonable progress being made toward reducing NPS polluted runoff?* We will review tracking and monitoring information through external review committees and TACs and assess the state of the Program.

Implementation of the MMs through MPs can be considered a "technology-based" approach to NPS pollution control. Application of MPs will reduce NPS pollutant loadings and improve water quality. As such, tracking the extent of MM implementation (and the associated MPs) will provide the initial measure of NPS Program success. Due to the areal extent and scale of NPS problems, improvements in water quality will take time. Ultimately, however, the long-term success of the NPS Program must be measured by corresponding improvements in water quality. This water quality-based approach to assessing success will be accomplished through the SWRCB's development of a comprehensive surface water quality program, to the extent that funds are available, by January 1, 2001, pursuant to section 13181(c)(1) of the Porter-Cologne Act. The comprehensive water quality program will address, among other issues, the following:

- To the extent possible, a determination regarding the extent to which existing water quality objectives are being met;
- To the extent possible, a determination regarding the sources of pollution in areas where objectives, standards, and guidelines are not being met; and
- Methods for determining the degree of improvement or degradation in coastal water quality over time.

[17] Implementation monitoring assesses whether activities were carried out as planned. It does not necessarily include water quality measurements. Our efforts to track whether BMPs were performed follow under this type of monitoring.

[18] Effective monitoring evaluates whether the specified activities (e.g., individual management practices, timber sale, construction project) had the desired effect. Monitoring definitions are described further in USEPA (1991).

[19] Compliance monitoring evaluates whether a water quality standard is being met.

[20] Baseline monitoring characterizes existing water quality conditions and establishes a database for planning or future comparisons. Continued baseline monitoring may become trend monitoring.

Prior to development of the comprehensive monitoring program, the SWRCB will, pursuant to section 13192 of the Porter-Cologne Act, on or before November 30, 2000, assess and report on the SWRCB's and RWQCBs' current surface water quality monitoring programs. Important elements to be considered in this report include, but are not limited to, the following:

- The physical, chemical, biological, and other parameters that a comprehensive water quality monitoring program should collect and evaluate in order to determine ambient water quality; and
- A strategy for assessing and characterizing discharges from NPS pollution.

In addition, the SWRCB, pursuant to Porter-Cologne Act section 13181(b)(1), will prepare and complete an inventory of existing water quality and monitoring activities within State coastal watersheds, bays, estuaries, and coastal waters, by January 1, 2000, to the extent that funds are available for this purpose.

Tracking Management Measure Implementation

Tracking MM implementation is the simpler, more straightforward component of the monitoring strategy. The MMs are directly implemented on ground via MPs. MPs are implemented by the landowner or user because of their stewardship approach to land use; it makes business sense; or it is in response to regulatory pressures or requirements, such as to meet waste discharge or other permit requirements.

This tracking program will be broad-based and inclusive of all MM categories and water bodies in California. A tracking program is currently being designed to identify:

- What MMs are implemented,
- Where MMs are implemented,
- Who is implementing them,
- When they are implemented,
- Why they are being implemented (e.g., because of self-interest, regulatory-encouragement, or regulation), and
- Which agencies and programs are supporting implementation?

The tracking program will also include specific performance measures and goals that can be used at the end of the five-year period to determine the scope and extent of MM implementation. Combined with the effectiveness monitoring (described below), it will allow us to gauge the success of program implementation efforts. An example of a performance measure would be "the number of approved farm plans which implement relevant agricultural measures." Examples of performance goals would be (1) "to have in place approved farm plans for 80 percent of the farms in each watershed" or (2) "implement agricultural MMs or MPs on 80 percent of farm lands in each watershed." The five-year review will be comprehensive in scope, addressing all of the measures and broken out on a watershed basis, to the extent possible. The measures and goals will be developed through an interagency effort which will include public involvement, such as the IACC and the Assessment TAC.

The State recognized several years ago the need to better track and evaluate the effectiveness of these projects. Through contracts with UCD ICE, the State is working to: (1) promote information exchange and coordination among watershed groups; (2) geographically track the implementation of MMs; and (3) determine the effectiveness of CWA sections 205(j) and 319(h) projects in protecting beneficial uses and improving water quality. All selected projects must complete a one-page contract summary which the SWRCB will make available to the public. At the completion of each funded project, all projects must complete a project survey form and agency staff may survey the project location and determine the aerial extent of MM implementation. The information gathered will be entered into an internet-accessible GIS and be provided as part of the required annual, biennial, and five-year cycle reports.

This MM information will augment information already collected for watershed projects in California. Data on the over 1,000 conservation, mitigation, and restoration projects being developed and implemented throughout California resides on-line in the Natural Resource Project Inventory (NRPI). NRPI is a cooperative data-collection effort of environmental scientists at the UCD-ICE and over 30 private, State, federal, and international organizations interested in environmental protection[21]. The goal of NRPI is to make project and group information accessible to anyone who wants to review current activities in their region or statewide.

NRPI is an expansion of previous inventories such as the California Watershed Projects Inventory (CWPI) supported by the USEPA, the SWRCB, and Cal/RA and the California Ecological Restoration Projects Inventory (CERPI) supported by the USEPA, the Society for Ecological Restoration, and DOC. NRPI also integrates newer efforts, such as the Biological Resource Division's Mendocino Coast Metadata Inventory and the California Interagency Noxious Weeds Coordinating Committee's Noxious Weeds Projects Inventory. Environmental planning activities and agreements such as Habitat Conservation Plans, Natural Community Conservation Plans, and other resource-based plans will also be candidates for the NRPI database[22]. Beginning with the 1998 CWA sections 205 (j) and 319 (h) grant projects, all project contractors are now required, prior to final payment, to complete a post-project survey form that the SWRCB will provide to ICE for inclusion in NRPI.

[21] NRPI is supported by the CBC whose 37 members include nine regional associations of county supervisors, 15 State agencies, UC, and the CARCD. Each of these members has designated one expert to bring in data from his or her respective agency. This information is then entered into the NRPI database/web page designed and hosted by the ICE. Participation by the CBC signatories is augmented by a growing list of data contributors including UCCE, the CRMP Council, and the Klamath Watershed Coordination Group.

[22] The NRPI structure will allow core searches of all underlying inventories at the same time. Each NRPI record points to the separate underlying inventory for more detailed information. The inventories also exist separately and can be searched independently. Each dataset will also be referenced spatially in a GIS, allowing the creation of dynamic maps of projects, groups, and datasets.

Because of ICE's long history of developing and applying natural resource science to environmental issues, computer resource infrastructure, and the synergistic effect of so many participating agencies, the SWRCB has committed to use NRPI as the primary means to track implementation of MMs. In the spring of 1999, the SWRCB executed a contract with ICE to modify NRPI's data structure and to redesign the reporting form used to inventory projects to capture information specific to the implementation of the MMs and to further populate the database. Information collected from all participating entities will include such items as implementing programs, authorities, MMs, and graphic coordinates. Modifications will also include a link to the SWRCB's GeoWBS which contains the CWA section 303(d) Impaired Water Body List.

Besides the NRPI, the CCC also has a system for tracking permitted land use activities. Currently, there is a wetland-specific component contained in the more general Permit Tracking System. The CCC is prepared to develop similar runoff-specific tracking elements to allow for the tracking of MM implementation for preventing and controlling NPS pollution.

Monitoring the Effectiveness of Management Practices

With the tracking system underway, the next component of the monitoring strategy is documenting and evaluating the effectiveness of the NPS pollution control practices. Establishing the effectiveness of the State's efforts to control NPS pollution will be a long-term, complicated, and expensive commitment for the following reasons:

- Nature of the NPSs of pollution are typically diffuse and difficult to define.
- NPS pollutants are varied and include sediment, nutrients, pathogens, salts, toxic substances, petroleum products, and pesticides.
- NPS pollution is extensive and spread over the entire State (155,000 square miles) and is not limited to specific outfalls. There are over 4,000 water bodies listed in the SWRCB's GeoWBS, of which 480 are listed as impaired.
- Watersheds are complex, and multiple sources within a watershed may contribute to the same pollutant.
- There is usually a substantial lag time between implementation of MPs and response in the watershed.
- The need for water quality monitoring, both qualitative and quantitative, is extensive.
- There are limited resources for water quality assessment.
- Regulatory authority is complex. Over 31 State agencies have NPS regulatory authorities and programs.

However, determining MM effectiveness is critical to understanding how MPs avoid pollution generation and improve water quality. The lead agencies are currently designing this component of the monitoring strategy. In the spring of 1999, the SWRCB executed a contract with UCD to develop a comprehensive monitoring program to assess the functioning of MPs. The comprehensive monitoring program will:

- Establish criteria to assess the functioning of MPs;
- Monitor practices in each major pollution source category (i.e., agriculture, forestry, urban sources, marinas, and hydromodification);
- Monitor long-term at least one watershed within the jurisdiction of each of the nine RWQCBs;
- Integrate NPS monitoring with other monitoring programs, including citizen monitoring programs; and
- Report monitoring information to all interested parties.

The Program Plan's monitoring will focus primarily on the on-site evaluation of MP effectiveness and their ability to avoid pollution generation. Pollution control success criteria will be developed for each major pollution source category (i.e., agriculture, forestry, urban sources, marinas, and hydromodification). These criteria will be grounded in simple, empirical observations of the effectiveness of MMs performed by landowners or community members. UCD will review potential indicators and develop a preliminary list of criteria. These criteria will be reviewed by panels of agency, industry, and community members. A suite of candidate measures will be tested in the field during the pilot phase of the monitoring program (year 2000). This pilot phase, called the Functioning Assessment Criteria Test (FACT), will be implemented by UCD with the support of community volunteers, landowners, and qualified monitoring experts. From FACT's success we will develop a broader effectiveness-monitoring program that will evaluate all MM sectors by the year 2013.

The RWQCBs are currently targeting two impaired water bodies per year in each region for developing TMDLs. Following TMDL development and adoption into the basin plan, the RWQCBs will begin TMDL implementation. We will target our NPS monitoring in those watersheds where NPS pollution is a significant contributor to water quality impairment. Monitoring will need to continue in these watersheds over many years to accurately document changes in pollutant loads and the effectiveness of MPs. The lead agencies will work with other agencies, key stakeholders, and citizen monitoring programs to craft a long-term monitoring strategy. At a minimum, the strategy should be designed to implement base-line monitoring one watershed per region per year for ten years.

Various effectiveness-monitoring programs are ongoing and will be evaluated during the pilot phase (FACT) so that the most beneficial comprehensive strategy can be developed. Furthermore, these monitoring programs will be augmented rather than replaced. This is particularly true in the forestry arena where the proper implementation and effectiveness of forestry MPs is being evaluated by the Monitoring Study Group (MSG). This MSG was created by the California BOF to determine how effective the Forest Practice Rules (FPR) are in protecting water quality. The CDF implemented hillslope monitoring in 1996 on 50 randomly selected Timber Harvesting Plans (THPs) in Humboldt and Mendocino Counties to provide information on forest practices within the range of Coho salmon. The program expanded in 1997 and 1998 to evaluate THPs throughout the State. Evaluation of 150 THPs occurred in areas with the greatest risk to water quality—roads, skid trails, landings, watercourse crossings, and watercourse and lake protection zones (WLPZs). In total, approximately 150 FPR requirements were evaluated. From this monitoring study, forestry regulators will determine whether erosion problems on hillslopes were due to improperly implemented FPRs or the inadequacy of the FPRs.

In the agricultural arena, the Dairy Quality Assurance Project has developed a method for measuring the effectiveness of dairy nutrient MPs. The crux of the method is dairy inspections by certified third party inspectors. The method of inspections is under development and will be assessed for possible use in evaluating other MMs.

Since our effectiveness monitoring will focus primarily on the on-site evaluation of MPs, we must coordinate with other monitoring programs to ensure an accurate assessment of the effects of NPS pollution on aquatic resources. A blend of monitoring programs to achieve multiple objectives will be the most effective long-term monitoring strategy. This blending of objectives can only occur through active program coordination. First, a subcommittee of the IACC will focus on assessment to improve interagency coordination of monitoring programs. Second, the SWRCB and RWQCB staffs will continue intra-agency coordination through the Monitoring and Assessment Team. Third, SWRCB and RWQCB staffs will continue to work on existing monitoring programs such as: (1) the Comprehensive Coastal Monitoring Strategy; (2) CALFED's Comprehensive Monitoring, Assessment, and Research program on the San Francisco Bay-Delta; (3) the Regional Monitoring Program of the San Francisco Bay; (4) the Central Coast Regional Monitoring Program; (5) the Sacramento River Toxic Pollutant Control Program; (6) the Southern California Bight Program; (7) U.S. Geological Survey's (USGS) National Water Quality Assessment Program (NAWQA); and (8) USGS's National Irrigation Water Quality Program.

An example of specific questions being posed for State monitoring include measuring the effectiveness of MPs to reduce contamination of surface and ground waters by synthetic pesticides and fertilizers. The State will work with CDPR, U.S. Department of Agriculture (USDA) (NRCS, USFS, FSA, and RCD), the agricultural community, agricultural producers, researchers, and other public interests to design a set of trials to compare movement of nutrients and pesticides both before and after implementation.

Because of the emphasis in the NPS Program on self-determined pollution prevention, landowners, farmers, ranchers, boat owners, and community members will often monitor the effectiveness of their own practices, interpret the results, and, if necessary, modify their practices. In the next 15 years, SWRCB and RWQCB staffs will improve community-based watershed monitoring efforts by: (1) developing and reviewing new methods for monitoring MM implementation and effectiveness; (2) disseminating quality assurance requirements; and (3) increasing training opportunities. Technical resources will be developed and distributed statewide. These include standard monitoring protocols, quality assurance plans, guidance on how to start a community-based monitoring program, and data storage and retrieval mechanisms. Monitoring protocols will be designed to evaluate MP effectiveness and optimize data comparability between watersheds. However, efforts will be made to tailor protocols to stakeholder needs and geographical diversity. Guidance on quality assurance will identify the data quality needs of important programs such as TMDLs. Training in monitoring design, monitoring techniques, data interpretation, quality assurance, and database management will continue. The SWRCB and RWQCB staffs will continue to support regional steering committees that foster partnerships among local, State, and federal governments and business, industry, and volunteer groups. If funding permits, the SWRCB will develop a statewide small grants program to support volunteer monitoring efforts.

The SWRCB and RWQCBs will work to resolve concerns about confidentiality of data collected voluntarily by landowners on their own practices. Sharing data will be beneficial in transferring knowledge about the success of certain practices. However, landowners may fear that regulators may use data to require additional monitoring or permit MPs. These concerns should be aired and addressed through discussions with agency staff, landowners, and appropriate industry representatives. Hopefully, successful solutions, such as the third party inspections developed in the Dairy Quality Assurance Project, can be achieved.

Resource needs identified by this work will form the basis for future resource requests to the State. SWRCB and RWQCB resources are inadequate for statewide comprehensive water quality monitoring. SWRCB is working to procure funding for those currently unfunded monitoring and assessment activities that are of central importance to the SWRCB's programs. The funding strategy will seek to fund key activities that meet multiple program mandates. This selection of the activities to be funded is based on overlapping needs for data that can best be addressed by an integrated monitoring and assessment effort. One of the key activities identified by management is to develop a compliance-monitoring program for NPS pollutants. We will seek a broad base of funding support from federal, State, and local government sources.

Assessing Internal Program

Evaluating the success of the NPS Program will include the elements of tracking and monitoring noted above. However, it will also include a systematic evaluation of whether we have achieved the short- and long-term goals of the program. To do this, staffs from the SWRCB, CCC, and other agencies will participate in the Assessment TAC to conduct biennial reviews and report on issues such as:

1. Completion of the activities identified in the five-year implementation plans and the attainment of their associated performance measures;
2. Performance of the system(s) (e.g., NRPI and the CCC's permit tracking system) used to track the implementation of MMs;
3. Effectiveness of the implemented MMs;
4. Involvement of the appropriate federal and State agencies in implementing the Program Plan and the mechanisms of agency participation (e.g., MOUs/MAAs [see Table 10]);
5. Public participation;
6. Coordination of agency and public activities via the IACC;
7. Identification of additional needs for public education and technical assistance;

8. Evaluation of the overall program performance and the program's ability to stay on schedule for full implementation of all identified MMs by 2013; and
9. Recommendations for program improvement.

In addition, the biennial review/workshop will discuss funding for implementation of the Program Plan. Issues to be discussed will include, but are not limited to, the following: (1) significant funding needs integral to the success of the Program Plan; (2) an analysis of funding mechanisms that can be used to continue needed MM development and research; (3) monitoring activities; and (4) long-term funding such as CWA section 319(h) grants, the State budget process, and statewide initiatives.

Reporting Program Effectiveness

The monitoring data will need to be routinely interpreted, assessed, and reported to the community of resource managers, landowners, farmers, ranchers, industry, and environmentalists who are interested in NPS pollution prevention. In this way, the reviewing audience can use the information on effectiveness of MMs to redesign and retest those practices.

Three separate reporting efforts are integral to the NPS Program. First, SWRCB and the CCC will provide biennial reports of its progress in meeting its objectives and performance measures. These reports will assess program success and recommend modifications to MMs and their implementation. These reports will be available to the public, implementing agencies, the Legislature, USEPA, and NOAA. Second, the SWRCB and RWQCBs provide a performance report semi-annually to USEPA. This performance report covers NPS activities funded by CWA section 319(h) funds. The report lists major accomplishments, describes progress towards future accomplishments, and accounts for tasks that are behind schedule. The third report is the annual progress report on NPS programs and projects funded by CWA section 319(h). This report, authored by SWRCB and RWQCBs, focuses on the progress made in meeting milestones identified in the annual CWA section 319(h) workplan.

The State will improve the on-line inventories of watershed projects (e.g., NRPI, CWPI) and monitoring programs. Efforts will ensure that the NPS monitoring program data are integrated into the comprehensive, user-friendly water quality database system called "System for Water Information Management" (SWIM) that is being developed by the SWRCB. The ultimate goal of SWIM is an on-line accessible database of real monitoring results. These data will be accessible for public and agency use and will enable participants to have equal use of data in developing comments and revising strategies.

H. Overall Program Assessment - Refining the Program

Making the Program information available for external review not only bestows a certain degree of credibility to the Program, it also enables public participation in the periodic assessment and refinement processes. Public involvement is encouraged through the Assessment TAC created by the IACC. The Assessment TAC will then cooperate with the other TACs (Technical Assistance, Education, and Regulation) to propose modifications to the NPS Program which may include:

- Shifts in Program efforts (e.g., additional target watersheds and additional MMs),
- Strengthening individual NPS-related programs (e.g., expediting MM implementation and increasing enforcement, when appropriate),
- Improving agency coordination,
- Increasing public education and participation, and
- Increasing funding.

Modifying and Adding Additional Management Measures

One of the biggest challenges facing the NPS Program is providing for the implementation of "additional MMs" where water quality is impaired or threatened even after the implementation of California's MM goals. It is important for California to identify waters that are not attaining or maintaining applicable water quality standards and to identify and develop additional MMs to address persistent water quality problems.

Goals

Our overall goal is to develop a continuing process for identifying and implementing additional MMs that include milestones for implementation, evaluation, and, as necessary, revision. These additional MMs will be developed when needed to attain and maintain water quality standards.

New Management Measures

In developing the Program Plan, California identified the following additional MMs:

- Education MMs for Agriculture, Forestry, Hydromodification, and Wetlands. California added Education/Outreach MMs to reflect the State's intention to promote public awareness and involvement in controlling NPS pollution (the g-Guidance included education MMs for the urban and marinas sectors only). Nearly all of the TACs recommended that California enhance public education so that individuals can take responsibility and make the cooperative approach work.
- Post-Harvest Evaluation for Forestry. The post-harvest evaluation for forestry will help evaluate the successful implementation of the State's forest practice requirements. From this evaluation, appropriate changes to or oversight of the requirements can be developed. This evaluation of the forest practice requirements has been initiated and is described in the Monitoring Section.
- Marina Solid Waste Facilities. In addition to operating and maintaining these facilities, there is a need to support the installation of waste management facilities.

Process for Developing Additional Management Measures

California will conduct the following activities related to additional MMs:

- Ensure agency and public participation in developing and implementing the additional MMs.

- Coordinate review of CZARA section 6217(g) MMs and identify an initial set of additional MMs that are applicable for implementation in California.
- Involve the Assessment and/or Technical Assistance TACs, created by the IACC, to identify and recommend additional MMs.
- Develop a process for identifying and implementing additional MMs to address "additional" pollutant sources (e.g., resource extraction and abandoned mines, pitch canker [forestry], water conservation, and aerial deposition).
- Implement additional MMs in next five-year implementation plan.
- Track MM and MP implementation and review and assess effectiveness.
- Implement a long-term strategy for addressing pollution from active and inactive mines. (Active and abandoned mines are a significant source of NPS pollution as shown in Table 3 and discussed below.)

Abandoned Mines

Introduction

The SWRCB is the lead agency for control of water pollution by any source, including abandoned mines. However, there is no specific, comprehensive program at either a State or federal level for cleaning up abandoned and inactive non-coal mines. Rather, abandoned and inactive mine cleanup is carried out under a variety of State, federal, and local programs.

Over a century of mining since 1849 has left California with literally tens of thousands of small abandoned "hardrock" mines. Although not significant polluters individually, they often contribute cumulatively to chronic toxicity in affected watersheds via metals loading. Similarly, abandoned hydraulic placer gold mines and abandoned aggregate mines degrade aquatic habitat via excessive sediment loading. Again, the most serious sites are usually handled directly (e.g., Malakoff Diggings State Park, a historic hydraulic mining site, is under WDRs for sediment discharge), but the cumulative effects of smaller sites are not even addressed.

A few mine cleanups have been carried out under the Federal Superfund Program pursuant to California's Title 27 Program, which regulates waste discharges to land, and California's Surface Mining and Reclamation Program. For the most part, the worst abandoned mines are being cleaned up under the Federal Superfund Program. USEPA is also considering listing additional abandoned mines on the National Priority List in the future, but these would be sites that cause serious environmental problems or pose a substantial threat to human health. In a few instances, RWQCBs have tried to affect cleanup of abandoned mines by placing them under WDRs pursuant to Title 27.

The main barrier to a comprehensive program for abandoned mines is liability. Under the federal CWA, a third party can sue an agency or private party that performs abatement work at an abandoned mine if the discharge from the mine continues to violate the CWA (refer to the Penn Mine lawsuit). California recently passed legislation that provides protection for "Good Samaritan" cleanup under State law. Efforts over the last few years to amend federal law to provide similar protection have failed (although these efforts continue). Thus, liability is the main barrier to a comprehensive program for cleaning up abandoned mines.

Goals

- Continue to regulate the most prodigiously polluting abandoned mines under the appropriate programs.
- Support efforts to resolve the liability issue, the main impediment to a coordinated effort to clean up abandoned mines.
- Develop strategies and measures for abating chronic toxicity and habitat degradation from the cumulative effects of numerous small sites.

Actions – Characterization and Cleanup

The SWRCB and RWQCBs have identified approximately 40 mines that cause serious water quality problems resulting from acid mine drainage and acute mercury loading. Additionally, within the last year, State and federal agencies have realized that drainage structures and sluices associated with abandoned hydraulic gold mines are a potential source of mercury to waters of the State. Mercury from these abandoned mines poses a serious potential threat to coastal waters because mercury transported from these sites may bioaccumulate in fish. To that end, State and federal agencies are collaborating with local entities to investigate mercury loading from abandoned hydraulic mine sites in the Bear and South Fork Yuba watersheds. This effort is being supported by State funds (Proposition 204 Grant, bond money) as well as by federal and local matching funds. The investigation could serve as a model for additional investigations of watersheds affected by hydraulic mining.

The DOC is inventorying abandoned mines statewide and is anticipating that there will be at least 20,000 sites. To manage this inventory, DOC developed a relational database that records the salient features found at abandoned mines. Because the SWRCB participated in developing the database, features that contribute to water quality degradation are incorporated into the database. DOC is incorporating existing inventory information and is coordinating data gathering efforts with other State and federal agencies. DOC intends to distribute the database and supporting software to State and federal agencies that are responsible for regulating abandoned mines. When that distribution occurs, the SWRCB and RWQCBs will have a powerful new tool for tracking work performed at abandoned mines, evaluating regional clean-up efforts in affected watersheds, and evaluating the impact abandoned mines have on watersheds.

As a land-managing agency, the USFS also has a rigorous abandoned mine reclamation program. The program includes: (1) a regionwide inventory of abandoned mines; (2) documentation of location; (3) types of environmental and/or resource problems evident; (4) rehabilitation measures required; and (5) potential sources of funding. The USFS has worked with various RWQCBs on numerous occasions in the rehabilitation of old mine sites. Restoration funding has come from appropriated USFS funds, the Comprehensive Environmental Response and Compensation Liability Act (CERCLA), and RCRA sources. In addition, BLM has begun formulating an abandoned mine reclamation program.

Actions - Water Quality Standards for Abandoned Mine Cleanup

The SWRCB has undertaken various efforts to manage the quality of the State's waters. The goal of CWC section 13000 is " ... to attain the highest water quality that is reasonable, considering all demands being made and to be made ... and the total values involved ... ." Similarly, the Federal Water Pollution Control Act, United States Code (USC) Title A3, section 1251, aims, among other goals, to restore and maintain chemical, physical, and biological integrity of the Nation's waters by eliminating the discharge of pollutants. Such goals are fairly general and pragmatic.

Assuming that the liability issues are resolved soon, applying these general goals to both prodigiously polluting abandoned and inactive mines (which tend to be large sites) and watersheds affected by numerous small abandoned and inactive mines would be a major challenge for the following reasons. First, agreement must be reached on what is the highest water quality that is reasonable. This requires a statement on what natural conditions may have existed before mining to serve as a general guide in restoring the chemical, physical, and biological integrity of the affected waters. Second, the total values involved must be determined, recognizing that large abandoned mines are inherently costly to clean up and that the State's fiscal resources are limited.

Projects for restoring grossly polluting sites should have specific clean-up objectives and water quality goals. These site-specific goals for each site will differ depending on the magnitude of the pollution problem, clean-up technology, and cost of abatement.

Efforts for restoring watersheds affected by numerous small sites must take a different tack because it is unlikely that small sites would ever be evaluated individually by regulating agencies. Agreement on water quality and beneficial uses of an affected watershed would have to be reached first. Next, the contribution of similar pollutants from other sources would have to be considered in the context of how much benefit would be gained by cleaning up small abandoned mines. Last, it would be unrealistic to expect restoration efforts at small sites to meet specific water quality goals because most efforts would likely be limited to "low-tech" earth moving and revegetation projects.

The measure of success for such efforts would necessarily be an overall improvement of the targeted watershed. That would necessitate a carefully thought out watershed monitoring program.

It is important to keep in mind that reclamation goals for both individual abandoned mines and watersheds affected by numerous abandoned mines must be established pragmatically to ensure that the best possible improvement in overall basin water quality is achieved for a given expenditure. All interested parties must be willing to accept that this may not necessarily achieve background conditions.

Resource Extraction

Introduction

Resource extraction (i.e., aggregate and metal mining) operations are regulated locally by State administered programs and by State and federal programs when they occur on federal land (although State programs have primacy). Extraction operations become water quality concerns when they:

- Have discharges that could impair water quality (e.g., cyanide heap leach gold mines); or
- Could impair beneficial uses (e.g., water quality, habitat) resulting from extracting resources (usually aggregate) from within or nearby stream channels.

All active mining projects must comply with the Surface Mining and Reclamation Act (SMARA). The goal of SMARA is to have mined lands "reclaimed" to a beneficial end use. Local Enforcement Agencies (LEAs), usually counties, implement SMARA. The DOC's Office of Mine Reclamation provides technical support to LEAs and has limited enforcement authority.

Mining projects that could impair water quality and/or beneficial uses of waters of the State may also be subject to regulations administered by RWQCBs (Title 27 of the California Code of Regulations [CCR], NPDES and Stormwater) or subject to conditions under the CWA section 401 Water Quality Certification Program (WQCrP) administered by the RWQCBs and initiated when there is a federal permit or license required (such as the USACOE's section 404 Program).

On the federal level, both the BLM and USFS have reclamation programs. The objectives of the federal programs are to minimize the environmental impacts resulting from mining activities and to ensure that disturbed lands are returned to uses consistent with long-term forest land and resource management plans. Reclamation is an integral part of Plans of Operation submitted by proponents of mining on public domain lands that propose surface disturbances. The reclamation requirements included in the Plans of Operation include measurable performance standards. Reclamation bonds, sureties, or other financial guarantees are commonly required for all mineral activity requiring a Plan of Operation. All lands disturbed by mineral activities must be reclaimed to a condition consistent with resource management plans, including State air and water quality requirements.

Traditionally, each State regulatory program functions independently of one another even though some have overlapping regulatory authority. State agencies are beginning to recognize, however, that conflicts often arise when resource extraction operations are regulated by independently functioning programs with overlapping authority. Moreover, agencies are beginning to realize that the cumulative effects of multiple resource extraction operations within a given area cannot be anticipated when regulatory programs address each project individually. For example, the cumulative effects on beneficial uses of four or five instream aggregate operations in the same stream might be detrimental even though each individual operation is complying with conditions of their permit. Clearly, as society's demand for resources such as aggregate grows, the cumulative effects of these operations must be taken into account.

Goals

- Continue to regulate extraction operations for active resources under current programs.
- Work toward coordinating better among local, State, and federal entities that implement regulatory programs so that the regulatory goals of each applicable program are met.
- Begin evaluating extraction operations that occur within or near active stream courses in the context of their cumulative effect on their watershed.
- Develop MPs for alleviating cumulative detrimental effects of multiple resource extraction operations.

Actions

Agencies are making greater efforts to avoid conflicts stemming from overlapping regulatory programs. For example, DOC acted on a recommendation from the SWRCB that SWRCB and RWQCB staffs be invited to SMARA workshops. These workshops provide an opportunity for DOC, SWRCB, and RWQCB staffs to learn where areas of conflict are likely to arise. SWRCB and RWQCB staffs regularly meet with USFS staff to ensure that resource extraction operations comply with State programs.

Cumulative effects of resource extraction operations are also beginning to be addressed on a watershed basis. Although the reason for these efforts vary (e.g., a concern that threatened species listing will force onerous regulations on landowners, efforts to preserve fragile or unique habitats), the result is that extraction activities are beginning to be evaluated within the larger context of their watershed effects.

As the cumulative effects of multiple resource extraction operations are determined, SWRCB and RWQCB will work with local, private, and federal interests to formulate MPs for protecting the overall health of a watershed. Projecting into the future, we can anticipate that these MPs likely will be based on site-specific studies sponsored by State and federal agencies via grants.

Critical Coastal Areas Management Measures

The primary goal of CCA designation is to channel program resources to protect special coastal habitats from NPS pollution degradation through the implementation of additional MMs. CCAs will be designated in areas of the California coastal zone (1) in which new or substantially expanding land uses may cause or contribute to the impairment of coastal water quality and (2) that contain or are adjacent to threatened or impaired coastal waters.[23]

Where appropriate, additional MMs will be developed that address these site-specific concerns and which protect and restore the habitats for which the CCA designation was established.

The CCA Committee will first identify MMs within CAMMPR for immediate implementation in the CCAs. This will be accomplished through utilizing lessons learned, the existing monitoring programs, and the understanding of site-specific concerns and the threat of new development. For example, the CCA Committee could use the CCC's Permit Tracking System (PTS) for analyzing the cause-and-effect relationship between land use MPs and water quality. This would allow for the identification of the most effective MMs for immediate implementation in the CCAs. The anticipated development of runoff-specific tracking elements for the CCC's PTS would further accelerate and facilitate the MM identification process. Moreover, the statewide NPS Program's efforts in developing an effectiveness monitoring program will also assist in identifying and channeling appropriate resources to the implementation of appropriate MMs in the CCAs.

New and innovative MMs will be developed when needed to provide additional protection for the CCAs from NPS pollution degradation. The CCA Committee will work with appropriate agencies and researchers to develop these additional MMs with special considerations for the physical and biological characteristics of the CCAs and the nature of contamination in the adjacent threatened or impaired coastal waters.

[23] For federal approval of its NPS Program, California must identify and map CCAs to protect against current and anticipated NPS pollution problems (CZARA section 6217[b][2]).

Determining Need for Additional Regulations

During program assessment, it may be determined that current efforts to prevent and control NPS pollution are not sufficient to protect water quality and safeguard beneficial uses. Additional regulations may therefore be necessary to reinforce the implementing agencies' abilities in fully implementing NPS MMs and enforcing against NPS violations. In considering additional regulations, the Regulation TAC, in cooperation with the Assessment and Technical TACs, will perform the following activities:

- Invite the involvement of experts and all agencies with jurisdictions over NPS issues;
- Encourage public participation and input;
- Review all existing applicable regulations of the agencies to avoid duplicative regulations;
- Conduct research on lessons learned and other states' experiences;
- Create technologically-defensible and economically-feasible regulations that will accomplish the objective of preventing and controlling NPS pollution; and
- Ensure regulation adoption by the lead agencies and approval by OAL.

III. FIVE-YEAR IMPLEMENTATION PLAN

A. Introduction/Structure

The Implementation Plan describes in detail the actions to be taken for the period of 1998 to 2003. Specific MMs within the six identified NPS categories (Agriculture, Forestry, Urban Areas, Marinas and Recreational Boating Activities, Hydromodification, and Wetlands/Riparian Areas/Vegetated Treatment Systems), CCAs, and Program monitoring are identified.

Based on past agency experiences, the CWA section 303(d) and TMDL priority lists, a survey of the stakeholders, and recommendations from the previous NPS TACs, the lead agencies have targeted specific geographic areas and NPS MMs for implementation in this first five-year cycle. The areas selected either have the most impaired water bodies or face immediate water quality threats from new and/or expanding development. Depending on their relative priority, the MMs were targeted as either primary, secondary, or tertiary. The Implementation Plan only addresses those MMs targeted at the primary and secondary level for the first five-year cycle. The MMs chosen are those determined to be the most effective and appropriate for California. The CCAs will be addressed based on a year to year review of potential environmental degradation of sensitive coastal resources such as those previously identified as ESHAs and special areas including California's NERRs, NEPs, and National Marine Sanctuaries (NMSs).

Seven process elements are prescribed for each of the MM categories. They are to: (1) assess problems; (2) target resources; (3) plan activities; (4) coordinate with agencies and the public; (5) implement MMs; (6) track and monitor actions; and (7) report on the effectiveness of the Program Plan. These steps are essential to ensuring effective and efficient implementation of the MMs which will enable the Strategy to achieve the defined goals of preventing and controlling NPS pollution. The Implementation Plan also identifies parties/agencies responsible for performing the activities. Funding sources and milestones to be achieved by the end of the five-year period are identified as well. The implementation timelines are realistic estimates but may change due to changes in agency coordination, funding, new information, and public cooperation.

Certain process elements for some of the targeted MM categories have not been completed due to the lack of information at this time. All relevant information for each process element for each primary and secondary MM will be established and entered into the first five-year plan by July 1, 2000, with the exception of numeric program performance measures. Numeric program performance measures will be established for each primary and secondary MM in the first five-year plan by October 1, 2000. If more data, another agency commitment, or some other piece of information is needed in order to fill in a particular piece of the matrix, the steps that will be taken to fill in that missing information will be described. The revised five-year plan will be distributed to the public (as an addendum to the Program Plan) by November 1, 2000.

Beginning in 2001, biennial reports will be completed for evaluation by the USEPA and NOAA, as well as other agencies and the public regarding the State's progress in implementing the NPS Program. The reports to be produced in 2001 and 2003 will provide details to address questions such as:

1. Have the activities identified in the five-year plans been completed and have the associated performance measures been achieved?
2. Has an MM implementation tracking system been established? Based on that system, what is the extent of MM implementation for all source categories throughout the State?
3. Has the IACC become active and successful in fostering implementation?
4. Has the SWRCB/RWQCBs published NPS enforcement guidance in 2001 as per CWC section 13369(a)(2)(B)?
5. Has the technical assistance to landowners and managers been improved through the issuance of technical guides, information sharing, "field-level" assistance and/or other activities?
6. Have other State and federal agencies and non-governmental entities become involved in implementing the NPS Program? Where necessary, have formal agreements been established to enhance the effectiveness of these partnerships?
7. Has the planning process for the next five-year plan (2003-2008) been established to achieve more specific plans that include measurable objectives and that involve a wide range of key stakeholders?
8. Have adequate efforts been made to identify funding needs and mechanisms to ensure continuing MM implementation and Program Plan success?

In 2001, the SWRCB, RWQCBs, and CCC, in coordination with the new TACs to be established by the IACC, will begin developing the next five-year implementation plan. The five-year implementation plan for 2003 to 2008 will outline: (1) strategies to complete the unfinished tasks from the first five years; (2) rectify the NPS program's shortfalls identified in the assessment process; (3) implement an additional set of MMs; and (4) expand the geographic coverage of the NPS Program.

B. Agriculture

The SWRCB, CCC, and other State agencies have identified seven MMs to address agricultural NPSs of pollution that affect State waters. The agricultural MMs include practices and plans installed under various NPS programs in California, including systems of practices commonly used and recommended by the USDA as components of RMS, WQMPs, and Agricultural Waste Management Systems. These RMSs are planned by individual farmers and ranchers using an objective-driven planning process outlined in the NRCS National Planning Procedures Handbook. The RMSs are designed to achieve sustainable use of the different natural resource areas—soil, water, air, plants, animals, and human considerations.

California's MMs to address agricultural sources of NPS pollution in California:

- 1A. Erosion and Sediment Control
- 1B. Facility Wastewater and Runoff from Confined Animal Facilities
- 1C. Nutrient Management
- 1D. Pesticide Management
- 1E. Grazing Management
- 1F. Irrigation Water Management
- 1G. Education/Outreach

According to USEPA (1993), agriculture contributes more than half of the pollution entering the Nation's water bodies; recent studies have identified it as the greatest source of water pollution in the United States. The primary agricultural NPS pollutants are nutrients, sediment, animal wastes, pesticides, and salts. Agricultural activities may also affect habitat through physical disturbances caused by livestock or equipment or through the management of water.

Management Measures:

Erosion and Sediment Control. MM 1A addresses NPS problems associated with soil erosion and sedimentation. Where erosion and sedimentation from agricultural lands affect coastal waters and/or State's inland water bodies, landowners shall design and install or shall apply a combination of practices to reduce solids and associated pollutants in runoff during all but the larger storms. Alternatively, landowners may apply the erosion component of an RMS as defined in the NRCS FOTG. The NRCS FOTG contains standards and specifications for installing these practices.

Facility Wastewater and Runoff from Confined Animal Facilities. Pursuant to MM 1B, facility wastewater and contaminated runoff from confined animal facilities must be contained at all times. Storage facilities should be of adequate capacity to allow for proper wastewater use and should be constructed so they prevent seepage to ground water, and stored runoff and accumulated solids from the facility shall be managed through a waste use system that is consistent with MM 1C or shall be removed from the site.

Nutrient Management. MM 1C addresses the development and implementation of comprehensive nutrient management plans for areas where nutrient runoff is a problem affecting coastal waters and/or water bodies listed as impaired by nutrients. Such plans would include: (1) a plant tissue analysis to determine crop nutrient needs; (2) crop nutrient budget; (3) identification of the types, amounts, and timing of nutrients necessary to produce a crop based on realistic crop yield expectations; (4) identification of hazards to the site and adjacent environment; (5) soil sampling and tests to determine crop nutrient needs; and (6) proper calibration of nutrient equipment. When manure from confined animal facilities is to be used as a soil amendment and/or is disposed of on land, the plan shall discuss steps to assure that subsequent irrigation of that land does not leach excess nutrients to surface or ground water.

Pesticide Management. Implementation of MM 1D is intended to reduce contamination of surface water and ground water from pesticides. Implementation of this measure will primarily occur through cooperation with the CDPR as provided in a MAA with the SWRCB. Elements of this measure include: (1) development and adoption of reduced risk pest management strategies (including reductions in pesticide use); (2) evaluation of pest, crop, and field factors; (3) use of Integrated Pest Management (IPM); (4) consideration of environmental impacts in choice of pesticides; (5) calibration of equipment; and (6) use of anti-backflow devices. IPM is a key component of pest control. IPM strategies include evaluating pest problems in relation to cropping history and previous pest control measures and applying pesticides only when an economic benefit will be achieved. When used, pesticides should be selected based on their effectiveness to control target pests and environmental impacts such as their persistence, toxicity, and leaching potential.

Grazing Management. MM 1E is intended to protect sensitive areas (including streambanks, lakes, wetlands, estuaries, and riparian zones) by reducing direct loadings of animal wastes and sediment. This may include restricting or rotationally grazing livestock in sensitive areas by providing fencing, livestock stream crossings, and locating salt, shade, and alternative drinking sources away from sensitive areas. Upland erosion can be reduced by, among other methods: (1) maintaining the land consistent with the California Rangeland WQMP or BLM and Forest Service activity plans or (2) applying the range and pasture components of an RMS (NRCS FOTG). This may include prescribed grazing, seeding, gully erosion control, such as grade stabilization structures and ponds, and other critical area treatment.

Irrigation Water Management. MM 1F promotes effective irrigation while reducing pollutant delivery to surface and ground waters. Pursuant to this measure, irrigation water would be applied uniformly based on an accurate measurement of crop water needs and the volume of irrigation water applied, considering limitations raised by such issues as water rights, pollutant concentrations, water delivery restrictions, salt control, wetland, water supply, and frost/freeze temperature management. Additional precautions would apply when chemicals are applied through irrigation.

Education/Outreach. The goals of MM 1G are to implement pollution prevention and education programs to reduce NPS pollutants generated from the following activities where applicable:

1. Activities that cause erosion and loss of sediment on agricultural land and land that is converted from other land uses to agricultural land;
2. Activities that cause discharge from confined animal facilities to surface waters;
3. Activities that cause excess delivery of nutrients and/or leaching of nutrients;
4. Activities that cause contamination of surface water and ground water from pesticides;
5. Grazing activities that cause physical disturbance to sensitive areas and the discharge of sediment, animal waste, nutrients, and chemicals to surface waters;
6. Irrigation activities that cause NPS pollution of surface and ground waters.

Management Measure Category: Agriculture

Management Measure Title: 1A – Erosion and Sediment Control

Management Measures Targeting Level: Primary

Objectives:

1. By the year 2002, develop MAA and WQMP with BLM.
2. By the year 2003, sediment/erosion control guidelines for six watersheds. Begin implementation of those guidelines.
3. By the year 2003, implement interagency streamlined permit process in 50 watersheds.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	To be completed as specified in Part III.A. – Introduction /Structure.										
Target	To be completed as specified in Part III.A. – Introduction /Structure.										
Plan	Develop resource management plans.	RWQCB 3, County Farm Bureau	RWQCB 3	CWA §319, USDA EQIP, California Farm Bureau (CFB), and partner's funds		x	x	x	x	x	
	Direct grant funds and cost sharing opportunities to projects that implement MPs.	RWQCB 3 RWQCB 7	Lands in irrigated agriculture and grazing throughout the Regions 3 and 7	CWA §319	Implementation of at least one new project each year	x	x	x	x	x	

R0018695

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Plan	Develop TMDLs for CWA §303(d) listed waters.	RWQCB 3 RWQCB 7 RWQCB 8	Lower Salinas River, Lower Pajaro River, Morro Bay Watershed, Salton Sea Transboundary Watershed, Newport Bay Watershed	CWA §319, CWA §104, CWA §106, General Fund (funding fairly secure for development through 2001)	Adopted TMDL according to established schedule; implementation of practices per the TMDL	x	x	x	x	x	
	Quantify measures to reduce impacts from erosion and sedimentation.	NRCS, RWQCB 4	Ventura County	CWA §319 TMDL	Agreement of stakeholders on top ten measures that should be implemented			x	x	x	As needed- rotate between watersheds with agricultural issues. Coordinate with TMDLs
	Work with stakeholders to develop watershed management plan (includes erosion control element)	RWQCB 5	Cache Creek	NPS, CALFED, other				x	x		
		RWQCB 5, local agency	West side tribs. Sacramento R.	CWA §319; Prop. 204	Educational workshops and public meetings						
	Develop MAA and WQMP with BLM.	SWRCB BLM	Statewide	Agency baseline	MAA and WQMP		x	x	x		
Coordinate	Promote interagency coordination to improve information transfer and to provide a singular agency perspective.	RWQCB 1	Russian, Gualala, Garcia, and Navarro Rivers	CWA §319	Number of interagency network sessions, outreach--see Outreach and Education		x	x	x		
	Participate in TACs for Cottonwood Creek	RWQCB 5; local agency	West side tribs. Sacramento R.	CWA §319	Attendance at meetings	x	x	x			

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Coordinate	Coordinate stakeholders for implementation of MMs.	RWQCB 4	Ventura County	CWA §319 TMDL	Number of meetings for consensus of stakeholders, MOUs/MAAs	x	x	x	x	x	As needed- rotate between watersheds with agricultural issues Coordinate with TMDLs
	Participation at interagency and watershed group meetings	RWQCB 3, Farm Bureaus, NRCS, local Conservation Districts, MBNMS WQPP, UCCE	Lands with irrigated agriculture and grazing throughout the region	CWA §319, USDA, EQIP, CFB, Guadalupe oil field settlement funds	Development and implementation of plans on recorded number of acres.		x	x	x	x	
Implement	Implement resource management plans.	RWQCB 3, County Farm Bureau (CFB), MBNMS WQPP, UCCE	Lands in irrigated agriculture and grazing throughout RWQCB 3	CWA §319, USDA EQIP, CFB, and partner's funds			x	x	x	x	
		RWQCB 3, RWQCB 2, CFB, MBNMS-WQPP, NRCS	Lower Salinas River, Lower Pajaro River, Pescadero and lands in irrigated agriculture and grazing throughout RWQCB 3	CWA §319, USDA-EQIP, CFB, and MBNMS			x	x	x	x	

R0018697

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement	Implement strategies for protection of resources from agricultural pollution, including erosion, in cooperation with the MBNMS WQPP.	RWQCB 3 MBNMS CCC SWRCB	Central Coast	CWA §319	Complete final WQPP agriculture plans by summer 1999 and begin implementation.	x	x	x	x	x	Ongoing activity Includes all NPSs impacting MBNMS watersheds
	Implement CFB's NPS Initiative pilot projects	RWQCB 7, CFB, NRCS	Lands in irrigated agriculture and grazing throughout RWQCB 7	CWA §319, USDA-EQIP, and CFB,			x	x	x	x	
	Implement TMDLs for CWA §303(d) listed waters.	RWQCB 3 RWQCB 7	Lower Salinas River, Lower Pajaro River, Morro Bay Watershed, Salton Sea Transboundary Watershed	CWA §319, CWA §104, CWA §106, General Fund (funding fairly secure for development through 2001)	Adopted TMDL according to established schedule; implementation of practices per the TMDL	x	x	x	x	x	
	Implement Erosion and Sediment (E&S) Control Plans to protect water quality standards.	NRCS RWQCB 4	Ventura County	CWA §319 TMDL	Number of Erosion and Sediment Control Plans implemented				x	x	As needed-rotate between watersheds with agricultural issues. Coordinate with TMDLs
	Promote hillside vineyard management practices to reduce erosion/sedimentation and improve riparian function and fish habitat.	RWQCB 1	Russian, Gualala, Garcia, and Navarro Rivers	CWA §319	Number of interagency network sessions, outreach--see Outreach and Education		x	x	x		
	Participate in implementation of CFB NPS Initiative pilot projects.	RWQCB 7, CFB, NRCS	Salton Sea Transboundary Watershed	CWA §319 EQIP, CFB		x	x	x	x	x	
	Implement BMPs for flood and sediment control	RWQCB 5	Salt and Sand Creek	NPS	Implementation of projects, field days	x	x				

R0018698

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement	Implement sediment and erosion control demonstration program	RWQCB 5, local agency	Cache Creek	Prop. 204	Construction of gravel bar(s)		x	x	x		
	Prepare education and outreach material for erosion control techniques	RWQCB 5, local agency	Cache Creek	Prop. 204	Preparation and distribution booklet; field tours		x	x	x		
	Implement model, interagency streamlined permit process piloted in Elkhorn Slough in other watersheds Statewide.	NRCS, DFG, RWQCBs, CCC, Sustainable Conservation, MBNMS WQPP	Elkhorn Slough, Morro Bay, Salinas River watersheds	Various sources	50 projects in five years	x	x	x	x	x	In 1998, 20 projects were implemented in Elkhorn Slough, Morro Bay, and Salinas River. Projects are scheduled to begin in FY 99-00.
	Implement management measures/practices to reduce sedimentation.	RWQCB 5, local agency	Panoche and Silver Creek, Arroyo Passajero	CWA §319				x	x	x	
Track and Monitor	Monitor long-term sediment management strategies	RWQCB 5, local agency	Union School Slough	CWA §319, CALFED			x	x	x	x	
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure.										

Management Measure Category: Agriculture

Management Measure Title: 1B – Facility Wastewater and Runoff from Confined Animal Facilities (all units)

Management Measure Targeting Level: Primary

Objectives:

1. By the year 2000, develop statewide strategy for Animal Feeding Operations (AFO).
2. By the year 2002, complete dairy waste management training for 50 percent of dairy produces in RWQCBs 1 and 5.
3. By the year 2003, inspect all AFO facilities in the RWQCB 5-Central Valley and RWQCB 8-Chino Basin.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years					Notes
						98	99	00	01	02	
Assess	Conduct surface and ground water quality monitoring to assess current and historic dairy waste impacts.	RWQCB 8	Chino Basin, Lake Elsinore/San Jacinto watershed		Database	x	x	x	x		
Target	To be completed as specified in Part III.A. – Introduction /Structure.										
Plan	Quantify nutrient load and propose reductions.	USEPA, SWRCB, RWQCB 4	RWQCB 4	Basin Planning , CWA §104 and §106 TMDL funds	Technical TMDLs			x	x	x	TMDLs for nutrients are scheduled for different watersheds each year
	Update nutrient reduction goals of RWQCB 4 Basin Plan.	RWQCB 4	RWQCB 4		Update plan by 7/2001		x	x	x		Triennial review and TMDL implementation, as required
	Foster grant program for NPS control on dairies.	RWQCB 1	Humboldt WMA	CWA §319	Number of projects		x	x	x	x	
	Develop manure removal strategies.	Local dairy agencies, RWQCB 8, Orange County Sanitation District (OCWD)	Chino Basin, San Jacinto Watershed		Reduction in manure remaining in Chino Basin	x	x	x			

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Plan	Work with USEPA and NRCS on development of the joint unified AFO National Strategy. Target EQIP funding to needed projects through participation on the State Technical Committee.	NRCS SWRCB USEPA RWQCBs	Statewide	Current staff, EQIP	Annual list of priority areas, number of plans produced	x	x	x	x	x	Ongoing activity
	Develop statewide strategy for AFO.	SWRCB	Statewide	Baseline	Statewide strategy		x	x			
Coordinate	Coordinate statewide and regional dairy waste management activities to develop more cohesive regulatory framework through monthly Interagency Confined Animal Coordination Group meetings and quarterly RWQCB roundtable meetings.	SWRCB	Statewide	CWA §319 Current staff	Monthly meeting summaries	x	x	x	x	x	Ongoing activity.-most significant impacts are in the San Joaquin Valley and Chino Basin
	Support and participate in Sonoma-Marin Animal Waste Committee, Dairy Waste Management Partnership Agreement (California Dairy Quality Assurance Program), and producer training through UC.	SWRCB	Statewide with emphasis on Regions 1 and 5	TSCA grant CWA §319 Current staff	Under the Partnership Agreement, complete dairy waste management training for 50 percent of producers in two years. Perform 1,000 independent evaluations in four years.	x	x	x	x	x	On going activity Also supports process element of implementation
Implement	Work with USEPA and NRCS on implementation of the joint unified AFOs National Strategy. Target EQIP funding to needed projects through participation on the State Technical Committee.	NRCS SWRCB EPA RWQCBs	Statewide	Current staff, EQIP	Annual list of priority areas, number of plans developed	x	x	x	x	x	Ongoing activity Also supports process element of implementation
	Implement updated dairy general NPDES permit.	RWQCB 8	RWQCB 8		Implement updated permit	x	x	x	x	x	
	Educate dairy industry on NPS impacts and control, foster stewardship ethic, develop self-regulatory body	RWQCB 1	Humboldt WMA	CWA §319	No. of participants, No. of projects, strategy with corrective actions		x	x	x	x	
	Address known dischargers in violation of water quality standards through increased use of regulatory authorities: - more inspections - increase number of inspections - consider issuing a general WDR in Central Valley.	SWRCB RWQCBs	Central Valley, Chino Basin, San Jacinto Watershed	General Fund, NPDES/WDR permit funds	Inspect 25 percent of all facilities annually		x	x	x	x	Ongoing activity

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98 99 00 01 02	Notes
Track and Monitor	To be completed as specified in Part III.A. – Introduction /Structure.						
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure.						

R0018702

Management Measure Category: Agriculture

Management Measure Title: 1C - Nutrient Management

Management Measure Targeting Level: Primary

Objectives:

1. By the year 2003, develop regional numeric nutrient criteria and incorporate into Basin Plans.
2. By the year 2003, develop and implement standards for heavy metals in organic and inorganic fertilizers.
3. By the year 2003, develop nutrient management guidelines in nine watersheds. Begin implementation of those guidelines.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years					Notes
						98	99	00	01	02	
Assess	Thirty-five (35) water bodies listed for nutrients with agricultural sources of sediment on CWA §303(d) list.	RWQCBs	Statewide	Current staff	CWA §303(d) list	x					
	For watersheds with limited information, inspect irrigated agriculture and grazing areas for nutrient discharges.	RWQCB 3	Lands with irrigated agriculture or grazing uses	New	Number of watersheds inspected per year	x	x		x	x	
Target	Thirty-three (33) water bodies targeted for nutrient TMDLs by year 2003.	SWRCB	Statewide	Current staff	TMDL schedule						
	Identify additional high quality water bodies in need of protection.										
Plan	Develop regional numeric nutrient criteria in cooperation with USEPA, RWQCBs, and Nutrient Criteria Team.	USEPA, SWRCB, RWQCBs	Statewide	CWA §319(h) grant	Develop regional criteria by 2000. Incorporate into basin plans by 2003	x	x	x	x	x	
	Evaluate and modify as appropriate for incorporation into basin plans.										
	Develop standards for heavy metals in organic and inorganic fertilizers.	DFA and SWRCB	Statewide		Standards	x	x	x			
	Develop TMDLs and associated implementation plans for CWA §303(d) listed water bodies.	RWQCB 1	Laguna de Santa Rosa, Scott River, Shasta River, Stemple Creek		TMDLs, implementation plans	x	x	x	x	x	

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Plan		RWQCB 3	L. Pajaro River, L. Salinas River, Monterey Bay and Morro Bay watersheds		TMDLs, implementation plans	x	x	x	x	x	
		RWQCB 5	Stockton and SJ Delta	State and federal TMDL funds	Validation of dissolved oxygen (DO) model; definition biochemical oxygen demand (BOD) and nutrient sources; determination of sediment load			x	x	x	TMDL for DO
	Develop nutrient management plans	RWQCB 8, Orange Cnty. Farm Bureau (OCFB), UCCE	Newport Bay watershed	CWA §319(h) funds	No. of nutrient management plans		x	x	x	x	Requirement of Newport Bay TMDL
Coordinate	Develop MOU or MAA with other regulatory agencies to control nutrients.	SWRCB, RWQCBs, NRCS	Statewide	Current							
	Coordinate with CFB, NRCD, agricultural groups, and educational institutions about appropriate level of nutrient applications for specific crops.	RWQCB 4	Ventura County	New	Guidance document on nutrient application rates						
	Coordination with stakeholders occurs during all phases of program.	See lead agency per process	Statewide	Current staff		x	x	x	x	x	
Implement	Regulate fertilizer materials and soil amendments pursuant to interagency MOU.	DFA DTSC CIWMB SWRCB	Statewide	Baseline	Measures specified in MOU	x	x	x	x	x	
	Implement CFB's NPS Initiative pilot projects	RWQCB 3, CFB, MBNMS-WQPP, NRCS	Upper and Lower Salinas River, Lower Pajaro River, and lands irrigated by agriculture and grazing throughout RWQCB 3	CWA §319, USDA-EQIP, CFB, and MBNMS			x	x	x	x	

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years					Notes
						98	99	00	01	02	
Implement	Implement strategies for protection of resources from agricultural pollution, including nutrients, in cooperation with the MBNMS WQPP.	RWQCB 3 MBNMS CCC SWRCB	Central Coast	CWA §319	Complete final WQPP agriculture plan by summer 1999 and begin implementation.	x	x	x	x	x	Ongoing activity Includes all NPSs impacting MBNMS watersheds
	Implement plans and specific MPs.										
	Implement TMDLs for CWA §303(d) listed water bodies.	RWQCB 1	Laguna de Santa Rosa, Scott River, Shasta River, Stemple Creek			x	x	x	x	x	
		RWQCB 3	L. Pajaro River, L. Salinas River, Monterey Bay and Morro Bay watersheds			x	x	x	x	x	
	Implement nutrient management plans	RWQCB 8, OCFB, UCCE	Newport Bay watershed	CWA §319(h) funds	Nutrient reduction from agr. lands to meet load locations		x	x	x	x	Requirement of Newport Bay TMDL
	Update WDRs for commercial nurseries	RWQCB 8	Newport Bay watershed	?	Updated WDRs for commercial nurseries		x	x	x	x	Requirement of Newport Bay TMDL
	Conduct research, outreach, and education for the regulated community through the Fertilizer Research and Education Program.	CDFA	Statewide	CWA §319(h)	Number of workshops; Number of publications		x	x	x	x	Ongoing activity
	Restore riparian areas – replace orchard with riparian vegetation	RWQB 5, local agencies	Phelan Island	CWA §319(h)	Replacement of orchards	x	x	x			
	Program for alternative practices for prunes	RWQB 5, local agencies	Phelan Island	CWA §319(h)	Education workshops; field meetings	x	x	x			
Track and Monitor	See monitoring and tracking sections of Fifteen-Year Strategy and Five-Year Plan.					x	x	x	x	x	

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Track and Monitor	Implement nutrient monitoring program to evaluate TMDL compliance.	RWQCBs	See list of TMDL implemented water bodies (above)			x	x	x	x	x	
	Develop and implement nutrient monitoring program	RWQCB 8	Newport Bay watershed	CWA §319(h)	Comprehensive nutrient monitoring program for evaluation of TMDL compliance		x	x	x	x	Requirement of Newport Bay TMDL
Report Biennially	See effectiveness and reporting sections of Fifteen-Year Strategy and Five-Year Plan.				Biannual NPS Report				x		

Management Measure Category: Agriculture

Management Measure Title: 1D – Pesticide Management

Management Measures Targeting Level: Primary

Objectives:

1. By the year 2000, complete and begin implementation of a WQPP for agricultural pesticides in the MBNMS.
2. By the year 2002, develop and begin implementation of effective pesticide control program in Newport Bay Watershed as part of TMDL.
3. By the year 2003, develop a total of six TMDLs for pesticides in RWQCB 5.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	To be completed as specified in Part III.A. – Introduction /Structure.										
Target	To be completed as specified in Part III.A. – Introduction /Structure.										
Plan	Develop strategies for protection of resources from agricultural pollution, including pesticides, in cooperation with the MBNMS WQPP.	RWQCB 3 MBNMS CCC SWRCB	Central Coast	CWA §319	Complete final WQPP agriculture plan by summer 1999 and begin implementation.	x	x	x	x	x	Ongoing activity. Includes all NPSs impacting sanctuary watersheds
	Identify pesticide impairment to beneficial uses/water quality; develop effective pesticide control program through TMDL development and implementation.	RWQCB 8, local agencies	Newport Bay watershed	To be determined	Toxics TMDL	x	x	x	x		Toxics TMDL to be approved by the State by January 2002
	Analyze irrigation return water.	RWQCB 4	Ventura County		Collect and analyze as necessary for pesticide TMDLs			x	x	x	
	Coordinate with WMI and TMDL units to document levels of pesticides in receiving waters.	RWQCB 4 CDPR	RWQCB 4		Number of watersheds reviewed. Summary of findings		x	x	x	x	

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Plan	Participate in the Sacramento River Watershed program to develop an organophosphate pesticide management strategy.	RWQCB 5S CDPR	Sacramento River Watershed	Sacramento River Watershed Project, CWA §319	Determine diazinon loading and toxicity evaluation	x	x	x			May extend to 2002. Will help TMDL development for diazinon.
	Develop TMDL for diazinon.	RWQCB 5S CDPR	Delta, Sacramento River, and San Joaquin River	Federal, CALFED	TMDL	x	x	x	x	x	
	Develop TMDL for chlorpyrifos.	RWQCB 5S CDPR	Delta and San Joaquin River	Federal, CALFED	TMDL	x	x	x	x	x	
	Develop water quality objectives for rice pesticides.	RWQCB 5S CDPR	Sacramento River	To be determined.	Water quality objectives						While work is a high priority, work cannot proceed without funding.
Coordinate	Prevent and mitigate threats to water quality from pesticides through coordination with the RWQCBs and implementation of the MAA and Pesticide WQMP with the CDPR.	SWRCB RWQCBs CDPR	Statewide	CWA §319	Conduct semi-annual technical briefings with CDPR and RWQCB staffs	x	x	x	x	x	Ongoing activity – RWQCB and CDPR staff work together as needed on indiv. pesticide TMDLs
	Review the control/eradication program for red imported fire ants (RIFA) in southern California in coordination with DFA, CDPR, and the RWQCBs.	CDPR, SWRCB, RWQCB 8, local agencies	Statewide Newport Bay Watershed	CWA §319	Comprehensive monitoring program for evaluation of impacts from RIFA eradication program	x	x	x	x		This may be an ongoing activity if eradication is not effective.
	Minimize/avoid NPS pollution in pest eradication programs. Consult with RWQCBs and SWRCB when developing programs.	DFA	Statewide		Consultation	x	x	x	x	x	
Implement	Implement strategies for protection of resources from agricultural pollution, including pesticides, in cooperation with the MBNMS WQPP.	RWQCB 3 MBNMS CCC SWRCB	Central Coast	CWA §319	Complete final WQPP agriculture plan by summer 1999 and begin implementation.	x	x	x	x	x	Ongoing activity. Includes all NPSs impacting sanctuary watersheds.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement	Enforce water quality standards.	RWQCB 4	RWQCB 4		Number of Enforcement Actions	x	x	x	x	x	
	Prevent aquatic toxicity from organophosphate pesticide residues through voluntary efforts to monitor for compliance with water quality standards.	CDPR, RWQCB 5, RWQCB 8	Sacramento River and San Joaquin River Watersheds; Newport Bay watershed	CDPR Regulation Fund, General Fund	Monitoring data		x	x	x	x	If by the year 2001-2002 use-season aquatic toxicity persists, CDPR will impose regulatory controls to lower dormant spray residues to acceptable levels.
	Reduce pesticides in both agricultural and urban surface water through local outreach to promote MPs that reduce pesticide runoff and through CDPR's registration process. Fund and assist in pesticide control applicator and grower training promoting pesticide management. Mitigate impacts through self-regulation as well as regulatory authorities of CDPR, SWRCB, and RWQCB.	CDPR, RWQCB 5, RWQCB 8, SWRCB	Statewide, with initial emphasis beginning with the San Joaquin River, Orestimba Creek, Sacramento River, Sacramento Slough, Wadsworth Canal, Colusa Basin Drain, Butte Slough; Newport Bay watershed	CALFED, CDPR Regulation Fund, General Fund, and Environmental License Fund	Number of pesticides evaluated in the registration process Number of pesticide control applicators and growers trained Decreases in OP pesticides use as reported in CDPR's pesticide use report database and corresponding increases in the use of lower risk pesticide control products. Descreases in surface water toxicity due to OP pesticides.		x	x	x	x	

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years					Notes
						98	99	00	01	02	
Implement	Prevent pesticide contamination of ground water through education, modeling, and monitoring. Components include voluntary wellhead protection stewardship programs with the County Agricultural Commissioners; CDPR's registration process in which potential adverse effects to ground water quality are evaluated; and creation of Pesticide Management Zones (PMZs) which restrict or prohibit use when criteria are met.	CDPR, County Agriculture Commission	Statewide	CDPR Regulation Fund, General Fund	Number of pesticides evaluated in the registration process Number of PMZs created		x	x	x	x	Ongoing program
	Form alliances with the regulated community to jointly focus on reducing environmental risks while providing pest management solutions using IPM applied research, demonstration, implementation, and outreach.	CDPR	Statewide	CDPR Regulation Fund	Number of alliances		x	x	x	x	
	Provide grants for applied research focused on IPM practices and technologies.	CDPR	Statewide	Food Safety Fund	Number of grants Amount of grants		x	x	x	x	
	Reduce rice pesticide loading in the Sacramento and San Joaquin Rivers by managing water in treated fields so that discharges of pesticides into surface waters do not impair beneficial uses.	CDPR, SWRCB, RWQCB 5	Sacramento River and San Joaquin River Watersheds	CDPR Regulation Fund, General Fund	Documentation of loadings		x	x	x	x	
Track and Monitor	Coordinate water quality sampling program for RIFA program.	CDPR, SWRCB, RWQCB 8, local agencies	Statewide, Newport Bay Watershed	CWA §319	Comprehensive monitoring program for evaluation of impacts from RIFA eradication program	x	x	x	x		This may be an ongoing activity if eradication is not effective
	Work with CDPR and RWQCBs to target funds for monitoring for TMDL development.	CDPR, SWRCB, RWQCBs	Statewide	CDPR	Monitoring agreements		x	x	x	x	CDPR has received approximately $800,000 per year to do this monitoring.
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure.										

Management Measure Category: Agriculture

Management Measure Title: 1E – Grazing Management

Management Measure Targeting Level: Primary

Objectives:

1. By the year 2000, develop MAA or MOU between SWRCB and BLM to implement CWA section 319 consistency review.
2. By the year 2003, complete rangeland WQMPs for two million acres throughout California.
3. By the year 2003, develop TMDLs with rangeland load allocation and implementation plans in two watersheds in RWQCB 1 and three watersheds in RWQCB 3.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	To be completed as specified in Part III.A. – Introduction /Structure.										
Target	To be completed as specified in Part III.A. – Introduction /Structure.										
Plan	Provide financial support for rangeland water quality workshops held by UC.	UCD Range and Agronomy, SWRCB	Statewide	CWA §319	Complete rangeland WQMPs for 500,000 acres each year.	x	x	x	x	x	Ongoing activity
	Participate in the MBNMS WQPP to develop strategies for protection of MBNMS resources from agricultural pollution, including rangeland.	RWQCB 3, MBNMS, CCC, SWRCB	Central Coast	CWA §319	Complete final WQPP agriculture plan by summer of 1999 and begin implementation	x	x	x	x	x	Ongoing activity, includes all NPSs impacting MBNMS watersheds
	Develop TMDLs for CWA §303(d) listed waters.	RWQCB 3	Lower Salinas River, Lower Pajaro River, Morro Bay Watershed	CWA §319, CWA §104, CWA §106, General Fund (funding fairly secure for development through 2001)	Adopted TMDL according to established schedule Implementation of practices per the TMDL	x	x	x	x	x	

R0018711

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Coordinate	Participate in the Range Management Advisory Committee to the BOF.	BOF/CDF, SWRCB	Statewide			x	x	x	x	x	Ongoing activity
	Implement CWA §319 consistency review in cooperation with BLM and other federal agencies.	BLM, SWRCB	Statewide	CWA §319	MAA or MOU	x	x	x			Includes all NPSs impacting BLM lands
	Participate on stakeholder technical advisory committee	RWQCB 5	Upper Pit River	NPS Program			x	x			
Implement	Participate in implementation of CFB NPS Initiative pilot projects, MBNMS WQPP Action Plan for Agriculture.	RWQCB 3, CFB, MBNMS, NRCS	Upper and Lower Salinas River, Lower Pajaro River	CWA §319, EQIP, Farm Bureau, MBNMS		x	x	x	x	x	
	Direct grant funds and cost sharing opportunities to projects that implement MPs.	RWQCB 3	Lands in irrigated agriculture and grazing throughout RWQCB 3	CWA §319	Implementation of at least one new project each year	x	x	x	x	x	
		RWQCB 5	Central Valley				x	x	x	x	
	Inspect areas with irrigated agriculture and grazing for sediment discharges and recommend or require abatement or new practices as appropriate.	RWQCB 3	Lands in irrigated agriculture and grazing throughout RWQCB 3	CWA §319, General Funds (funding not secure)	Number of inspections each year; number of inspection reports; implementation recommendations made in reports	x	x	x	x	x	
	Implement TMDLs for 303(d) listed waters.	RWQCB 1	Humboldt WMA Garcia River Watershed	CWA §319	Number of ranch plans per acres, monitoring plan, Number of sites monitored, data report		x	x	x	x	
		RWQCB 3	Lower Salinas River, Lower Pajaro River, Morro Bay Watershed	CWA §319, CWA §104, CWA §106, General Fund (funding fairly secure for development through 2001)	Adopted TMDL according to established schedule Implementation of practices per the TMDL	x	x	x	x	x	

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement	Participate in the MBNMS WQPP to implement strategies for protection of MBNMS resources from agricultural pollution, including rangeland.	RWQCB 3 MBNMS CCC SWRCB	Central Coast	CWA §319	Complete final WQPP agriculture plan by summer 1999 and begin implementation.	x	x	x	x	x	Ongoing activity. Includes all NPSs impacting MBNMS watersheds
	Provide technical assistance to implement NPS Program for livestock grazing	RWQCB 5	Central Valley	NPS Program	Organized talk, field tours, individual meetings		x	x			
	Restoration project relying on BMP implementation (e.g. livestock enclosure fencing, stream channel erosion control measures, riparian revegetation)	RWQCB 5	Upper Pit River	NPS Program	Implementation of BMPs		x	x			
	Program for schools to initiate a watershed education program	RWCB5	Upper Pit River	NPS Program	Establish "river center"		x	x			Only partially funded
Track and Monitor	Resurvey participants in rangeland water quality workshops to determine extent of implementation of ranch water quality MPs.	UCCE	Statewide	CWA §319	Annual summary of level of implementation		x	x	x	x	
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure.										

R0018713

Management Measure Category: Agriculture

Management Measure Title: 1F – Irrigation Water Management

Management Measure Targeting Level: Secondary

Objectives:

1. By the year 2003, implement MMs to mitigate or reduce impacts from irrigation waters and drainage discharges.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	Coordinate with WMI and TMDL units to document levels of use and associated impacts to beneficial uses.	RWQCB 4	RWQCB 4		Basin Plan updates/TMDL assessments		x	x	x	x	
	Coordinate TMDL unit work with stakeholders to document levels of use and associated impacts to beneficial uses.	RWQCB 8	Newport Bay watershed				x	x	x	x	
Target	To be completed as specified in Part III.A. – Introduction /Structure.										
Implement	Coordinate with CFB, NRCS, agricultural groups, and educational institutions to promote appropriate irrigation techniques.	NRCS RWQCB	Ventura County	CWA §319	Number of stakeholder meetings		x	x	x	x	
	Quantify measures to reduce impacts from irrigation waters.	Agriculture groups	Ventura County; Newport Bay watershed	CWA §319	Documentation of selected (preferred) measures			x	x	x	RWQCB will coordinate as necessary for completion of TMDLs.
Plan	Develop methods and practices to manage and reduce toxic elements in drainage water.	DWR, DFA, SWRCB	San Joaquin Valley	Proposition 204 funds transfer	Documentation of feasible methods		x	x	x	x	Six-year program with funding under Proposition 204
	Conduct environmental planning for San Luis Drain.	SWRCB, Westlands Water District, USBR	San Joaquin Valley	Agricultural stakeholders	MOU, environmental documentation, discharge permit		x	x	x	x	
	Develop Basin Plan amendment for salt and boron for lower San Joaquin River	RWQCB 5	San Joaquin River	NPS Program	Basin Plan amendment		x	x			

R0018714

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Plan	Develop TMDL for salt and boron in San Joaquin River	RWQCB 5	San Joaquin River	NPS Program				x	x		
	Administer grant to evaluate implementation of economic incentives	RWQCB 5	San Joaquin River	NPS Program	Meetings; final report	x	x	x			
	Develop TMDL for selenium in San Joaquin River	RWQCB 5	San Joaquin River	NPS Program				x	x		
Coordinate	Hold bimonthly RWQCB Irrigated Agriculture Roundtable for information and strategy exchange.	SWRCB	RWQCBs 3, 5, 7	Baseline	Recommendations to SWRCB for NPS management of irrigated agriculture		x	x	x	x	Ongoing
	Participate in the San Joaquin Valley Drainage Implementation Program (SJVDIP).	DWR	San Joaquin Valley	Proposition 204 funds transfer	Revised drainage MP		x	x			
	Participate in stakeholder meetings on salt and boron implementation control plan	RWQCB 5	San Joaquin River	NPS Program	Meeting attendance		x	x	x	x	
Implement	Implement salt and boron control program	RWQCB 5	San Joaquin River	NPS Program				x	x	x	
	Real time management of salt in San Joaquin River	RWQCB 5	San Joaquin River	CALFED			x	x	x	x	
Track and Monitor	Perform effectiveness monitoring for salt and boron control program	RWQCB 5	San Joaquin River	NPS Program	Prepare and issue monitoring orders; receive and review monitoring reports			x	x	x	
	Real time management of salt in San Joaquin River	RWQCB 5	San Joaquin River	CALFED			x	x	x	x	
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure.										

C. Forestry

There are 12 MMs to address various phases of forestry operations relevant to controlling NPSs of pollution that affect State waters. The forestry MMs are for the most part a system of practices used and recommended by the BOF and CDF in rules or guidance.

California's MMs to address silvicultural sources of nonpoint pollution:
2A. Preharvest Planning
2B. Streamside Management Areas
2C. Road Construction/Reconstruction
2D. Road Management
2E. Timber Harvesting
2F. Site Preparation/Forest Regeneration
2G. Fire Management
2H. Revegetation of Disturbed Areas
2I. Forest Chemical Management
2J. Wetlands Forest
2K. Postharvest Evaluation
2L. Education/Outreach

Silviculture contributes pollution to 17 percent of the polluted rivers and 21 percent of the polluted lakes in California (SWRCB, 1996). Without adequate controls, forestry operations may degrade the characteristics of waters that receive drainage from forest lands. For example (1) sediment concentrations can increase due to accelerated erosion, (2) water temperatures can increase due to removal of over-story riparian shade, (3) dissolved oxygen can be depleted due to the accumulation of slash and other organic debris, and (4) concentrations of organic and inorganic chemicals can increase due to harvesting and fertilizers and pesticides.

Management Measures:

Preharvest Planning. Silvicultural activities shall be planned to reduce potential delivery of pollutants to surface waters. Components of MM 2A address aspects of forestry operations, including: the timing, location, and design of harvesting and road construction; site preparation; identification of sensitive or high-erosion risk areas; and the potential for cumulative water quality impacts.

Streamside Management Areas (SMAs). SMAs protect against soil disturbance and reduce sediment and nutrient delivery to waters from upland activities. MM 2B is intended to safeguard vegetated buffer areas along surface waters to protect the water quality of adjacent streams.

Road Construction/Reconstruction. MM 2C requires that road construction/reconstruction shall be conducted so as to reduce sediment generation and delivery. This can be accomplished by following, among other means, preharvest plan layouts and designs for road systems, incorporating adequate drainage structures, properly installing stream crossings, avoiding road construction in SMAs, removing debris from streams, and stabilizing areas of disturbed soil such as road fills.

Road Management. MM 2D describes how to manage roads to prevent sedimentation, minimize erosion, maintain stability, and reduce the risk that drainage structures and stream crossings will fail or become less effective. Components of this measure include inspections and maintenance actions to prevent erosion of road surfaces and to ensure the effectiveness of stream-crossing structures. The measure also addresses appropriate methods for closing roads that are no longer in use.

Timber Harvesting. MM 2E addresses skid trail location and drainage, management of debris and petroleum, and proper harvesting in SMAs. Timber harvesting practices that protect water quality and soil productivity also have economic benefits by reducing the length of roads and skid trails, reducing equipment and road maintenance costs, and providing better road protection.

Site Preparation and Forest Regeneration. Impacts of mechanical site preparation and regeneration operations—particularly in areas that have steep slopes or highly erodible soils or where the site is located in close proximity to a water body—can be reduced by confining runoff on site. MM 2F addresses keeping slash material out of drainageways, operating machinery on contours, timing of activities, and protecting ground cover in ephemeral drainage areas and SMAs. Careful regeneration of harvested forest lands is important in protecting water quality from disturbed soils.

Fire Management. MM 2G requires that prescribed fire practices for site preparation and methods to suppress wildfires should be conducted as feasible in a manner that limits loss of soil organic matter and litter and that reduces the potential for runoff and erosion. Prescribed fires on steep slopes or adjacent to streams and that remove forest litter down to mineral soil are most likely to impact water quality.

Revegetation of Disturbed Areas. MM 2H addresses the rapid revegetation of areas disturbed during timber harvesting and road construction—particularly areas within harvest units or road systems where mineral soil is exposed or agitated (e.g., road cuts, fill slopes, landing surfaces, cable corridors, or skid trails) with special priority for SMAs and steep slopes near drainageways.

Forest Chemical Management. Application of pesticides, fertilizers, and other chemicals used in forest management should not lead to surface water contamination. Pesticides must be properly mixed, transported, loaded, and applied; and their containers must be disposed of properly. Fertilizers must also be properly handled and applied since they also may be toxic depending on concentration and exposure. Components of MM 2I include applications by skilled workers according to label instructions, careful prescription of the type and amount of chemical to be applied, use of buffer areas for surface waters to prevent direct application or deposition, and spill contingency planning.

Wetland Forest Management. Forested wetlands provide many beneficial water quality functions and provide habitat for aquatic life. Under MM 2J, activities in wetland forests shall be conducted to protect the aquatic functions of forested wetlands.

Postharvest Evaluation. The goals of MM 2K are to incorporate postharvest monitoring, including: (a) implementation monitoring to determine if the operation was conducted according to specifications and (b) effectiveness monitoring after at least one winter period to determine if the specified operation prevented or minimized discharges.

Education/Outreach. The goals of MM 2L are to implement pollution prevention and education programs to reduce NPS pollutants generated from applicable silvicultural activities.

Management Measure Category: Forestry

Management Measure Title: Applicable to all MMs

Management Measure Targeting Level: All MMs are designated at the primary level, except for 2G-Fire Management and 2I-Forest Chemical Management which are at the secondary level and 2J-Wetlands Forest which is at the tertiary level.

Objectives:

1. By year 2001, adopt FPR to address watercourse and lake protection zones, roads and landings, exempt and emergency timber operations, mass wasting, and cumulative watershed effects.
2. By year 2003, increase agency staffing, broaden enforcement authority, increase review of THPs, and monitor effectiveness of MPs.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years					Notes
						98	99	00	01	02	
Assess	A number of water bodies are identified on the CWA §303(d) list as having silvicultural activities that contribute to water quality impairments	RWQCBs (excluding RWQCB 8)	Statewide	Current Staff	CWA §303(d) list	x		x		x	
Target	Of the impaired waters noted above, a number of water bodies are targeted for TMDL development by year 2003.	RWQCBs (excluding RWQCB 8)	Statewide	Current Staff	TMDL schedule	x		x		x	
Plan	Review the following issues and prepare recommendations that amend FPR: • Watersheds with ESA or CWA §303(d) listings, • Mass wasting, • Cumulative effects, • Scientific validity of rules for protection of ESA-listed salmonids, • Methodology for watershed assessment and cumulative effects assessment.	CDF, CDMG UC	Statewide, especially North Coast	State	Set of FPR amendments sent to BOF Amendments to CDF administrative manual	x	x				
	Propose modifications of the FPR to the BOF to address TMDLs and requirements of CZARA.	SWRCB RWQCB	Statewide	Budget Change Proposal (BCP) 99-00	Submit proposed FPR package to BOF	x	x	x			

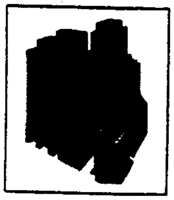
Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	98	99	00	01	02	Notes
	Adopt FPR amendments.	BOF	Statewide	State	FPR adopted by BOF		x	x	x		Rules cannot become effective until calendar year following OAL approval.
					FPR approved by OAL			x	x		
					FPR become effective			x	x	x	
	Prepare and adopt watershed assessment and MP for Jackson State Forest.	CDF RWQCB 1	North Coast	State	Watershed assessment and MP	x	x				Coordinate with Noyo River TMDL.
Coordinate	Ongoing activity as part of FPR adoption	BOF	Statewide	State		x	x	x	x		
	Public review of proposed FPR amendments.	BOF	Statewide	State	Public comments	x	x	x			
Implement	Prepare budget for additional State agency staff to implement and enforce FPR.	CDF DFG RWQCB 1	Statewide, especially North Coast	State	Budgets submitted and approved	x				x	Enhanced MMs implementation
					Additional staff hired and trained		x				
	Implement amended FPR.	CDF	Statewide	State						x	
	Support legislation giving CDF civil administrative authority and substantial penalties to enforce FPR.	SWRCB CDF	Statewide	State	New statues enacted		x				Enhanced MMs enforcement.
	Implement watershed assessment and MP for Jackson State Forest.	CDF RWQCB 1	North Coast	State	Implementation of MP			x			
	Implement projects to reduce fuel loads	RWQCB 5, local agencies	Willow and Stockton Creek watersheds; American River Watershed	Prop 204			x	x	x		
Track and Monitor	Conduct statewide implementation/ effectiveness monitoring program.	CDF	Statewide	State	Monitor 50 sites per year	x	x	x	x	x	
					Provide biennial reports to BOF	x		x		x	

R0018719

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
	Develop and implement administrative and repeated monitoring components.	BOF	Statewide	State	Develop new components Implement new components		x	x	x	x	Administrate = how well did planning evaluate potential impact? Repeated = re-monitor sites after stressing events
	Monitor implementation of MP in Jackson State Forest.	CDF RWQCB 1	North Coast	State	Monitoring of management plan, including instream trend and project monitoring			x	x	x	Instream monitoring component supplements hillslope component
	Monitor effects of hand application herbicides on surface water.	RWQCB 1	North Coast	General Fund	Monitor ten sites per year		x	x	x		
	Increase review of THPs.	RWQCB 1	North Coast	BCP 99-00	25 percent of THPs will be reviewed		x	x	x	x	
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure										

R0018720

D. Urban Areas



The SWRCB, CCC, and other State agencies have identified 15 MMs to address urban NPSs of pollution that affect State waters. With approximately 80 percent of the nation's population living in coastal areas, controlling polluted runoff in urban areas is a challenge. Negative impacts of urbanization on coastal and estuarine waters are well documented in a number of sources, including California's CWA section 305(b) and section 319 reports and the Nationwide Urban Runoff Program.

California's MMs to address urban sources of nonpoint pollution:

- 3.1 Runoff from Developing Areas
  - A. Watershed Protection
  - B. Site Development
  - C. New Development
- 3.2 Runoff from Construction Sites
  - A. Construction Site Erosion and Sediment Control
  - B. Construction Site Chemical Control
- 3.3 Runoff from Existing Development
  - A. Existing Development
- 3.4 On-site Disposal Systems (OSDSs)
  - A. New OSDSs
  - B. Operating OSDSs
- 3.5 Transportation Development (Roads, Highways, and Bridges)
  - A. Planning, Siting, and Developing Roads and Highways
  - B. Bridges
  - C. Construction Projects
  - D. Chemical Control
  - E. Operation and Maintenance
  - F. Road, Highway, and Bridge Runoff Systems
- 3.6 Education/Outreach
  - A. Pollution Prevention/Education: General Sources

Major pollutants found in runoff from urban areas include sediment, nutrients, oxygen-demanding substances, road salts, heavy metals, petroleum hydrocarbons, pathogenic bacteria, and viruses. Suspended sediments constitute the largest mass of pollutant loadings to receiving waters from urban areas. Construction is a major source of sediment erosion. Petroleum hydrocarbons result mostly from automobile sources. Nutrient and bacterial sources include garden fertilizers, leaves, grass clippings, pet wastes, and faulty septic tanks. As population densities increase, a corresponding increase occurs in pollutant loadings generated from human activities. Many of these pollutants enter surface waters via runoff without undergoing treatment.

Urban runoff management requires that several objectives be pursued simultaneously. These objectives include the following (American Public Works Association, 1981):

- Protection and restoration of surface waters by the minimization of pollutant loadings and negative impacts resulting from urbanization;
- Protection of environmental quality and social well-being;
- Protection of natural resources, e.g., wetlands and other important aquatic and terrestrial ecosystems;
- Minimization of soil erosion and sedimentation problems;
- Maintenance of the predevelopment hydrologic conditions;
- Protection of ground water resources;
- Control and management of runoff to reduce or prevent flooding; and
- Management of aquatic and riparian resources for active and passive.

Management Measures:

The control of urban NPS pollution requires the use of two primary strategies: (1) the prevention of pollutant loadings and (2) the treatment of unavoidable loadings. California's urban MMs are organized to parallel the land use development process in order to address the prevention and treatment of NPS pollution loadings during all phases of urbanization. This strategy relies primarily on the watershed approach, which focuses on pollution prevention and source reduction practices. Emphasizing pollution prevention and source reduction practices over treatment practices is favored because conducting education practices and incorporating pollution prevention practices into project planning and design activities are generally more effective, require less maintenance, and are more cost-effective in the long term than treatment strategies. Treatment strategies should only be used to address unavoidable loadings or where they are truly cost-effective.

The major opportunities to control NPS loadings occur during the following three stages of development: (1) the siting and design phase, (2) the construction phase, and (3) the post-development phase. Before development occurs, land in a watershed is available for a number of pollution prevention and treatment options, such as setbacks, buffers, or open space requirements, as well as wet ponds or constructed urban runoff wetlands that can provide treatment of the inevitable runoff and associated pollutants. In addition, siting requirements and restrictions and other land use ordinances, which can be highly effective, are more easily implemented during this period. After development occurs, these options may no longer be practicable or cost-effective. MMs 3.1A through 3.1C address the strategies and practices that can be used during the initial phase of the urbanization process.

The control of construction-related sediment loadings is critical to maintaining water quality. The implementation of proper erosion and sediment control practices during the construction stage can significantly reduce sediment loadings to surface waters. MMs 3.2A and 3.2B address construction-related practices.

After development has occurred, lack of available land severely limits the implementation of cost-effective treatment options. MM 3.6A focuses on improving controls for existing surface water runoff through pollution prevention to mitigate NPSs of pollution generated from on-going domestic and commercial activities.

Management Measure Category: 3.1 – Urban Areas

Management Measure Title: 3.1 – Runoff from Developing Areas; 3.1A - Watershed Protection; 3.1B - Site Development; and 3.1C - New Development

Management Measure Targeting Level: Secondary

Objectives:

1. Provide general goals for State and local agencies to use in developing comprehensive watershed protection programs for guiding future development and land use activities in a manner that will prevent and mitigate the effects of NPS pollution.
2. Reduce the generation of NPS pollutants and mitigate the impacts of urban runoff and associated pollutants that result from new development or redevelopment.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	Develop watershed task forces and coordinate task force efforts with RWQCB programs.	RWQCB 4	Los Angeles Region		• Quarterly meetings • WMI Chapters		x	x	x	x	As needed for WMI and TMDL development and implementation
	Conduct more intensive site-specific evaluations of impacts of Cal/Trans and local government road maintenance practices.	RWQCB 6	Regionwide		Inspections	x	x	x	x	x	
Target	Target applicable MMs through the WMI implementation plans.	SWRCB RWQCBs	Statewide	Current staff	Include MMs in WMI implementation plans	x	x	x	x	x	
	Support the Urban Pesticide Committee (UPC) in its role in coordinating activities of the SF Bay Area and Central Valley agencies and other entities interested in OP pesticides in urban creeks	RWQCB 2, RWQCB 5	Urban areas in SF Bay Area and Central Valley	NPS Program, TMDL funding, and BCPs	Funding of RWQCB staff to conduct UPC meetings and coordinate agency activities			x	x	x	

R0018723

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Plan	Promote watershed planning and the development of regional watershed MPs that include MMs, and foster implementation of these plans.	SWRCB, SCC, CCC, local and regional entities, RCDs, Governor's Office of Planning and Research	Regional Watersheds	CWA §§205j and 319 SB 271 DOC Division Of Land Resources Protection grant program	Development of at least five watershed plans that include MMs and provide for their implementation by 2002. Upgrade CEQA checklist and General Plan guidelines and provide training to local government staffs. Include CAMMPR in the Office of Planning and Research: A Guide to Planning in California. Integrate MMs into Basin Plans as needed.	x	x	x	x	x	
	Review project plans for road construction and maintenance.	RWQCB 6	Region wide		Inspections	x	x	x	x	x	
Coordinate	Provide technical support to cities in development of Urban Runoff Plans using the Model Urban Runoff Program (MURP).	SWRCB, RWQCBs (excluding RWQCB 8), CCC	Statewide (watershed based)	CWA 319 Local governments	Distribute MURP to all Phase II NPDES cities and other local governments on request Develop a CAMMPR guidance module for USEPA sponsored NPDES permit writers conference Host a MURP seminar at the League of Cities Planners Institute	x	x	x	x	x	
	Work with municipalities to develop appropriate grading ordinances aimed at controlling impacts from new development.	RWQCB 3, CCC, MBNMS WQPP in Central Coast RWQCB 6	MBNMS Regionwide	NPDES Storm Water—Non Chapter 15	Grading ordinances	x	x	x	x	x	

R0018724

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Coordinate	Coordinate with developer and regulatory agencies, erosion standards for development.	Local planning agencies, RWQCB 4	Los Angeles Region		Reduction in number of erosion and sedimentation complaints by 50 percent	x	x	x	x	x	
	Conduct BMP workshops for local developers	RWQCB 6, RWQCB 8	Regionwide	NPDES Storm Water—Non Chapter 15	Workshops	x	x	x	x	x	
Implement	Incorporate applicable MMs into NPDES permits that come up for review	SWRCB, RWQCBs, SWQTF	Statewide (watershed based)	NPDES	Incorporation of MMs into NPDES permits that come up for renewal Develop a CAMMPR guidance module for USEPA-sponsored NPDES permit writer's conference.	x	x	x	x	x	
	Review new LCPs, LCPAs, and CDP applications brought before it for appropriate NPS pollution prevention and control.	CCC	Coastal Zone	BCPs		x	x	x	x	x	
	Implement Water Quality Protection Program for Monterey Bay National Marine Sanctuary.	MBNMS WQPP CCC RWQCBs 2 and 3	MBNMS	BCPs CWA §319 NOAA	WQPP Structural and nonstructural controls pilot program (to include elements such as erosion and sedimentation controls, regional urban runoff management strategy, technical training, and public education)		x	x	x	x	
	Work with cities and counties to implement MURP.	CCC, RWQCB 2 and 3, MBNMS WQPP	MBNMS and region wide	BCPs, CWA §319, Local governments	MURP implementation in three new cities or counties			x	x	x	

R0018725

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement	Enforce sites where erosion and sedimentation are uncontrolled.	RWQCB 4	Los Angeles Region			x	x	x	x	x	
	Citizen's Monitoring Program	RWQCB 5	Sacramento River Watershed	NPS Program	Convening workshops		x	x	x		
	Through the UPC, assist municipalities in addressing OP pesticide TMDLs by coordinating work needed to be performed as part of TMDL elements (e.g., source identification, implementation). Work with CDPR through the UPC and in developing urban OP pesticide TMDLs.	RWQCB 2, RWQCB 3	Urban areas in SF Bay Area and Central Valley	NPS Program, TMDL funding	Active participation of CDPR, municipalities and other interested entities (e.g., pesticide registrants, UC Departments) in UPC			x	x	x	
Track and Monitor	Incorporate applicable MMs into Urban TMDL development strategies and implementation plans.	RWQCBs	Watershed Management Areas (WMAs) CWA §303(d) listed water bodies	State and Federal	To be determined			x	x	x	
	Permit tracking five-year review.	RWQCBs (excluding RWQCB 8), CCC	Statewide by Region	State and one-time grant	Increased use of MM and number of WQ issues reviewed in permits					x	To complete performance measures review, one-time funding will be necessary.
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure										

Management Measure Category: Urban Areas

Management Measure Title: 3.4 - On-site Disposal Systems; 3.4A - New On-site Disposal Systems; and 3.4B - Operating On-site Disposal Systems

Management Measure Targeting Level: Secondary

Objectives:

1. Improve coordination among State agencies and between State and local agencies in all matters dealing with OSDS.
2. Develop a consistent statewide and/or regional approach to policy interpretation, regulation, implementation, and development of standards for OSDS to support regional and/or local regulation.
3. Provide financial, technical, and educational assistance to help ensure that OSDSs are located, designed, installed, operated, inspected, and maintained to prevent the discharge of pollutants onto surface water and into ground water.
4. Provide financial and technical assistance for and educational information on "alternative" OSDS technologies (i.e., other than conventional gravity septic tank-leachfield systems).

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	To be completed as specified in Part III.A. – Introduction /Structure										
Target	Provide loans or grants to counties for upgrades to individual systems.	SWRCB, local municipalities	Statewide	SRF loans	Loans provided and individual systems upgraded				x	x	OSDS TAC Recommendation
Plan	Establish uniform statewide standards for minimum criteria for OSDS siting and design (appropriate additional criteria will depend on local geographical and topographical conditions and level of protection required for regional beneficial uses).	SWRCB	Statewide	Proposed BCP	Minimum criteria						OSDS TAC Recommendation
	Review local OSDS-related policies and ordinances of local governments within one or more regions (e.g., within the MBNMS) and evaluate these planning and implementation mechanisms for regional consistency and effectiveness.	CCC in coordination with SWRCB, RWQCBs, and others (excluding. RWQCB 8)	Identified CCAs (e.g., the MBNMS)	CZMA or CWA grants	Matrix and analysis of ordinances, policies, criteria, etc.		x				Modeled after similar recommended action in MBNMS (WQPP) Urban Action Plan

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years					Notes
						98	99	00	01	02	
Coordinate	Assign or redirect SWRCB and/or RWQCB staffs to support OSDS activities.	SWRCB, RWQCBs in coordination with other agencies that have related/ overlapping authority	Statewide	BCPs or redirection of staff; MOUs with other agencies	New OSDS Unit at the SWRCB	x	x	x	x	x	Recommendation in NPS Initiatives Report and OSDS TAC Report
	Develop a Memorandum of Agreement (MOA) between public agencies that operate facilities that use OSDS (e.g., Cal/Trans, DPR, Dept. of Corrections) and the SWRCB, RWQCBs, and local health departments to ensure that the public facilities meet the same technical standards and achieve the same level of scrutiny as other OSDSs.	SWRCB	Statewide	General Funds	MOA		x				Pointed out as a problem in the OSDS TAC report
	Establish a State and/or regional center for the coordination and advancement of OSDS research and development to provide education and training to educators, designers, installers, and regulators of OSDS.	Sea Grant or NEP	Statewide; begin in pilot project area (e.g., CCA or NEP such as SMB NEP)	General Fund appropriated through new legislation	Facility with training materials and website					x	Model after program in Buzzards Bay Project National Estuary Program See also OSDS TAC Report Stakeholder recommendation (Heal the Bay [HTB])
	Develop a program to provide homeowner education and to encourage or require appropriate system operation and maintenance.	Nonprofit in coordination with SWRCB, RWQCBs, (excluding RWQCB 8) local municipalities	Statewide	CWA §319	HomeASyst program developed and used in a reported number of homes.					x	OSDS TAC Recommendation (Can model after the "HomeASyst" program for OSDSs that is implemented in North Carolina and other states)

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement	Provide assistance to local developers in achieving the stated OSDS MM objectives.	SWRCB, RWQCBs (excluding RWQCB 8) in coordination with other agencies that have related/ overlapping authority	Statewide	BCPs or redirection of staff; MOUs with other agencies	New OSDS Unit at the SWRCB	x	x	x	x	x	Recommendation in NPS Initiatives Report and OSDS TAC Report
	Prepare clear and formal guidance concerning the application of existing SWRCB policies as they relate to OSDS.	SWRCB	Statewide	General Funds BCP	Guidance memorandum Update the Minimum Guidelines for the Control of Individual Wastewater Treatment and Disposal Systems by including non-standard systems		x				Recommendation in NPS Initiatives Report and OSDS TAC Report Refers to SWRCB Resolutions No. 68-16 and 88-63 RWQCB 2 suggestion
	Provide technical assistance and oversight on siting and proper application of alternative technology.	SWRCB and RWQCBs	Statewide	General funds	Distribution and Implementation of California On-Site Sewage Disposal System Ordinance, 3/99			x		x	Recommendation in NPS Initiatives Report and OSDS TAC Report
	Adopt statewide performance standards for all OSDSs within the coastal zone by January 2001.	DHS with SWRCB, CCC	Statewide	General Funds	Standards for WDRs			x			See potential requirements in AB 885
	Achieve compliance with above standards within 3 years after adoption of OSDS performance standards.	SWRCB	Statewide	General Funds	Use of 3-tier authority or enforcement actions					x	See potential requirements in AB 885
	Provide technical assistance for assessing cumulative impacts of OSDS and aid local agencies in the development of procedures for addressing cumulative impacts.	SWRCB, RWQCBs, and CCC in coordination with a local government	Pilot project in a critical coastal area (MBNMS or San Luis Obispo County?)	NOAA funds	Development of watershed modeling and cumulative assessment tools (GIS, etc.)			x	x		Recommendation in NPS Initiatives Report and OSDS TAC Report Coordinate with CCC ReCAP Project?

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement	Develop a uniform standard of practice for the inspection of OSDS and pumping of tanks if necessary during real estate transfers or property refinancing.	SWRCB, RWQCB (excluding RWQCB 8)	Statewide							x	OSDS TAC Recommendation
	Establish a State and/or regional center for the coordination and advancement of OSDS research and development (including alternative systems).	Sea Grant or NEP	Statewide; begin in pilot project area (e.g., CCA or NEP such as SMB NEP)	General Fund appropriated through new legislation	Facility with training materials and website					x	Model after program in Buzzards Bay Project NEP See also OSDS TAC Report Stakeholder recommendation (HTB)
	Develop consistent inspection and reporting protocols and certification of inspection forms for septic tank pumpers.	SWRCB, RWQCB (excluding RQWCB 8)	Statewide							x	OSDS TAC recommendation
	Develop data management systems to provide better tracking of inspection, maintenance, and performance information for OSDSs.	SWRCB, RWQCB (excluding RQWCB 8)	Statewide							x	OSDS TAC recommendation
	Provide technical assistance for siting new on-site systems to ensure that (1) suitable septage disposal facilities are available for existing and proposed OSDSs and (2) construction standards were met during and after installation.	SWRCB, RWQCB (excluding RQWCB 8), CCC	Statewide			x	x	x	x	x	
	Develop and implement a program for annual inspection and certification of on-site system compliance to determine that the systems are operating in a manner that protects water quality.	SWRCB, RWQCB	Statewide			x	x	x	x	x	Trigger if other actions do not occur Stakeholder recommendation (HTB)

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement	Review and update the waiver resolutions.	RWQCB 2	Marin, Alameda, Contra Costa, San Mateo, Napa, Solano, Sonoma, Santa Clara Counties	BCP	Update two waiver resolutions per year for eight counties						
	Develop requirements for OSDS-maintenance-related activities (e.g., septic tank pump, switching of leachfields), where appropriate, based on occupancy patterns.	SWRCB, RWQCB (excluding RQWCB 8)	Statewide	Current staff	Guidelines	x		x		x	Stakeholder recommendation (HTB)
Track and Monitor	Support the development of improved OSDS inspection and maintenance practices.										OSDS TAC recommendation
	Evaluate the adequacy of local oversight programs which have been under waiver resolutions with the RWQCB.	RWQCB 2	Marin, Alameda, Contra Costa, San Mateo, Napa, Solano, Sonoma, Santa Clara Counties	BCP	Produce two Evaluation Reports per year for eight counties with findings and recommendations		x	x	x	x	RWQCB 2 suggestion
	Develop a mechanism to track effectiveness and implementation of urban BMPs for OSDSs and sediment/erosion control.	SWQTF	Regional	Contract staff					x		SWQTF subcommittee
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure										

Management Measure Category: Urban Area

Management Measure Title: 3.6A - Education and Outreach

Management Measure Targeting Level: Primary

Objectives:

1. Implement educational programs to provide greater understanding of watersheds.
2. Raise awareness of and increase the use of applicable urban MMs and MPs where needed to control and prevent adverse impacts to surface and ground water.
3. Involve the general public in coastal and watershed protection programs.
4. Improve watershed education in public schools.
5. Improve NPS practitioners' ability to support community-based watershed management.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	To be completed as specified in Part III.A. – Introduction /Structure										
Target	To be completed as specified in Part III.A. – Introduction /Structure										
Plan	Develop urban pesticide control education program.	Local agencies, RWQCBs 2, 4, and 8	Newport Bay, SFB, Los Angeles County	CWA §319	Pesticide control program Household pesticide media campaign			x	x	x	RWQCB 8 suggestion SWQTF/Public Information Public Participation (PIPP) Committee
	Develop and implement a watershed and polluted runoff component into the Adopt-A-Highway Program.	Cal/Trans	Statewide	Cal/Trans	Pollution prevention information given to every Adopt-A-Highway participant			x	x	x	Adopt-A-Highway is currently a Coastal Cleanup Coordinating partner

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Plan	Outreach and education under WMI—stakeholder meetings and workshops.	RWQCB 6	WMI target watersheds (Truckee, Upper Truckee, Carson, Owens, Mojave River watersheds)	CWA §§104/106, 319 Program Cost Account (PCA) 111 (WMI)		x	x	x	x	x	
	Public education—plan and participate in activities such as Air Faire, Truckee River Days, Earth Day, National Wetlands Month; place educational exhibits and make presentations at public schools and in other public places.	RWQCB 6 local agencies	Regionwide	CWA §§104/106, 319 PCA 111 (WMI)		x	x	x	x	x	
Coordinate	Coordinate and participate in training sessions, workshops, and community events.	SWRCB, RWQCBs, CCC	Regional	Current staff	List of events participated in	x	x	x	x	x	RWQCB 3 suggestion
	Integrate watershed and polluted runoff information into public information provided by the CCC's General Education Program.	CCC	Statewide	Current staff	Information on the CCC web page, including links to education and water quality programs, and list of contacts	x	x				
				CCC license plate	Chapter(s) in Coastal Resources Guide and/or Coastal Access Guide(s)					x	CCC's Coastal CPR Plan
	Provide watershed and polluted runoff information at coastal access points—such as State Parks, piers, beaches locations.	DPR, CCC	Statewide	State Parks current staff SCC CCC license plate	Posting of information in existing displays and, where feasible, installation of additional displays Conduct talks with park visitors Conduct special community education events at parks	x	x	x	x	x	CCC's Coastal CPR Plan DPR suggestion
Implement	Implement education component of MURP—a joint project by the City of Watsonville, MBNMS, and CCC.	MBNMS, CCC	Monterey Bay	Cal/RA, CCC current staff	Local education program		x	x			CCC's Coastal CPR Plan
	In public schools, participate in Adopt-a-Watershed and other watershed-awareness activities.	RWQCB 6, local agencies	Regionwide with focus in WMI target watersheds	CWA §§104/106, 319 PCA 111 (WMI)		x	x	x	x	x	

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement		RWQCB 8, local agencies	Regionwide with focus in WMI target watersheds	CWA §§104/106, 319 PCA 436 (NPS)		x	x	x	x	x	
	Use the RWQCB's table top watershed model to demonstrate the water quality impacts from development activities.	RWQCB 6	Regionwide with focus in WMI target watersheds	CWA §§104/106, 319 PCA 111 (WMI)		x	x	x	x	x	
	Prepare newspaper articles and press releases to increase public awareness of watershed issues.	RWQCB 6	Regionwide with focus in WMI target watersheds	CWA §§104/106, 319 PCA 111 (WMI)		x	x	x	x	x	
	Integrate watershed and polluted runoff information into the CCC's General Education Programs and applicable publications.	CCC	Statewide	CCC license plate	Chapter in Save Our Seas Program and SEA Camp curriculum(s)	x	x	x	x	x	CCC's Coastal CPR Plan
	Integrate watershed and polluted runoff information into the CCCs General Education Programs and applicable publications.	CCC	Statewide	CCC license plate	Field monitoring guide for Adopt-A-Beach programs Integrate watershed and polluted runoff messages into Coastal Cleanup media		x	x	x	x	CCC's Coastal CPR Plan
	Distribute a Polluted Runoff Edition of the SCC's magazine *Coast & Ocean*.	SCC	Statewide	SCC	An edition of *Coast & Ocean*			x			Suggested at meeting with SCC
	Support financially the development, distribution, and implementation of K-12 watershed education curriculum.	SWRCB	Statewide	CWA §319	Complete K-12 Watershed Curriculum	x	x	x	x	x	Urban TAC recommendation
	Provide training in use of watershed curricula and development of watershed education programs to teachers and administrators.	SWRCB through Adopt-A-Watershed	Statewide	SRF loan CWA §319	Training for 300 teachers or administrators per year	x	x	x	x	x	Urban TAC recommendation
	Distribute watershed/water quality K-12 appropriate curricula.	SWRCB via Adopt-A-Watershed	Statewide	SRF loan CWA §319	2500 copies per year	x	x	x	x	x	Urban TAC recommendation
	Sacramento River Watershed Program, Public Outreach and Education Subcommittee.	RWQCB 5	Northern Central Valley	Congressional Appropriations	Workshops Technical documents Watershed brochure		x	x	x	x	

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement	Conduct Placer County RCD bioassessment and training seminars and related activities.	Placer County RWQCB 5	Northern Central Valley	CWA §319(h)	Conduct bioassessment training Conduct seminars on sedimentation		x	x			See grant for details.
	Assess watershed and polluted runoff educational programs in California, including public awareness baseline and follow-up surveys and evaluate their effectiveness	CCC	Statewide	CWA §319 CCC License Plate funds Other government or corporate grants	Guide to programs and effectiveness Marine and Coastal Educational Resources Directory		x	x	x	x	CCC's Coastal CPR Plan
Track and Monitor	Assess watershed and polluted runoff educational programs in California, including public awareness baseline and follow-up surveys and evaluate their effectiveness.	CCC	Statewide	California Department of Education Cal/RA	Compendium of State agency programs related to NPS/CZARA Program				x		Most NPS/CZARA State agency partners are involved in California Environmental Education Interagency Network (CEEIN)
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure										

E. Marinas and Recreational Boating Management Measures[24]

Recreational boating and marinas are increasingly popular uses of coastal areas and inland surface water bodies (e.g., lakes and delta). And, they are an important means of public access, and California must balance the need for protecting the environment and the need to provide adequate public access (USEPA, 1993). Because marinas and boats are located at the water's edge, pollutants generated from these sources are less likely to be buffered or filtered by natural processes. When boating and adjunct activities (e.g., marinas and boat maintenance areas) are poorly planned or managed, they may pose a threat to water quality and the health of aquatic systems and may pose other environmental hazards. Sources of pollution associated with marinas and boating include:

- Poorly flushed waterways;
- Pollutants discharged from boats (recreational boats, commercial boats, and "live-aboards");
- Pollutants carried in storm water runoff;
- Physical alteration of wetlands and of shellfish/ other benthic communities during construction of marinas, ramps, and related facilities;
- Pollutants generated from boat maintenance activities on land and in the water.

> California's marina and recreational boating MMs:
>
> 4.1 Assessment, Siting and Design
> - A. Water Quality Assessment
> - B. Marina Flushing
> - C. Habitat Assessment
> - D. Shoreline Stabilization
> - E. Storm Water Runoff
> - F. Fueling Station Design
> - G. Sewage Facilities
> - H. Waste Management Facilities
>
> 4.2 Operation and Maintenance
> - A. Solid Waste Control
> - B. Fish Waste Control
> - C. Liquid Material Control
> - D. Petroleum Control
> - E. Boat Cleaning and Maintenance
> - F. Maintenance of Sewage Facilities
> - G. Boat Operation
>
> 4.3 Education/Outreach
> - A. Public Education

There are 16 MMs to address marina and boating sources of nonpoint pollution. Effective implementation of these MMs can (1) avoid impacts associated with siting marinas and boat maintenance areas, (2) ensure the best available design and construction practices (for new and expanding facilities), (3) ensure appropriate operation and maintenance practices to prevent and/or reduce the delivery of NPS pollutants to State waters, and (4) encourage the development and use of effective pollution control and education efforts. The MMs cover the following operations and facilities:

- Any facility that contains ten or more slips, piers where ten or more boats may tie up, or any facility where a boat for hire is docked;
- Any residential or planned community marina with ten or more slips;
- Any mooring field where ten or more boats are moored;
- Public or commercial boat ramps;
- Boat maintenance or repair yards that are adjacent to the water and any federal, State, or local facility that involves recreational boat maintenance or repair on or adjacent to the water.

The Implementation Plan involves targeting implementation of six of the 16 marina and boating MMs, specifically those measures for water quality assessment, sewage facilities, boat cleaning and maintenance, hazardous waste

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[24] Commercial and military ports are not targeted in this Program Plan because they are subject to the storm water NPDES permits regulating industrial and construction activities. Commercial ports are also required to submit a port master plan (PMP) for certification by the CCC. The PMP must include the conditions contained in Coastal Act section 30711. An NPS-related condition is "an estimate of the effect of development on habitat areas and the marine environment, a review of existing water quality, habitat areas, and quantitative and qualitative biological inventories, and proposals to minimize and mitigate any substantial adverse impact." Section 30711 further states that, "each city, county, or city and county which has a port within its jurisdiction shall incorporate the certified [PMP] in its [LCP]." In addition, activities in military ports are subject to federal consistency review by the CCC, affording the State an opportunity to ensure that appropriate NPS pollution prevention and control measures are in place. Ports located in the San Francisco Bay are under the jurisdiction of SFBCDC and subject to regulations of the MPA.

management, and public education. These MMs and related actions were identified by representatives of the marina and boating community at four meetings held between December 1998 and April 1999 and by the SWRCB, RWQCBs, and CCC. The 1994 Marina TAC Report provided additional recommendations. The 16 MMs are summarized below.

Assessment, Siting, And Design Management Measures:

41.A **Water Quality Assessment.** Consider impacts to water quality in siting and designing new and expanding marinas.

41.B **Marina Flushing.** Site and design marinas to provide for maximum flushing and circulation of surface waters, which can reduce the potential for water stagnation, maintain biological productivity, and reduce the potential for toxic accumulation in bottom sediment.

41.C **Habitat Assessment.** Site and design marinas to protect against adverse impacts on fish and shellfish, aquatic vegetation, and important locally, State, or federally designated habitat areas.

41.D **Shoreline Stabilization.** Stabilize shorelines where shoreline erosion is a pollution problem.

41.E **Storm Water Runoff.** Implement runoff control strategies to remove at least 80 percent of suspended solids from storm water runoff coming from boat maintenance areas (some boatyards may conform to this provision through NPDES permits).

41.F **Fueling Station Design.** Locate and design fueling stations to contain accidental fuel spills in a limited area; and provide fuel containment equipment and spill contingency plans to ensure quick spill response.

41.G **Sewage Facilities.** Install pump out, pump station, and restroom facilities at new and expanding marinas where needed to prevent sewage discharges directly to State waters.

41.H **Waste Management Facilities.** Install facilities at new and expanding marinas where needed for the proper recycling or disposal of solid wastes (e.g., oil filters, lead acid batteries, used absorbent pads, spent zinc anodes, and fish waste as applicable) and liquid materials (e.g., fuel, oil, solvents, antifreeze, and paints).

Operation And Maintenance Management Measures:

4.2A **Solid Waste Control.** Properly dispose of solid wastes produced by the operation, cleaning, maintenance, and repair of boats to limit entry of these wastes to surface waters.

4.2B **Fish Waste Control.** Promote sound fish waste management where fish waste is an NPS problem through a combination of fish cleaning restrictions, education, and proper disposal.

4.2C **Liquid Material Control.** Provide and maintain the appropriate storage, transfer, containment, and disposal facilities for liquid materials commonly used in boat maintenance; and encourage recycling of these materials.

4.2D **Petroleum Control.** Reduce the amount of fuel and oil that leaks from fuel tanks and tank air vents during the refueling and operation of boats.

4.2E **Boat Cleaning and Maintenance.** Minimize the use of potentially harmful hull cleaners and bottom paints and prohibit discharges of these substances to State waters.

4.2F **Maintenance of Sewage Facilities.** Maintain pumpout facilities in operational condition and encourage their use so as to prevent and control untreated sewage discharges to surface waters.

4.2G **Boat Operation.** Prevent turbidity and physical destruction of shallow-water habitat resulting from boat wakes and prop wash.

Education and Outreach Management Measures:

4.3A **Public Education.** Institute public education, outreach, and training programs to prevent and control improper disposal of pollutants into State waters.

Management Measure Category: Marinas and Recreational Boating

Management Measure Title: 4.1A--Water Quality Assessment

Management Measure Targeting Level: Primary

Objectives:

1. By the year 2003, determine baseline water quality conditions in at least 50 percent of California's marinas in targeted geographical regions.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	Inventory existing data on water quality conditions at marinas to identify levels and potential sources of priority pollutants/stressors such as metals (e.g., copper, lead, tributyltin [TBT]), pathogens/high coliform counts, and other pollutants associated with boat discharges/vessel wastes and other recreational boating-related operations).	CCC, RWQCBs	Statewide	CWA §319 or CZMA §6217	Compilation of data from 1998 CWA §303(d) list, §305(b) report, and other sources.		x				Marina TAC and attendees of 1998-1999 stakeholder meetings identified the need for State to provide baseline data to aid in assessing the effectiveness of implementing MPs.
Target	To be completed as specified in Part III.A. – Introduction /Structure										
Plan	To be completed as specified in Part III.A. – Introduction /Structure										

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Coordinate	Provide water quality data to marinas (port captains, harbor masters, lessors, marina owners, etc.) and the public to help identify baseline conditions.	RWQCBs, SWRCB	MBNMS and San Francisco, Tomales, Morro, Santa Monica, and San Diego Bays, Anaheim Bay and Hunting-ton Harbor Marin County (as pilot project in RWQCB 2).	To be determined. BCP	Water quality assessment reports developed and provided to marina operators and for the boating community						Sources of data may include NPDES permits, CWA §401 certifications, CEQA reports, State Mussel Watch Program, and regional surveys (e.g., Coordinated Monitoring Program of the Comprehensive Management Plan for San Diego Bay)
Implement	Establish baseline water quality data at marinas.	RWQCBs, SWRCB	MBNMS and San Francisco, Tomales, Morro, Santa Monica, and San Diego Bays	To be determined.	See above		x			x	
					Plans to establish baseline data at marinas				x	x	
		RWQCB 8 with SWRCB, SCCWRP, DFG (Mussel Watch data), and other entities	Lower Newport Bay and Anaheim/ Huntington Harbor	SWRCB BCP for additional funding SWRCB grant to SCC Wetlands Restoration Project (WRP) Current funds	On-line searchable water quality database	x	x	x	x	x	Limited data are available from BPTCP program; need to update and conduct additional monitoring
Track and Monitor	To be completed as specified in Part III.A. – Introduction /Structure										
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure										

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Management Measure Category: Marinas and Recreational Boating

Management Measure Title: 4.1G and 4.2F--Sewage Facilities Siting, Design, and Maintenance

Management Measure Targeting Level: Primary

Objectives:

1. By the year 2003, establish regional standards for the minimum number of sewage facilities (e.g., fixed, mobile, and/or floating pump outs, dump stations, and restrooms) per recreational vessel in the MBNMS, San Francisco, Tomales, Morro, Santa Monica, and San Diego Bays, and SFB Delta.
2. Provide for the installation and maintenance of an adequate number of sewage facilities in the above-listed regions, and increase accessibility to and use of all facilities.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	Identify water bodies on CWA §303(d) list that are listed for bacteria (or other indicators related to vessel sewage) and that are potentially affected by discharges at marinas.	SWRCB	Statewide assessment		Data provided to marina operators (port captains, harbormasters, lessors, marina owners, etc.) and public		x				See also actions for water quality assessment (MM 4.1A)
	Assess effectiveness of current vessel sewage waste programs in selected regions.	MBNMS WQPP	MBNMS		Assessment and recommendations for changes to current program						
		San Francisco Estuary Project (SFEP)	SFB								
		Morro Bay NEP	Morro Bay								
		SMB NEP	Santa Monica Bay								
		Orange County, City of Newport Beach, RWQCB 8	Lower Newport Bay				x	x			Requirement of Newport Bay fecal coliform TMDL
	Assess whether or not adequate enforcement powers exist for and are being implemented by federal, State, and/or local enforcement personnel.	SWRCB, RWQCBs, DBW	Statewide by region	CWA §319	Assessment and recommendations for new laws if needed			x			Recommendation from 2/99 CCBN meeting

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Target	Expand educational programs aimed at marina operators to (a) promote a better understanding of the need to construct and maintain vessel sewage pump out facilities, (b) get commitment to construct new pump outs; and (c) provide assistance in applying for Clean Vessel Act (CVA) grant funds.	DBW	Statewide by region	CVA	Workshops and education materials	x	x	x	x	x	Recommendation in SFEP letter (1/99)
	Identify future sources of funding for installation of sewage pump out facilities pending reauthorization of CVA.	DBW	Statewide	Current staff	Support for funding in CVA reauthorization		x				
Plan	Establish minimum standards defining what constitutes an "adequate" number of pump outs, dump stations, and/or restroom facilities.	RWQCBs (excluding RWQCB 8) and DBW (coordinate with permit and leasing agencies and regional entities [e.g., MBNMS and NEPs])	Statewide by region (e.g., MBNMS, Santa Monica Bay, Morro Bay, and SFB NEPs, San Diego Bay)	CVA, CWA §319	MOA among SWRCB, RWQCBs, and DBW establishing minimum standards for regions		x	x			Recommendation in 1/19/99 letter from SFEP DBW guidelines are one station per 300 boats—California currently has 125 stations for 85,000+ boats (or less than one station per 680 boats)
Coordinate	Establish agreements regarding the lead or shared responsibility for inspection of pump out facilities.	RWQCBs (excluding RWQCB 8) and local health departments	Statewide by region	Agency General Funds	MAAs or MOUs with appropriate agencies		x	x	x		Recommendation in Marina TAC and Initiatives in NPS Mgmt.
	Establish clear lines of authority for enforcement of violations	RWQCBs and local governments	Statewide by region	Agency General Funds	MAAs by region			x			Recommendation in SFEP letter (1/99)

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Coordinate	Develop and regularly maintain a vessel sewage information clearinghouse to include: • BMPs; • Guidance on how to comply with federal, State, and local laws and regulations; • Examples of effective pump out operations currently used around the State; • Referrals to sources of reliable information.	DBW	Statewide	CVA, CWA §319, and other grants as applicable	Internet web site with information and links to other sites (DBW, UC Sea Grant, USCG Auxiliary, etc.)	x	x	x	x	x	Marina TAC recommendation
Implement	Meet minimum standards through: (a) Financial incentives (e.g., grants to marinas; launch ramp grants to provide dump stations);	DBW	Statewide by region	CVA, CWA §319	Meet standards in target regions by 2003		x	x	x	x	Marina TAC recommendation
	(b) Permit and lease conditions through permit issuance and renewal as appropriate.	City and county government, and other permit and lessor agencies (e.g., CCC, BCDC, SLC, DPR)	Statewide by region	Agency General Funds			x	x	x	x	Marina TAC recommendation
	(c) Recommend or require as necessary that commercial entities install pump out facilities.	RWQCB 2, Marin County Parks and Recreation Department, DPR, and National Park Service	Tomales Bay, Marin County	BCP	Assist commercial entities in applying for CVA grants Install pump out facilities			x x	x x	x x	
	(d) Instigate enforcement program and effectively enforce violations	RWQCBs and local gov'ts	Statewide by region	Agency General Funds		x	x	x	x	x	

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years					Notes
						98	99	00	01	02	
Track and Monitor	Pursue a water quality indicator test specific for human pathogens (e.g., evaluate utility of switching from total and fecal coliform indicators to enterococcus as an indicator of public health risk related to vessel sewage).	SWRCB (Ocean Plan Unit staff)	Statewide	Current staff	Address issue in Ocean Plan Triennial Review			x			Marina TAC recommendation
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure										

Management Measure Category: Marinas and Recreational Boating

Management Measure Title: 4.2E--Boat Cleaning and Maintenance

Management Measure Targeting Level: Primary

Objectives:

1. By the year 2003, develop and establish programs to implement BMPs for underwater hull cleaning and maintenance in 50 percent of marinas in the MBNMS and San Francisco, Morro, Santa Monica, and San Diego Bays.
2. Increase the availability and promote the use of financially feasible hull paints and cleaning materials whose contents are less toxic or that break down to non-toxic levels quickly within the marine environment, and decrease the use and release to State waters of toxic recreational boating hull paints (e.g., TBT and copper-based paints).

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	Identify water bodies on CWA §303(d) list that are listed for copper, tributyltin, detergents (or other indicators related to boat cleaning and maintenance) and that are potentially affected by discharges at marinas.	SWRCB	Statewide assessment		Data provided to marina operators (port captains, harbormasters, lessors, marina owners, etc.) and public		x				See also actions for water quality assessment (MM 4.1A)
Target	Develop education program where divers who clean boats inform boat owners that they work in the water so please do not pollute, and divers provide information about less toxic bottom paints.	Dive groups	Statewide	CWA §319	Educational materials		x	x	x	x	Recommendations from Marina TAC and 12/98 marina stakeholder meeting
Plan	To be completed as specified in Part III.A. – Introduction /Structure										
Coordinate	Develop model ordinances and provide training for local enforcement personnel.	CCC	Statewide by region	To be determined	Training component for local enforcement personnel			x	x	x	Recommendation from 2/99 CCBN meeting
	Develop and regularly maintain a "clearinghouse" of boat cleaning and maintenance information such as: • Boat cleaning and maintenance BMPs; • A shopping guide for non-toxic paints, cleaners, solvents, etc.; • Guidance on how to comply with local, State, and federal laws and regulations; • Referrals to other sources of reliable information.	CCC (coordinate with CCBN)	Statewide	CCC general funds; CWA §319 and other grants as applicable	Internet web site with information and links to other sites (DBW, UC Sea Grant, USCG Auxiliary, etc.)		x			x	Marina TAC recommendation (The CCBN web page provides information at http://ceres.ca.gov/coastalcomm/ccbn/ccbndx.html)

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Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	98	99	00	01	02	Notes
Implement	Implement short-course hull-cleaning training and certification programs and policies using a 2-tier program based on: Tier 1: Self-certification program approved by SWRCB and CCC with specific targets (e.g., 75 percent of boat cleanings in region done by certified divers after four years); Tier 2: Regional certification (trigger to develop regional certification would be if self-certification program fails to meet identified targets).	RWQCBs (excluding RWQCB 8) or regional entity such as the MBNMS WQPP (coordinate with diver trade associations)	Regionally in State, beginning in San Diego, MBNMS, and SFB NEP	CWA §319 Federal dollars passed through NMSs or NEPs	Training and certification program initiated in 1+ regions 95 percent of marinas in above regions certify divers 75 percent of boat cleanings in region done by certified divers			x x	 x		Recommended by Marina TAC, 12/98 marina stakeholder meeting, and MBNMS WQPP. In addition, a strategy in WQPP Action Plan III (Marinas & Boating) is to initiate a regional certification program.
	Promote the use of non-toxic products and target toxic products: (a) Hold a conference addressing recreational boating hull paints;	UC San Diego Cooperative Extension Sea Grant	Statewide	CWA §319, Sea Grant	Conference, with recommendations added to five-year plan		x	x			Recommendation from 12/98 marina stakeholder meeting
	(b) Work with manufacturers, distributors and USEPA to increase research and development and speed up the review and release to market of financially-feasible, non-toxic marine products;	SWRCB and DTSC (coordinate with NMMA)	Statewide	To be determined.	50 percent increase in alternative products in stores		x	x	x		Recommendation from 12/98 marina stakeholder meeting
	(c) Compile a list of options for less toxic products and distribute them through marinas, boatyards, and marine products stores;	CCBN	Statewide	CWA §319, Sea Grant	List of options		x	x	x	x	Strategy in MBNMS WQPP Action Plan III (Marinas and Boating)
	(d) Phase out of the use of toxic hull paints on State and local agency- owned vessels regardless of size;	Cal/RA and Cal/EPA	Statewide	General funds	Certifications by agencies		x	x	x	x	Recommendation from 12/98 marina stakeholder meeting
	(e) Recommend measures to reduce the transport of toxics into State waters from boats that have TBT or other toxic hull paints applied out-of-State;	SWRCB USEPA	California-Mexico border issue	To be determined	Recommendations added to five-year plan		x	x	x	x	Marina TAC recommendation

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement	(f) Assess and promote stripping and refinishing technologies that reduce emissions and discharges, as well as regional guidelines for hull paint preparation to reduce premature detachment from hulls;	Port captains and harbor masters, boatyards	MBNMS pilot project and Statewide	To be determined	Clean technologies manual and guidelines		x	x	x	x	Strategy in MBNMS WQPP Action Plan III (Marinas & Boating)
	(g) Develop legislation that prohibits the sale and use of toxic hull paints, as necessary after a thorough analysis of situation.	SWRCB SCC	Statewide	To be determined	Passage of new legislation					x	Trigger, if toxic paints still widely applied and financially feasible alternatives are available
Track and Monitor	To be completed as specified in Part III.A. – Introduction /Structure										
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure										

Management Measure Category: Marinas and Recreational Boating

Management Measure Title: 4.1H, 4.2A, and 4.2C--Hazardous and Toxic Materials Management

Management Measure Targeting Level: Primary for 4.1H-Waste Management Facilities and 4.2A-Solid Waste Control

Secondary for 4.2C-Liquid Material Control

Objectives:

1. Resolve potential regulatory and liability issues that currently discourage many harbor districts and marinas from taking a more active role in hazardous waste management.
2. Develop convenient disposal options for boaters that allow for the drop off and collection of hazardous wastes in marinas and harbors.
3. By the year 2003, develop and implement one or more pilot Temporary Waste Collection Program(s) where 100 percent of marinas in the pilot region(s) are included as collection points during the regular recruitment of common household hazardous wastes by municipalities and counties.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	Assess existing hazardous waste disposal and used oil recycling services available to California boaters in order to identify gaps in service.	CCC, SFEP, and Santa Monica Bay Restoration Project	Statewide by region	CIWMB	Report to CIWMB and public	x	x	x			A survey of marinas in Northern and Southern California has been conducted by the CCC's BCGC.
Target	To be completed as specified in Part III.A. – Introduction /Structure										
Plan	To be completed as specified in Part III.A. – Introduction /Structure										
Coordinate	To be completed as specified in Part III.A. – Introduction /Structure										
Implement	Resolve issues discouraging harbors and marinas from temporarily storing hazardous and toxic materials generated by boaters (such as waste oil, batteries, paints, solvents, antifreeze, detergents, and contaminated fuels) until pickup and/or recycling by local waste management agencies. (For example, investigate the possibility of obtaining categorical exemptions for harbors for periodic collection and/or transport of small quantities of hazardous materials.)	DTSC, City and County Household Hazardous Waste (HHW) agencies	MBNMS pilot project and Statewide	CWA §319	MOA (e.g., between DTSC, HHW agencies, RWQCBs, SWRCB, and Port Captains and Harbor Masters Association) or new legislation			x			Recommendations from Marina TAC, 12/98 and 1/99 marina stakeholder meetings, and MBNMS WQPP Action Plan III (Marinas & Boating)

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years					Notes
						98	99	00	01	02	
Implement	Coordinate waste disposal and recycling programs to include marinas as a collection point during the regular recruitment of common household hazardous wastes. Key steps may include: • Plan development of temporary waste collection program that includes recycling programs for waste oil and batteries; • Obtain funding; • Develop sites; • Establish procedures to handle materials at collection points within designated harbors and marinas; • Implement pickup services program; and • Implement education programs.	City and County Environ-mental Health and HHW Departments (coordinate with waste management districts and port captains and harbor masters; in MBNMS coordinate with WQPP)	MBNMS pilot project and Statewide	SWRCB, DTSC, and/or CIWMB grants			x	x	x	x	Marina TAC recommendation (Marina TAC identified waste oil and batteries as the two most voluminous hazardous wastes) See also Strategy M.4 in MBNMS WQPP Action Plan III (Marinas & Boating)
Track and Monitor	To be completed as specified in Part III.A. – Introduction /Structure										
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure										

Management Measure Category: Marinas and Recreational Boating

Management Measure Title: 4.3--Education/Outreach

Management Measure Targeting Level: Primary

Objectives:

1. Communicate to boaters and owners/operators of marinas and boatyards the environmental and economic impacts of pollution; identify and increase the awareness and use of MMs and BMPs where needed to prevent and control adverse impacts associated with marinas and boats.
2. Enhance and coordinate State educational, technical and financial assistance, and enforcement programs to assist the boating community's efforts to implement MMs to prevent and control polluted runoff from marinas, boat yards, and boating activities.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	Assess existing pollution prevention and control programs regionally and/or statewide.	DBW CCC	Statewide								
	Assess existing efforts to develop coordinated regional or watershed-based public education and outreach programs related to marina and boat-related activities; identify educational/outreach program needs statewide and expand and build upon effective efforts.	CCBN	Statewide by region	CIWMB, CWA §319, CVA funds, CCC license plate funds, UC Coop. Ext., and other sources		x	x	x	x	x	Marina TAC recommendation. The CCBN is comprised of agency, public and private members.
Target	To be completed as specified in Part III.A. – Introduction /Structure										
Plan	To be completed as specified in Part III.A. – Introduction /Structure										
Coordinate	Continue implementation of the CCC's BCGC, which includes the facilitation of the California CCBN as a forum to conduct public outreach, manage marina and boating impacts, and participate in the development and implementation of NPS MMs and NPS Program strategies and action plans.	CCC	Statewide	CIWMB	Conduct BCGC; develop action plan for the future	x	x				The CCC's BCGC is currently funded through April 2000 only.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement		CCC	Statewide	CIWMB	Marina and Boater education materials including: • 60,000 California Boater kits • Pollution Solutions binders • Catalog of Marina and Boater education materials	x	x	x			To date 30,000 California Boater kits have been developed and are being distributed at boat shows, in dock walking programs, and through marine dealerships. The kits contain a "Quick Reference Clean Green Boating" placard and other materials on environmentally sound boating practices.
		CCC	Statewide	CIWMB	Volunteer "Dockwalking" training in Northern and Southern California		x	x			Focuses on training trainers. Approximately 100 people attended an April 1999 dock walking training in SFB area. An additional training in San Diego/ Los Angeles regions is planned in 1999.
		CCC	Statewide	CIWMB	Conferences	x	x	x	x	x	Partnering with local agencies, the CCC co-hosted two conferences in 1998 addressing boat pollution reduction strategies

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Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Implement		CCC	Southern California	CIWMB	Research of target groups in Southern California		x				
	Conduct education workshop.	SFEP, RWQCB 2	Marin County	BCP	Education brochure and workshop		x				
	Post-educational information at boat ramps and other areas.	DPR, DBW, CCC, Santa Monica Bay Restoration Project	Statewide	CIWMB, SCC, CCC license plate	Posting of information in existing displays; installation of new displays	x	x				To date, CCC has installed more than 250 signs around the State to date.
Track and Monitor	To be completed as specified in Part III.A. – Introduction /Structure										
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure										

F. Hydromodification Management Measures

The SWRCB, CCC, and other State agencies have identified seven MMs to address hydromodification sources of nonpoint pollution affecting State waters. Hydromodification includes modification of stream and river channels, dams and water impoundments, and streambank/shoreline erosion.

California's MMs to address sources of nonpoint pollution related to hydromodification activities:

5.1 Channelization/Channel Modification
- A. Physical and Chemical Characteristics of Surface Waters
- B. Instream and Riparian Habitat Restoration

5.2 Dams
- A. Erosion and Sediment Control
- B. Chemical and Pollutant Control
- C. Protection of Surface Water Quality & Instream and Riparian Habitat

5.3 Streambank and Shoreline Erosion
- A. Eroding Streambanks & Shorelines

5.4 Education/Outreach
- A. Educational Programs

Channel modification activities are undertaken in rivers or streams to straighten, enlarge, deepen, or relocate the channel. These activities can affect water temperature, change the natural supply of fresh water to a water body, and alter rates and paths of sediment erosion, transport, and deposition. Hardening the banks of waterways with shoreline protection or armor also accelerates the movement of surface water and pollutants from the upper reaches of watersheds into coastal waters. Channelization can also reduce the suitability of instream and streamside habitat for fish and wildlife by depriving wetlands and estuarine shorelines of enriching sediments, affecting the ability of natural systems to filter pollutants, and interrupting the life stages of aquatic organisms (USEPA, 1993).

Dams can adversely impact hydrology and the quality of surface waters and riparian habitat in the waterways where the dams are located. A variety of impacts can result from the siting, construction, and operation of these facilities. For example, improper siting of dams can inundate both upstream and downstream areas of a waterway. Dams reduce downstream flows, thus depriving wetlands and riparian areas of water. During dam construction, removal of vegetation and disturbance of underlying sediments can increase turbidity and cause excessive sedimentation in the waterway.

The erosion of shorelines and streambanks is a natural process that can have either beneficial or adverse impacts on riparian habitat. Excessively high sediment loads resulting from erosion can smother submerged aquatic vegetation, cover shellfish beds and tidal flats, fill in riffle pools, and contribute to increased levels of turbidity and nutrients.

Management Measures:

Channelization/Channel Modification. California's MMs for channelization and channel modification promote the evaluation of channelization and channel modification projects. Channels should be evaluated as a part of the watershed planning and design processes, including watershed changes from new development in urban areas, agricultural drainage, or forest clearing. The purpose of the evaluation is to determine whether resulting NPS changes to surface water quality or instream and riparian habitat can be expected and whether these changes will have a detrimental (or negative) impact. Existing channelization and channel modification projects can be evaluated to determine the NPS impacts and benefits associated with the projects. Modifications to existing projects, including operation and maintenance or management, can also be evaluated to determine the possibility of improving some or all of the impacts without changing the existing benefits or creating additional problems. In both new and existing channelization and channel modification projects, evaluation of benefits and/or problems will be site specific.

Dams. The second category of MMs addresses NPS pollution associated with dams. Dams are defined as constructed impoundments that are either: (1) 25 feet or more in height *and* greater than 15 acre-feet in capacity or (2) six feet or more in height *and* greater than 50 acre-feet in capacity. MMs 5.2A and 5.2B address two problems associated with dam construction: (1) increases in sediment delivery downstream resulting from construction and operation activities and (2) spillage of chemicals and other pollutants to the waterway during construction and operation. MM 5.2C addresses the impacts of reservoir releases on the quality of surface waters and instream and riparian habitat downstream.

Streambank and Shoreline Erosion. The third category of hydromodification measures addresses the stabilization of eroding streambanks and shorelines in areas where streambank and shoreline erosion creates a polluted runoff problem. Bioengineering methods such as marsh creation and vegetative bank stabilization are preferred. Streambank and shoreline features that have the potential to reduce polluted runoff shall be protected from impacts, including erosion and sedimentation resulting from uses of uplands or adjacent surface waters. This MM does not imply that all shoreline and streambank erosion must be controlled; the measure applies to eroding shorelines and streambanks that constitute an NPS problem in surface waters.

Education/Outreach. MMs 5.4A focuses on the development and implementation of pollution prevention and education programs for agency staffs and the public, as well as the promotion of assistance tools that emphasize restoration and low-impact development. Education, technical assistance, incentives, and other means can be used to promote projects that: (1) reduce NPS pollutants, (2) retain or reestablish natural hydrologic functions (e.g., channel restoration projects and low-impact development projects), and/or (3) prevent and restore adverse effects of hydromodification activities.

Management Measure Category: Hydromodification

Management Measure Titles: 5.1 – Channelization/Channel Modification; 5.3 – Streambank and Shoreline Erosion; and 5.4-Education/Outreach (Hydromodification)

Management Measure Targeting Level: Primary for MM 5.4-Education/Outreach and secondary for all others.

Objectives:

1. By the year 2001, implement CWA §401 certification program regulations to delegate program authority to the RWQCBs.
2. By the year 2002, develop a technical assistance manual that will assist local governments and small businesses with guidelines for designing projects to avoid wetlands and riparian areas.
3. By the year 2001, adopt general WDRs that prescribe channel maintenance activities with minimal threat to water quality.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	To be completed as specified in Part III.A. – Introduction /Structure										
Target	To be completed as specified in Part III.A. – Introduction /Structure										
Plan	Ensure compliance with CEQA and Porter-Cologne Act when certifying nationwide permits.	USACOE/ SWRCB	Statewide	State Fee	Certification of selected activities	x	x	x	x	x	
	Develop regulations that delegate CWA §401 authority to RWQCBs.	SWRCB	Statewide	State Fee, Grants, BCP	Implementation	x	x	x			
	Develop CEQA guidelines for wetlands and watershed analysis (e.g. an appendix to CEQA guidelines).	SWRCB, CCC, Office of Planning and Research	Statewide	State Fee, Grants, BCP	Modified CEQA guidelines	x	x	x	x	x	
	Develop a technical assistance program for project design that will include guidelines for designing projects to avoid wetlands and riparian areas.	SWRCB	Statewide	State Fee	Guidance to RWQCBs and local government on MPs, model ordinance provisions, methods of establishing setbacks	x	x	x	x		
	Participate in regional floodplain planning activities, such as Bay Area Wetlands Planning Group (BAWPG).	Various	Regional	CWA §319	Statewide application of regional initiatives	x	x	x	x	x	

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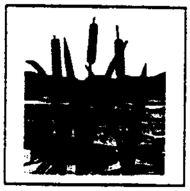
Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Plan	• Develop a framework linking stream, hydrological, and ecological functions to beneficial uses, • Develop criteria for protecting ecological functions and other beneficial uses of streams, • Prepare staff report for Basin Plan Amendment • Draft Stream Protection Policy	RWQCB 2	Regionwide		• A report linking beneficial uses to stream functions specific to the Bay Area • Outline criteria for protecting beneficial uses of streams specific to the Bay Area • Draft staff report to initiate Basin Planning process • Draft Stream Protection Policy	x x x x	x x x x	x x x x	x x x x	x x x x	
Coordinate	Establish formal agreements between agencies on program-level issues in order to streamline the permitting process and better protect resources.	SWRCB, RWQCBs, DFG, CCC, USACOE, USEPA, USFWS	Statewide	State Fee, Grants, BCP	Joint application forms, consolidated permits, MOUs or MAAs	x	x	x	x	x	
	Participate in USEPA Floodplain Management Group to develop guidance on floodplain management.	USEPA	Statewide	CWA §319	Guidance	x	x	x	x	x	
	Work cooperatively with USACOE on modifying and improving emergency permits.	USACOE/ SWRCB	Statewide	State Fee	Certification of Emergency Permits	x	x	x	x	x	
	Coordinate wetlands-related projects in southern California with the work of the wetlands recovery project.	SCC, RWQCB 8	Southern California	?	Include projects in WRP database	x	x	x	x	x	
	Conduct stakeholder workshops.				Convene a technical forum and summary of comments from workshops	x	x	x	x	x	
Implement	Education (see actions under Urban, Education MM)					x	x	x	x	x	

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years					Notes
						98	99	00	01	02	
Implement	Assist entities engaged in hydromodification activities by disseminating up-to-date technical information on: flood management methods which preserve natural riparian values; construction and long-term maintenance costs of traditional and alternative flood management approaches; setbacks in floodplains and designating floodways; examples of existing ordinances and policies which minimize the need for channelization and channel hardening.	SWRCB	Statewide	State Fee, Grants, BCP	Technical Documents	x	x	x	x	x	
	a) Adopt general WDRs that prescribe MPs for various channel maintenance activities that pose minimal threat to water quality. b) Initiate enforcement actions when necessary.	RWQCB 2, SWRCB, Bay Area Storm Water Management Agencies Association (BASMAA), USACOE	Regionwide	CWA §319, CWA §104	a. Attend monthly meetings to identify MPs with associated channel maintenance activities b. Adopt general WDRs by RWQCB 2	x	x	x			
	Construct wetlands improvements	RWQCB 5 and local agencies	Cache Creek	Prop. 204			x	x	x		
Track and Monitor	Monitor for water quality improvement resulting from wetlands improvements	RWQCB 5 and local agencies	Cache Creek	Prop. 204			x	x	x		
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure										

G. Wetlands, Riparian Areas, and Vegetated Treatment Systems



The SWRCB, CCC, and other State agencies have identified four MMs to promote the protection and restoration of wetlands and riparian areas and the use of vegetated treatment systems as means to control NPSs of pollution. Wetlands and riparian areas reduce polluted runoff by filtering out runoff-related contaminants, such as sediment, nitrogen, and phosphorus, thus maintaining the water quality benefits of these areas is important. These areas also help to attenuate flows from higher-than-average storm events. This protects downstream areas from adverse impacts, such as channel scour, erosion, and temperature and chemical fluctuations. Changes in hydrology, substrate, geochemistry, or species composition can impair the ability of wetland or riparian areas to filter out excess sediment and nutrients and therefore can result in deteriorated water quality. The following activities can cause such impairment: drainage of wetlands for cropland, overgrazing, hydromodification, highway construction, deposition of dredged material, and excavation for ports and marinas.

California's MMs to protect and restore wetlands and riparian areas and use vegetated treatment systems as means to control pollution from nonpoint sources:

- 6A. Protection of Wetlands & Riparian Areas
- 6B. Restoration of Wetlands & Riparian Areas
- 6C. Vegetated Treatment Systems
- 6D. Education/Outreach

Management Measures:

6A **Protection of Wetlands/Riparian Areas.** Implementation of MM 6A is intended to protect the existing water quality improvement functions of wetlands and riparian areas as a component of NPS Programs.

6B **Restoration of Wetlands/Riparian Areas.** Restoration of wetlands and riparian areas (MM 6B) refers to the recovery of a range of functions that existed previously by reestablishing hydrology, vegetation, and structure characteristics. Damaged or destroyed wetland and riparian areas should be restored where restoration of such systems will significantly abate polluted runoff.

6C **Vegetated Treatment Systems.** MM 6C promotes the installation of vegetated treatment systems (e.g., artificial or constructed wetlands) in areas where these systems will serve a polluted runoff-abatement function. Vegetated filter strips and engineered wetlands remove sediment and other pollutants from runoff and wastewater and prevent pollutants from entering adjacent water bodies. Removal typically occurs through filtration, deposition, infiltration, absorption, adsorption, decomposition, and volatilization.

6D **Education/Outreach.** MM 6D promotes the establishment of programs to develop and disseminate scientific information on wetlands and riparian areas and to develop greater public and agency staff understanding of natural hydrologic systems—including their functions and values, how they are lost, and the choices associated with their protection and restoration.

Wetlands, Riparian Areas, and Vegetated Treatment Systems

Management Measure Titles: 6A - Protection of Wetlands and Riparian Areas; 6B - Restoration of Wetlands and Riparian Areas; and 6D - Education/Outreach (Wetlands)

Management Measure Target Level: Primary for MM 6D and secondary for all others.

Objectives:

1. By the year 2001, implement CWA§401 certification program regulations to delegate program authority to the RWQCBs.
2. By the year 2002, develop a technical assistance manual that will assist local governments and small business with guidelines for designing projects to avoid wetlands and riparian areas.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	To be completed as specified in Part III.A. – Introduction /Structure										
Target	To be completed as specified in Part III.A. – Introduction /Structure										
Plan	Ensure compliance with CEQA and Porter-Cologne Act when certifying nationwide permits.	USACOE/ SWRCB	Statewide	State Fee	Certification of selected activities	x	x	x	x	x	
	Develop regulations that delegate CWA §401 authority to RWQCBs.	SWRCB	Statewide	State Fee, Grants, BCP	Implementation	x	x	x	x	x	
	Develop CEQA guidelines for wetlands and watershed analysis (e.g., an appendix to CEQA guidelines).	SWRCB, CCC, Office of Planning and Research	Statewide	State Fee, Grants, BCP	Modified CEQA guidelines	x	x	x			
	Develop a technical assistance program for project design that will include guidelines for designing projects to avoid wetlands and riparian areas.	SWRCB	Statewide	State Fee	Guidance to RWQCBs and local government on MPs, model ordinance provisions, methods of establishing setbacks	x	x	x	x		
	Participate in regional floodplain planning activities, such as BAWPG.	Various	Regional	CWA §319	Statewide application of regional initiatives	x	x	x	x	x	

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Coordinate	Establish formal agreements between agencies on program-level issues in order to streamline the permitting process and better protect resources.	SWRCB, RWQCBs, DFG, CCC, USACOE, USEPA, U.S. Fish and Wildlife Service (USFWS)	Statewide	State Fee, Grants, BCP	Joint application forms, consolidated permits, MOUs or MAAs	x	x	x	x	x	
	Participate in USEPA Floodplain Management Group to develop guidance on floodplain management.	USEPA	Statewide	CWA §319	Guidance	x	x	x	x	x	
	Coordinate wetlands-related projects in Southern California with the work of the wetlands recovery project.	SCC	Southern California	?	Include projects in WRP database	x	x	x	x	x	
Implement	Education (see actions under Urban, Education MM)					x	x	x	x	x	
	Provide financial assistance to encourage environmentally friendly floodplain management.	SWRCB	Statewide	SRF	Various	x	x	x	x	x	
	Provide incentives for flood management approaches that minimize the need for channelization and channel hardening.	SWRCB	Statewide	State Fee, Grants, BCP	Regulatory flexibility, expedited permit review, and waived or reduced fees			x	x	x	
Track and Monitor	To be completed as specified in Part III.A. – Introduction /Structure										
Report Biennially	To be completed as specified in Part III.A. – Introduction /Structure										

H. Critical Coastal Area

Actions

An initial task in the Strategy and the Implementation Plan is to create the CCA Interagency Committee to complete a list of criteria and methods for CCA designation. The Committee will consider the factors listed in the Strategy, as well as other criteria used by other programs to identify sensitive coastal areas. While CCA delineation will be based on special water quality concerns and may deviate from other classifications, the final CCA recommendation to be used by the CCC and SWRCB will fully consider other existing programs. Other programs that will be used to help designate CCAs include the ASBS, NERRs, the MBNMS WQPP, university research programs, TMDLs, and regional monitoring efforts. CCA designation will provide resources to special coastal areas which do not achieve priority ranking within other sections of this plan and will therefore provide solutions to program deficits.

In addition to creating a committee to identify CCA criteria, the Implementation Plan will include these specific actions:

1. Identify and map CCAs using newly developed criteria.
2. Dedicate funding and other resources to areas in which new or substantially expanding land uses may cause or contribute to the impairment of water quality within CCAs.
3. Increase public interest in protecting special coastal habitats by implementing additional MMs, supporting public education and outreach, and continuing local watershed restoration and research efforts within the CCAs.

CCA Coordination

The renewed emphasis by local governments and stakeholders on watershed-scale resource management (including the offshore marine component of watersheds) has provided California with initial information to help identify CCAs and apply additional MMs to these areas. Related programs from which to gain information include:

- The SWRCB has designated CWA section 319(h) funds for restoration efforts in watersheds with impaired water quality or impaired aquatic communities.
- The SWRCB, through the WQCP for the Ocean Plan, designates ASBS in State tidelands and submerged lands and can limit or prohibit discharges in their general proximity.
- The SWRCB BPTCP (CWC §§13390-13396) has identified numerous toxic coastal sediment deposits from urban and agricultural runoff.
- The CCC, RWQCB 4, and other entities are developing a long-term MP for the dredging and disposal of contaminated sediments for coastal waters adjacent to Los Angeles County. This plan must include components for watershed management and source reduction.
- The Cal/RA is leading a statewide work group to identify and coordinate offshore Marine Management Areas, which may be linked to adjacent CCAs.
- The MBNMS WQPP is developing a water quality plan that, when completed, may provide a mechanism to apply additional MMs to CCAs within watersheds draining to Monterey Bay.
- If a TMDL is completed within a designated CCA, the TMDL and CCA activities will be coordinated to help determine if additional MMs are needed.

Critical Coastal Areas

Objectives:

1. Identify and map initial list of CCAs.
2. Develop an ongoing process to identify CCAs and additional NPS MMs to implement as necessary in CCAs.
3. Provide information on CCAs (areas adjacent to impaired, threatened, and/or pristine coastal waters, including ocean waters that fail to attain or maintain Ocean Plan water quality standards) to local, State, and regional decision makers and the public.
4. Review water quality and land use data every two years as part of the CWA §305(b) WQAP.
5. Review the effectiveness of existing MM implementation in CCAs and identify and implement additional MMs as needed to protect and restore CCAs.
6. Update CCA list, maps, and watershed information at least every two years and report on implementation efforts at public hearings every two years.

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Assess	Convene a workgroup or use existing interagency forums, whose mission is to develop a process to identify CCAs and to identify and provide for the implementation of additional MMs in CCAs.	CCC SWRCB	Statewide	Current Staff (CZARA)	Workgroup meetings and process		x		x		The State will provide opportunities for public participation in the development of this process.
	Review the effectiveness of existing MMs in CCAs	CCC, RWQCBs	Regional	Special Grants Mitigation Funds	Regional assessment of CCA WQ issues.		x	x		x	

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Target	Identify and map CCA watersheds, including corresponding: • Areas of regional significance. • Special coastal habitats not a priority within other sections of this plan. • Coastal and ocean waters threatened by reasonably foreseeable increases in pollution loading. • Coastal and ocean waters not meeting water quality standards. • Coastal and ocean waters designated to prohibit degradation of water quality. • Pristine coastal waters.	CCC and SWRCB with RWQCBs	Watersheds that classify as CCAs pursuant to CZARA §6217(b)(2)	Current Staff (CZARA)	CCA list with maps available on Internet Review of CCA list and updates as needed		x		x x		As conditioned in the USEPA/NOAA Findings, CCAs include areas within the MBNMS and areas covered by NPDES storm water permits. The SWRCB and CCC will review lists and maps at public hearings.
Plan	Identify and implement applicable MMs to protect or restore water quality in coastal and ocean waters adjacent to CCAs.	CCC RWQCBs	CCAs	CZARA CWA §319	Implementation strategies and reports on status of implementation.				x	x	
Coordinate	Create CCA work groups to identify available resources and future needs.	CCC, RWQCBs	Coastal California	Current agency resources	Regional and site specific coordination agreements and resource allocation.			x	x		
	Identify key nonprofit and community groups for collaboration on regional CCA classification and review.	CCC CCA Committee	Regional	Current Staff	Number of participating nonprofit/community groups		x	x	x		

Process Element	Actions/ Statements	Lead Agency	Geographic Area	Potential Funding	Performance Measures	Years 98	99	00	01	02	Notes
Coordinate	Convene public review of CCA implementation projects.	CCC RWQCBs	Regional	Current Staff Implementation Grants	Public Comments					x	
Implement	Work with local researchers and agencies to develop Additional MMs.	CCC CCA Committee	Regional and statewide	Special Grants	Modified and New MMs			x	x	x	
	Support funding of additional MM implementation.	CCC SWRCB	CCAs	Special Grants	Additional MM implementation		x	x	x	x	
Track and Monitor	Provide summaries of water quality and land use information for each identified CCA.	RWQCBs, CCC.	CCAs	Current Staff Special Grants	Summaries with data/maps			x		x	
Report Biennially	Provide information on CCA efforts to local, State, and regional decision-makers, regional review committee, and the public.	CCC RWQCBs	Statewide	Current Staff	Meeting presentations			x		x	
	Update CCA list, maps, and watershed information at least every two years, and report on implementation efforts and committee meetings.	CCC, RWQCBs	Statewide	Current Staff (CZARA)	Updated CCA lists and maps Reports of implementation on web site			x		x	

I. Monitoring

Objectives

A. Evaluate the effectiveness of specific MMs or BMPs in improving water quality or achieving water quality standards.
B. Maximize usefulness of monitoring by coordinating effectiveness monitoring with other monitoring programs.
C. Improve usefulness of community-based watershed monitoring efforts by developing and reviewing new methods for ambient and effectiveness monitoring, disseminating quality assurance requirements, and increasing training opportunities.
D. Improve data acquisition, evaluation, and access.

Objective		Actions	Lead Agency	Geographic Area	Potential Funding	Performance Measures	98	99	00	01	02	Notes
		MONITORING EFFECTIVENESS OF BEST MANAGEMENT PRACTICES										
A	1.	Design and implement a monitoring strategy to evaluate effectiveness of BMPs statewide that will:										
	a.	Create criteria to assess functioning of BMPs used to reduce pollution from agriculture, forestry, urban practices, and marinas.	SWRCB UCD	Statewide	State	Functioning assessment criteria		x	x			
	b.	Develop protocols and quality assurance methods for BMP functioning assessment criteria.	SWRCB UCD	Statewide	State	Written protocols, QA Plan		x				
	c.	Monitor functioning of one BMP per sector (agriculture, forestry, urban practices, and marinas) in at least two watersheds.	SWRCB UCD	Statewide	State	Monitoring data		x				
	d.	Develop database on BMP effectiveness.	SWRCB UCD	Statewide	State	Database		x				
	e.	Develop and implement a monitoring strategy to monitor effectiveness of BMPs in reducing NPS pollution. Design a strategy that links to regional/local ambient or project monitoring.	SWRCB, RWQCBs, UCD	Statewide	State	Monitoring strategy, Monitor 9 key watersheds statewide, Report on effectiveness of BMPs			x			
	f.	Evaluate and report effectiveness of rangeland BMPs.	RWQCB 3	Morro Bay	CWA §319 National Monitoring Program	Report						
	g	Disseminate statewide knowledge of BMP effectiveness.	RWQCB 3	Morro Bay	CWA §319 National Monitoring Program	National Conference					x	

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COORDINATION OF MONITORING PROGRAMS												
B	2.	Coordinate BMP effectiveness monitoring with existing monitoring programs (e.g. Mussel Watch, Toxic Substances Monitoring Program, TMDL monitoring, CALFED, USGS, DWR, MBNMS) to better assess reductions in NPS pollution.	SWRCB, RWQCBs (Monitoring Team) UC Davis	Statewide	Current Staff	Regional or watershed-based monitoring strategies		x	x	x	x	Initiatives recommendation
		a. Pilot monitoring strategy in nine key watersheds statewide.	SWRCB, RWQCBs	Statewide	Current Staff CWA §319	Nine monitoring programs				x	x	
	3.	Design and implement ambient monitoring and data evaluation efforts:										
		a. Implement coastal monitoring plan in Central Coast Region.	RWQCB 3	Central Coast Region	Current Staff, State	Monitoring report	x	x	x	x	x	
		b. Coordinate and assist SCC WRP coastal monitoring activities.	Local agencies, RWQCB 4, RWQCB 8 RWQCB 9, USEPA	Southern Coastal areas	To be determined	Coastal monitoring data	x	x	x	x		
		c. Develop and implement watershed-monitoring programs for support of CWA §§305(b) and 303(d) assessments using community partnerships.	RWQCBs	Statewide	To be determined	Monitoring programs, water quality data	x	x	x	x	x	Selected watersheds every two years
		d. Monitor pathogens weekly at popular beaches with summertime urban runoff inputs.	DHS, County Health Departments	Beaches with flowing storm drains and high visitor use	State General Fund	All beaches with flowing storm drains and high visitor use monitored	x	x	x	x	x	Funding secure for FY 98-99 only
	4.	Improve knowledge of NPS contributions to impaired water bodies:										
		a. Monitor pathogens in shellfish areas and upland watersheds to determine sources of contamination.	RWQCBs	Humboldt Bay, Morro Bay, Tomales Bay, North San Diego County	State	Monitoring reports	x	x	x			Funding secure for FY 98-99, FY 99-00 only
		b. Implement monitoring program for TMDL development.	RWQCB 8	Lake Elsinore, Big Bear Lake	To be determined	TMDLs		x	x	x		
		c. Review TMDL compliance monitoring data.	RWQCB 8	Newport Bay	CWA §104/106	Evaluation of TMDL compliance	x	x	x	x	x	Nutrient TMDL, sediment TMDL and fecal coliform TMDL

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B, C, D	5.	Improve understanding of the effects of NPS pollution on the biological integrity of streams:										
	a.	Use DFG's Bioassessment Protocols to assess and evaluate water quality and establish baseline water quality and trend information. Link to GIS layers.	SWRCB and DFG	Statewide	BCP, CWA §319	Baseline agency monitoring and trend data on GIS layers Web accessible	x	x	x	x	x	Statewide coordination of program needed.
	b.	Provide a California bioassessment lab to serve as a source of reference information for bioassessments, including internet and web site.	SWRCB	Statewide	BCP, CWA §319	Reference information available online and at California bioassessment lab Provide information for development of biological criteria	x	x	x	x	x	
B, C, D	6.	Train community members in bioassessment procedures and sedimentation issues.	RWQCBs, RCDs, nonprofit groups	Statewide	CWA §319 grants, e.g. Placer County RCD	# of trainings	x	x	x			
COMMUNITY-BASED WATERSHED MONITORING												
C	7.	Establish a Technical Advisory Council to review and recommend monitoring protocols and quality assurance measures	SWRCB, CARCDs, volunteer monitoring organizations	Statewide	CWA §319	Written review of protocols	x	x	x	x	x	
	8.	Develop and disseminate revised monitoring protocols for community-based monitoring methods. Focus on methods that track implementation or effectiveness of MMs.	SWRCB, UCD, DFG	Statewide	Current Staff, CWA §319	Monitoring protocols, Specialized regional keys for bioassessment.	x	x	x	x	x	
	9.	Develop generic quality assurance plans for monitoring methods.	SWRCB	Statewide	Current staff, BCP	QA plans	x	x	x	x	x	
C, D	10.	Establish regional watershed assessment and monitoring resource centers. Provide technical support, information, and training to NPS practitioners, landowners, and community groups.	Numerous	SFB area, Sacramento watershed, Los Angeles Basin, San Diego, Lake Tahoe	CWA §319 funds, municipal storm water programs, private foundations	Ten trainings per year	x	x	x	x	x	

C, D	11.	Train landowners, community groups, and RCD staff in appropriate watershed monitoring methods.	SWRCB, CARCDs, volunteer monitoring organizations	Statewide	CWA §319	Three trainings per year	x	x	x	x	x	
B, C, D	12.	Establish Sanctuary Citizen Watershed Monitoring Network to link 15 existing monitoring groups; provide standardized training and data sharing.	RWQCB 3, MBNMS WQPP, SWRCB, nonprofit groups	MBNMS	CWA §319	Regional protocols and guidebook; two trainings per year, shared data and equipment	x	x	x	x	x	
	13.	Direct, facilitate, and support technical development and application of citizen monitoring data.	SWRCB, volunteer monitoring organizations	Statewide	BCP, CWA §319	Baseline citizen biological monitoring and trend data with Quality Assessment Quality Control (QAQC).	x	x	x	x	x	
DATA ACCESS												
D	14.	Populate the statewide SWIM with data from NPS watershed assessments and community-based monitoring	SWRCB (Information Management Team) RWQCBs	Statewide	State staff	Ten monitoring projects per year		x	x	x	x	
	15.	Enable public access to SWIM.	SWRCB (Information Management. Team) RWQCBs	Statewide	State staff, EMPACT	On-line database of discharger, agency and community-based monitoring data				x	x	
D	16.	Populate existing on-line databases (e.g., California Coastal Water Quality Monitoring Inventory, 305b, Surf Your Watershed) with data.	SWRCB, RWQCBs	Statewide	State staff, EMPACT	Up-to-date meta-data for major monitoring programs, Two on-line databases linked to SWIM					x	

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APPENDICES

APPENDIX A. MEETING FEDERAL REQUIREMENTS

Federal Requirements Under Section 319 Of CWA
Check List on Nine Key Elements

Index for the Nine Key Elements of an Effective NPS Program as described in the USEPA NPS Program and Grants Guidance for Fiscal Years 1997 and Future Years (May 1996)

1. ***The State program contains explicit short- and long-term goals, objectives, and strategies to protect surface and ground water.***

a.	The California program includes a Vision Statement.	1
b.	California has specified MMs as long-term goals to be implemented by 2013 directed toward the expeditious achievement and maintenance of beneficial uses of water.	CAMMPR, 1
c.	Short-term (e.g., 1-5 year) objectives and activities have been specified for implementing the MMs that are linked to the vision statement.	86
d.	The California program addresses both surface and ground water.	1
e.	California has identified performance measures that will be used to assess the State's success in achieving its goals and objectives.	86
f.	Implementation strategies have been prepared that identify activities and the expected effects of those activities on water resources.	86, WMI Chapters

2. ***The State strengthens its working partnerships and linkages with appropriate State, Tribal, regional, and local entities (including conservation flood control districts), private sector groups, citizens groups, industry groups, and Federal agencies.***

a.	The State relies on several statewide partnerships to provide for input and recommendations from representatives of federal, State, Tribal, and local agencies, private sector groups, and citizens groups, regarding NPS program direction, project selection, and other similar aspects of program administration.	45
b.	These partnerships meet regularly and promote collaborative and inclusive decision making.	50
c.	The State program specifies procedures to provide for periodic public input into the program.	45
d.	California's program actively supports broad-based local watershed efforts that incorporate a variety of organizations and interests into the implementation of NPS activities.	39
e.	The State uses its partnerships effectively to promote comprehensive solutions that avoid the transfer of problems among environmental media.	51

3. ***The State uses a balanced approach that emphasizes both statewide NPS programs and on-the-ground management of individual watersheds where waters are impaired and threatened.***

a.	The SWRCB and RWQCBs' WMI document is a multi-year work plan that contains NPS implementation actions directed at both specific priority watersheds and activities of a statewide nature.	39
b.	The SWRCB/RWQCBs prepare annual work plans for CWA Section 319 funding, consistent with the WMI document that contains NPS implementation actions directed at both specific priority watersheds and activities of a statewide nature.	42
c.	The CCC has prepared a Polluted Run-off Strategy that is a multi-year work plan that contains NPS implementation actions directed at both specific priority watersheds and activities of a wider scope, consistent with its jurisdiction.	40
d.	State tracks both statewide activities and watershed projects.	71
e.	State has institutionalized its program beyond the annual implementation of CWA section 319 funded activities and projects.	Vol. I
f.	State uses an integrated watershed approach for assessment, protection, and remediation that is well integrated with other water or natural resource programs.	24
g.	Each of the nine RWQCBs adopt Basin Plans that identify existing and potential beneficial uses, establish basin specific water quality objectives, contain implementation, surveillance and monitoring plans, and include enforceable prohibitions against certain types of discharges.	33

4. ***The State program (a) abates known water quality impairments from NPS pollution and (b) prevents significant threats to water quality from present and future activities.***

a.	State has comprehensively characterized water quality impairments and threats throughout the State which are caused or significantly contributed to by NPSs.	25
b.	State program addresses all significant NPS categories and subcategories and promotes pollution prevention through the implementation of appropriate MMs.	CAMMPR
c.	State program has identified specific programs to abate pollution from categories of NPSs which cause or substantially contribute to the impairments identified in its assessments.	CAMMPR
d.	State has identified specific programs to prevent future water quality impairments and threats that are likely to be caused by NPS pollution.	19 CAMMPR

5. ***The State program identifies waters and their watersheds impaired by NPS pollution and identifies important unimpaired waters that are threatened or otherwise at risk. Further, the State establishes a process to progressively address these identified waters by conducting more detailed watershed assessments and developing watershed implementation plans, and then by implementing the plans.***

a.	State water quality assessments (including those performed under CWA sections 305[b], 319[a], 303[d], 314, and others), along with the California Unified Watershed Assessment, form the basis for the identification of the State's planned NPS activities and projects.	25
b.	State activities focus on remediating the identified impairments and threats and on protecting the identified at-risk waters.	25
c.	State has provided for public participation in the overall identification of problems to be addressed in the State program and in the establishment of a process to progressively address these problems.	19, 26
d.	State NPS priorities are communicated to, consistent with, and reflected in program planning and implementation activities by other water resource management agencies operating within the State.	45
e.	State revises its identification of waters and revisits its process for progressively addressing these problems periodically (e.g., once every five years).	9

6. ***The State reviews, upgrades, and implements all program components required by section 319(b) of the CWA, and establishes flexible, targeted, and iterative approaches to achieve and maintain beneficial uses of water as expeditiously as practicable. The State programs include:***
   - ***A mix of water quality-based and/or technology-based programs designed to achieve and maintain beneficial uses of water; and***
   - ***A mix of regulatory, nonregulatory, financial, and technical assistance as needed to achieve and maintain beneficial uses of water as expeditiously as practicable.***

a.	The State program identifies MMs to control NPSs of pollution focusing on measures which will be effective to address the most prevalent types of NPS pollution.	CAMMPR
b.	Identification of regulatory and nonregulatory programs to achieve implementation of the measures.	24
c.	Processes used to coordinate and, where appropriate, integrate various programs used to implement NPS controls in the State.	45
d.	Five-year implementation plans with goals, objectives, and milestones for program implementation and a process to revise these implementation plans twice by 2013.	86
e.	A legal opinion describing the State authorities available for implementing the MMs.	Appendix: Legal opinion
f.	Sources of funding from federal (other than CWA section 319), State, local, and private sources.	62
g.	Monitoring and other evaluation programs to help determine short- and long-term program effectiveness.	69
h.	The State program also incorporates/coordinates with existing baseline requirements established by other applicable federal or State laws to the extent that they are relevant.	30, 45 CAMMPR

7. ***The State identifies federal lands and activities which are not managed consistently with State NPS program objectives. Where appropriate, the State seeks USEPA assistance to help resolve issues.***

a.	The State works with federal agencies to resolve potential inconsistencies among federal programs and activities and the State programs.	52
b.	Where the State cannot resolve federal consistency issues to its satisfaction, it requests USEPA assistance to help resolve the issues.	52
c.	The State coordinates with federal agencies to promote consistent activities and programs and to develop and implement joint or complementary activities and programs.	47

8. ***The State manages and implements its NPS Program efficiently and effectively, including necessary financial management.***

a.	The State fosters plans for watershed projects and statewide activities that are well-designed with sufficient detail to assure effective implementation.	65
b.	The State's watershed projects focus on the critical areas and critical sources within those areas that are contributing to NPS problems.	65
c.	State implements its activities and projects, including all tasks and outputs, in a timely manner.	69
d.	State has established systems to assure that the State meets its reporting obligations.	77
e.	State utilizes the GRTS effectively.	65
f.	State has developed and uses a fiscal accounting system capable of tracking expenditures of both CWA section 319 funds and nonfederal matching funds.	42
g.	NPS projects include appropriate monitoring and/or environmental indicators to gauge effectiveness.	65

9. ***The State periodically reviews and evaluates its NPS management program using environmental and functional measures of success and revises its NPS assessment and its management program at least every five years.***

		Page #
a.	The State has and uses a process to periodically assess both improvements in water quality and new impairments or threats.	69
b.	The State uses a feedback loop based on monitoring and other evaluative information to assess the effectiveness of the program in meeting its goals and objectives, revises its activities, and tailors its annual workplans, as appropriate, in light of its review.	9
c.	The State's annual report successfully portrays the State's progress in meeting milestones, implementing BMPs, and achieving water quality goals.	77

Federal Requirements Under Section 6217 Of CZARA
Check List On Conditions

Index for the section 6217 CZARA Conditions for Program Approval for the California Coastal NPS Program as described in the Program Findings and Conditions issued by USEPA/NOAA, July 1998.

1. ***Include NPS MMs in conformity with the Guidance Specifying MMs for Sources of Nonpoint Pollution in Coastal Waters (EPA, January 1993), issued under the authority of Section 6217(g) of the Coastal Zone Act Reauthorization Amendments of 1990.***

	Page #
a. MMs have been adopted by the SWRCB and CCC for agriculture, forestry, urban areas, marinas and recreational boating, hydromodification, and wetlands and riparian areas.	CAMMPR
b. The State Porter-Cologne Act provides authorities that will be used, as necessary, to implement the MMs, in conformity with CZARA requirements for enforceable policies and mechanisms (see #2 below).	CAMMPR
c. The State and local authorities and programs being used to implement the MMs are clearly described.	CAMMPR, 24
d. Implementation strategies have been developed to implement the MMs statewide by 2013.	24

2. ***Identify authorities that can be used to prevent nonpoint pollution and require management measure implementation, as necessary.***

	Page #
a. The Chief Counsels of the SWRCB and the CCC have prepared legal opinions concerning their respective authorities to implement the MMs for each of the appropriate source categories.	Appendix: Legal Opinions
b. For each of the source categories, the NPS Plan provides a description of the voluntary or incentive-based programs, including the methods for tracking implementation of MMs and evaluating those programs that the State will use to encourage implementation of the MMs.	CAMMPR CZARA Submittal (1995)
c. A description of the mechanisms or processes that link the implementing agencies for each of the source categories with the enforcement agencies and a commitment to use the existing enforcement authorities, where necessary, is included in the State program.	Appendix

3. ***Prepare a fifteen-year program strategy that briefly describes the State's overall approach and schedule to ensure implementation of the MMs and improve water quality within 15 years of the date of conditional approval.***

	Page #
a. California's NPS Program Plan has been "upgraded" to include a Strategy.	24
b. The goal of the NPS Program is to implement the MMs by 2013 (within 15 years of the date of federal conditional approval pursuant to CZARA).	1
c. The program has a process whereby the State will determine the need to use a backup authority and/or to adopt additional enforceable policies and mechanisms to ensure implementation of the MMs within 15 years.	54, 85

4. ***Nested within the longer-term Strategy, prepare a five-year implementation plan that provides more specifics for achieving full implementation of the MMs.***

	Page #
a. The Implementation Plan is more specific than and nested within the longer term Strategy for achieving full implementation of the MMs.	86
b. The Implementation Plan describes when, where, and how program implementation will occur, including mechanisms for tracking and monitoring implementation.	159
c. The Implementation Plan contains interim milestones and benchmarks, including a time frame; and will be updated, as necessary, but at least every five years. Achieving the milestones and benchmarks of these plans will serve as a basis for evaluating progress in achieving program implementation goals.	86
d. The Implementation Plan is designed to ensure adequate progress in achieving the Strategy and is integrated and consolidated with other federal and State water quality programs.	86

5. ***Common program elements required by CZARA (technical assistance, critical coastal areas, additional MMs, administrative coordination, and monitoring) should be included in the 15-Year Program Strategy and Implementation Plan.***

	Page #
a. The program includes mechanisms for ensuring coordination among State agencies and between State and local officials with a role in the implementation of the MMs.	45
b. The program includes activities to provide technical assistance to local governments and the public for implementing MMs.	62
c. A process has been developed to provide for the identification of critical coastal areas.	28
d. The program includes an additional management measure process for developing and revising MMs to be applied in critical coastal areas and in areas where necessary to attain and maintain water quality standards. In addition, the State has described a process to identify additional MMs for forestry necessary to attain and maintain water quality standards.	78, 111
e. California includes in its program a monitoring element to enable the State to assess over time the extent to which implementation of MMs is reducing pollution loads and improving water quality.	69

APPENDIX B. LEGAL OPINIONS

STATE WATER RESOURCES CONTROL BOARD
CHIEF COUNSEL'S STATEMENT
FOR THE
CALIFORNIA'S NONPOINT SOURCE POLLUTION CONTROL PROGRAM

NOVEMBER 1999

CHIEF COUNSEL'S STATEMENT
FOR THE
CALIFORNIA'S NONPOINT SOURCE POLLUTION CONTROL PROGRAM

STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD
OFFICE OF CHIEF COUNSEL
NOVEMBER 1999

CHIEF COUNSEL'S STATEMENT

I hereby certify that in my opinion the State of California can use the Porter-Cologne Water Quality Control Act[1] as a backup authority in the California's Nonpoint Source Pollution Control Program to prevent nonpoint source pollution and to ensure management measure implementation. This authority can be used to address nonpoint source pollution due to agricultural operations, urban sources, marinas, hydromodification activities and wetlands. This authority is described below.

I. INTRODUCTION

In 1990 Congress enacted legislation requiring states with approved coastal zone management programs to prepare and submit a coastal nonpoint pollution control program to the United States Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) for approval.[2] The program's purpose was to restore and protect coastal waters through the implementation of management measures for nonpoint pollution sources. To further this effort, EPA was directed to develop management measure guidance.[3] State programs had to provide for implementation of management measures in conformity with this guidance, referred to as the (g) guidance.[4]

In September 1995, California submitted its program, a joint effort of the California Coastal Commission and the State Water Resources Control Board (State Water Board), to EPA and NOAA. For five nonpoint pollution sources, agricultural operations, urban sources, marinas, hydromodification activities and wetlands, the state proposed voluntary or incentive-based programs to implement the (g) guidance management measures. The state identified the Porter-Cologne Water Quality Control Act (Porter-Cologne) as a backup enforcement authority to ensure management measure implementation.[5]

In 1998 EPA and NOAA conditionally approved California's program.[6] For final program approval, EPA and NOAA require a legal opinion from the State Water Board's

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1 Wat. Code § 13000 et seq.

2 Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA), 16 U.S.C. § 1455b.

3 *Id.* § 6217(g), 16 U.S.C. § 1455b(g).

4 *Id.* § 6217(b), 16 U.S.C. § 1455b(b). See Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, EPA, 840-B-92-002 (January 1993) (Management Measure Guidance).

5 The state also identified Porter-Cologne as a backup authority to implement the forestry management measures. EPA and NOAA found that California's program includes management measures for forestry activities in conformity with the (g) guidance and enforceable policies and mechanisms for implementation. However, the state program needs more management measures. See *infra*, fn. 6.

6 Letter, dated June 30, 1998, to Rusty Areias, Chairman, California Coastal Commission, and John Caffrey, former Chairman, State Water Board, from Jeffrey R. Benoit, Director, Office of Ocean and

Chief Counsel that Porter-Cologne can be used as a backup authority to prevent nonpoint pollution and to ensure management measure implementation[7] for these five sources.[8]

The following discussion addresses this issue. The discussion begins with an overview of Porter-Cologne. It then addresses three specific questions raised by EPA and NOAA regarding Porter-Cologne's use as a backup authority.

II. OVERVIEW OF PORTER-COLOGNE

Porter-Cologne is the primary water quality control law for California. In addition, the act authorizes the state to implement the federal Clean Water Act.[9] Porter-Cologne applies broadly to all state waters, including surface waters, wetlands, and groundwater.[10] Its provisions reflect the legislative intent that activities and factors that could affect the quality of state waters "be regulated to attain the highest water quality that is reasonable . . . ."[11] Porter-Cologne applies to both point and nonpoint sources.[12]

Porter-Cologne is administered regionally, within a framework of statewide coordination and policy.[13] The state is divided into nine regions, each governed by a regional water quality control board (Regional Water Board).[14] The State Water Board oversees and guides the Regional Water Boards through several activities. The State Water Board adopts state policy for water quality control, statewide water quality control plans, and regulations that are binding on the Regional Water Boards.[15] In

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Coastal Resource Management, NOAA, and Felicia Marcus, Regional Administrator, EPA Region 9, transmitting Findings for the California Coastal Nonpoint Program.

[7] The state program has identified 61 management measures for six categories, including agriculture, forestry, urban areas, marinas, hydromodification, and wetlands. These measures are nearly identical to the (g) guidance management measures. The state measures are included in a draft document, dated June 3, 1999, entitled California's Nonpoint Source Pollution Control Program, Vol. II: California Management Measures for Polluted Runoff.

[8] See Final Administrative Changes to the Coastal Nonpoint Pollution Control Program Guidance for section 6217 of [CZARA] (Oct. 1998). This document states that NOAA and EPA will approve those program elements for which the states have proposed voluntary or incentive-based programs, backed by existing state enforcement authority, if the states provide a legal opinion that such authorities can be used to prevent nonpoint pollution and require management measure implementation. The states must also describe the voluntary or incentive-based programs, including the methods for tracking those programs, and the processes that link the implementing agency with the enforcement agency.

[9] 33 U.S.C. § 1251 et seq.; see Wat. Code §§ 13160, 13160.1, 13170, 13370-13389.

[10] See Wat. Code §§ 13000, 13050(e).

[11] *Id.* § 13000.

[12] See *Lake Madrone Water District* v. *State Water Resources Control Board* (1989) 209 Cal.App.3d 163, 171-175, 256 Cal.Rptr. 894 (*Lake Madrone)*; *Tahoe-Sierra Preservation Council* v. *State Water Resoruces Control Board* (1989) 210 Cal.App.3d 1421, 1435, 259 Cal.Rptr. 132; 63 Ops.Cal.Atty.Gen. 51, 53-359 (1980) *(Tahoe-Sierra)*.

[13] See Wat. Code § 13000.

[14] *Id.* §§ 13200, 13201.

[15] See *id.* §§ 1058, 13140-13147, 13170.

addition, the State Water Board must approve regional water quality control plans before they become effective.[16] The State Water Board also adopts statewide general permits.[17] They review Regional Water Board decisions on petitions for review.[18] Finally, the State Water Board exercises budgetary control over the Regional Water Boards and provides centralized legal services to the Regional Water Boards.[19]

A. Planning

Porter-Cologne addresses two primary functions - planning and waste discharge regulation. Porter-Cologne's planning authority extends to any activity or factor which may affect water quality.[20] These factors include, for example, not only waste discharges, but also saline intrusion, reduction of waste assimilative capacity caused by reduction in water quantity, hydrogeologic modifications, and watershed management projects.[21]

Both the State and the Regional Water Boards plan for water quality control. The State Water Board is charged with adopting state policy for water quality control.[22] These policies contain principles and guidelines for long range resource planning, including ground and surface water management.[23] They also contain water quality objectives at key locations for planning and operation of water resource development projects and for water quality control activities.[24] Since 1968 the State Water Board has adopted 13 policies.[25]

In addition to the State Water Board-adopted policies, Porter-Cologne establishes state policy for the coastal marine environment.[26] This policy states that wastewater discharges must be treated to protect present and future beneficial uses, and, where

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[16] *Id.* § 13245.

[17] See *id.* §§ 13263(I), 13377; 40 C.F.R. § 122.28; Cal. Code Regs., tit. 23, § 2235.2.

[18] See Wat. Code § 13320; Cal. Code Regs., tit. 23, §§ 2050-2068.

[19] See Wat. Code §§ 186, 13168.

[20] See *id.* § 13000, 13050(I), 13140, 13142, 13241.

[21] See discussion in Chief Counsel's Statement for the State Nonpoint Source Management Program Administered by the [State Water Board] and the [Regional Water Boards] (October 1988), pp. C-1 through C-2.

[22] Wat. Code §§ 13140-13142.

[23] *Id.* § 13142.

[24] *Ibid.*

[25] These policies cover enclosed bays and estuaries, the use and disposal of inland waters used for powerplant cooling, water quality control, maintaining high quality waters, water reclamation, shredder waste disposal, the underground storage tank pilot program, sources of drinking water, enforcement, investigation and cleanup and abatement of discharges under Water Code section 13304, municipal solid waste, guidance on development of regional toxic hot spot cleanup plans, and pollutant policy for the San Francisco Bay-Delta.

[26] Wat. Code § 13142.5.

feasible, to restore past beneficial uses of the receiving waters.[27] Highest priority must be given to improving or eliminating discharges that adversely affect wetlands, estuaries, and other biologically sensitive areas, important water contact areas, shellfish areas, and ocean areas subject to massive waste discharge.[28]

The State Water Board can also adopt water quality control plans for waters requiring water quality standards under the Clean Water Act (essentially surface waters)[29] and must adopt a water quality control plan for ocean waters and for enclosed bays and estuaries.[30] Water quality control plans designate beneficial uses of water, establish water quality objectives to protect those uses, and contain a program to implement the objectives.[31] The beneficial use designations and water quality objectives together constitute water quality standards for purposes of the Clean Water Act.[32] The program of implementation must describe the nature of actions that are necessary to meet the objectives, including recommendations for action by both private and public entities.[33] The program also includes a time schedule and describes proposed surveillance activities to assess compliance with objectives.[34]

Water quality control plans can prohibit the discharge of waste, or certain types of waste, in specified areas or under certain conditions.[35] The Ocean Plan,[36] for example, prohibits the discharge of waste to 34 coastal "areas of special biological significance".[37]

In addition to the Ocean Plan, current State Water Board-adopted plans include the Thermal Plan,[38] which addresses temperature control in coastal, interstate, estuarine and bay waters, and the Delta Plan,[39] covering San Francisco Bay and the

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[27] *Ibid.*

[28] *Ibid.*

[29] See 33 U.S.C. §§ 1313, 1362.

[30] Wat. Code §§ 13170, 13170.2, 13391. The State Water Board has adopted an ocean plan, entitled Water Quality Control Plan, Ocean Waters of California (1997) (Ocean Plan). The State Water Board adopted a plan for enclosed bays and estuaries in 1991. This plan was rescinded in 1991 in response to an adverse ruling in litigation filed to invalidate the plan. See State Water Board Res. No. 94-87.

[31] Wat. Code § 13050(j).

[32] See 40 C.F.R. § 131.3(i).

[33] Wat. Code § 13242.

[34] *Ibid.*

[35] *Id.* § 13243.

[36] See *supra*, fn. 27.

[37] Ocean Plan, *supra*, fn. 30, ch. V, B; see State Water Board publication entitled "Areas of Special Biological Significance", August, 1998.

[38] Water Quality Control Plan for the Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California (September 18, 1975).

[39] Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (May 22, 1995).

Sacramento-San Joaquin Delta. Plans adopted by the State Water Board supersede any Regional Water Board-adopted plans to the extent of any conflict.[40]

Each Regional Water Board must adopt a water quality control plan for waters within the region.[41] The regional plans must conform with state policy for water quality control,[42] and they must be approved by the State Water Board.[43]

Both state policy for water quality control and state and regional water quality control plans are binding on other state agencies, departments, and boards, unless they are otherwise directed or authorized by statute.[44] In the latter case, they must notify the State or Regional Water Board of their authority for not complying.[45]

B. Waste Discharge Control

1. Permitting

Porter-Cologne also establishes a program to regulate waste discharges that could affect water quality.[46] This program is the principal way that state water quality control policies and plans are implemented. The program covers waste discharges to land as well as to surface and groundwaters.[47] Any person discharging or proposing to discharge waste that could affect water quality must file a report of waste discharge with the Regional Water Board, unless the Regional Water Board waives the filing.[48] A report is also required if the discharger proposes a material change in the character, volume, or location of a discharge.[49] The Regional Water Board must then issue waste discharge requirements to the discharger, unless requirements are waived.[50] The requirements must implement applicable state policies and state and regional water quality control plans.[51] The requirements can also prohibit the discharge of waste or certain types of waste, either under certain conditions or in specified areas.[52]

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[40] Wat. Code § 13170.

[41] *Id.* §§ 13240-13247.

[42] *Id.* § 13240.

[43] *Id.* §§ 13245, 13246.

[44] *Id.* §§ 13146, 13247.

[45] *Ibid.*

[46] See *id.* §§ 13260-13274; 13376-13384.

[47] See *id.*, §§ 13050(e), 13260(a), 13263(a).

[48] See *id.* §§ 13260, 13269, 13376. Persons discharging into a community sewer system are excepted from this requirement.

[49] See *id.* § 13264.

[50] See *id.* §§ 13263, 13269, 13377.

[51] *Id.* §§ 13263, 13377; see id. §13240.

[52] *Id.* § 13243.

The activities subject to regulation under waste discharge requirements include both point and nonpoint source discharges. Under the Clean Water Act, the point source discharge of pollutants to surface waters must be regulated under a National Pollutant Discharge Elimination System (NPDES) permit.[53] A point source is a discernible, confined and discrete conveyance, such as a pipe, ditch, or channel, but excluding irrigated agricultural return flows and agricultural stormwater discharges.[54] Waste discharge requirements for point source pollutant discharges to surface waters serve as NPDES permits for purposes of the Clean Water Act.[55]

Nonpoint pollution sources generally are sources that don't meet the definition of a point source. Nonpoint source pollution typically results from land runoff, precipitation, atmospheric deposition, drainage, seepage, or hydrologic modification.[56] The term "discharge of waste" in Porter-Cologne covers nonpoint, as well as point, sources of pollution.[57]

"Waste" is broadly defined in Porter-Cologne to include sewage and "any and all other waste substances, liquid, solid, gaseous, or radioactive, associated with human habitation, or of human or animal origin, or from any producing, manufacturing, or processing operation . . . ." This definition includes all Attorney General interpretations of the terms "sewage", "industrial waste", and "other wastes" under Porter-Cologne's predecessor legislation.[58] The Attorney General had interpreted the latter terms to include wastes from a variety of activities typically considered nonpoint, such as:

° drainage, flow, or seepage containing debris or eroded earth from logging operations;[59]

° garbage disposal;[60]

° drainage, flow or seepage containing garbage, ashes, mixed refuse, or solid industrial waste from inactive or closed dumps;[61]

° return irrigation or drainage water from agricultural operations;[62]

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[53] See 33 U.S.C. §§ 1311, 1342.

[54] *Id.* § 1362(14).

[55] Wat. Code § 13374.

[56] See Management Measure Guidance, *supra*, fn. 4, p. 1-1.

[57] See *supra*, fn. 11.

[58] *Lake Madrone, supra*, fn. 11, 209 Cal.App. 3d at 169, 256 Cal.Rptr. 894; see Recommended Changes in Water Quality Control, Final Report of the Study Panel to the California State Water Resources Control Board, Study Project, Water Quality Control Program (1969) (Final Report), App. A, p. 23.

[59] 27 Ops.Cal.Atty.Gen. 182, 184 (1956).

[60] 16 Ops.Cal.Atty.Gen. 125, 126-30 (1950).

[61] 27 Ops.Cal.Atty.Gen. 182, 184 (1956).

[62] *Ibid.*

° pesticides improperly applied to waters of the state, or which find their way into waters of the state after application;[63]

° changes in the physical or chemical characteristics of receiving waters caused by extraction of minerals from a streambed;[64] and

° dumping of earth moved from construction operations, or drainage of wastewater from construction sites.[65]

These examples indicate that discharges of waste are not limited to waste disposal but also include releases of pollutants as part of other activities.[66] Hydrological or hydrogeological modifications, for example, that cause the release of wastes into state waters may be regulated under waste discharge requirements.

On the other hand, the Attorney General has concluded that salt water intrusion and reductions in waste assimilative capacity caused by diversions which reduce water quantity are not discharges of waste.[67] These activities may, however, be addressed in state policy for water quality control and state or regional water quality control plans, which are binding on other state agencies.[68]

The Regional Water Boards are primarily responsible for issuing waste discharge requirements and NPDES permits. Waste discharge requirements may be either individual or general, for a category of discharges.[69] The Regional Water Boards may, likewise, adopt either individual or general NPDES permits.[70]

The State Water Board can issue or modify Regional Water Board-adopted waste discharge requirements in response to a petition for review of the requirements.[71] The State Water Board can also issue general waste discharge requirements.[72] The State Water Board has used this authority, for example, to adopt general requirements for small

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[63] 43 Ops. Cal.Atty.Gen. 302, 304 (1964).

[64] 32 Ops.Cal.Atty.Gen. 139, 140-41 (1958).

[65] 16 Ops.Cal.Atty.Gen. 125, 130-31 (1950).

[66] See e.g., *Lake Madrone, supra*, fn. 11 (release of accumulated sediment from a dam held a discharge of waste). See also discussion in Sawyer, *State Regulation of Groundwater Pollution Caused by Changes in Groundwater Quantity or Flow* (1988) Pacific L.J. 1267, 1273-1275.

[67] See 44 Ops.Cal.Atty.Gen. 126, 128 (1964).

[68] See *id.* at 128-130.

[69] See Wat. Code § 13263(a) & (i).

[70] See 40 C.F.R. § 122.28; *id.* § 13377; Cal. Code Regs., tit. 14, §§ 2235.1 & 2235.2.

[71] See Wat. Code § 13320(c).

[72] See Wat. Code § 13263(i). See also section 13274, which requires the State Water Board or a Regional Water Board to adopt general waste discharge requirements for sewage sludge and other biological solids.

domestic wastewater systems.[73] Like the Regional Water Boards, the State Water Board has independent authority to issue individual and general NPDES permits. The State Water Board has issued several general NPDES permits, including two covering stormwater discharges from industrial sources[74] and construction sites,[75] respectively.

2. Investigations

Both the State and Regional Water Boards have broad powers to investigate water quality.[76] They can investigate water quality in connection with any action authorized or required under Porter-Cologne, including the development or review of water quality control plans or waste discharge requirements.[77] Their investigative powers include the authority to conduct sampling; inspect facilities, records, and monitoring equipment; and issue subpoenas for the production of evidence.[78]

The State and Regional Water Boards can require state and local agencies to investigate and report on any technical factors involved in water quality control.[79] In addition, they can require any person who has discharged, discharges, proposes to discharge or is suspected of discharging waste, whether from a point or a nonpoint source, to monitor and report information.[80]

The Regional Water Boards are primarily responsible for inspecting regulated facilities.[81] The State Water Board can enter and inspect a non-NPDES facility in response to a petition for review.[82] The State Water Board also has independent authority to enter and inspect facilities covered under the NPDES permit program.[83]

Recent amendments to Porter-Cologne impose specific responsibilities on the State Water Board with respect to investigating coastal water quality.[84] Subject to the availability of funds, the State Water Board must prepare a report for the Legislature that

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[73] See General Waste Discharge Requirements for Discharges to Land by Small Domestic Wastewater Treatment Systems, Water Quality Order No. 97-10 DWQ.

[74] Waste Discharge Requirements (WDRS) for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities, NPDES General Permit No. CAS000001, Water Quality Order No. 97-03-DWQ.

[75] Waste Discharge Requirements (WDRS) for Discharges of Storm Water Runoff Associated with Construction Activity, NPDES General Permit No. CAS000002, Order No. 92-08 DWQ.

[76] See Wat. Code §§ 183, 186, 13163, 13267(a),. 13383.

[77] See *ibid.*

[78] See *id.* §§ 183, 186, 1080, 13221, 13267, 13383.

[79] See *id.* §§ 13165 & 13225(c).

[80] See *id.* §§ 13267 & 13383.

[81] See *ibid.*

[82] See *id.* § 13320(c).

[83] See *id.* § 13383.

[84] *Id.* § 13181, added by Stats. 1997, c. 899, § 2.

proposes implementing a comprehensive program to monitor the quality of coastal watersheds, bays, estuaries, and their marine resources. The pollutants targeted for monitoring include, at a minimum, bacteria and viruses, petroleum hydrocarbons, heavy metals, and pesticides.[85] The program must include an identification of pollution sources and estimates of total pollutant discharges, to the extent possible, recommended actions that should be undertaken to maintain and improve coastal water quality, and other information.[86]

3. Enforcement

The Regional Water Boards also have primary authority for enforcement. They may choose from a variety of enforcement options.[87] These include notices to comply for minor violations,[88] time schedule orders,[89] cleanup and abatement orders,[90] cease and desist orders,[91] administrative civil liability orders,[92] and referrals to the Attorney General for injunctive relief and civil and criminal penalties.[93] The Regional Water Boards can use their enforcement authority to respond to unauthorized discharges, discharges in violation of waste discharge requirements or prohibitions, discharges that cause or threaten to cause pollution or nuisance, and violations of monitoring or reporting requirements.[94]

The State Water Board is authorized to take enforcement action in certain instances, although the State Water Board normally defers to the appropriate Regional Water Board. The State Water Board can take enforcement action in the first instance for NPDES-related violations.[95] For non-NPDES violations, the State Water Board can use the same enforcement tools as the Regional Water Boards in response to a petition for review of a Regional Water Board action.[96] The State Water Board can also issue notices to comply for minor violations.[97]

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[85] *Ibid.*

[86] *Ibid.* The State Water Board is in the process of contracting with the Southern California Coastal Water Research Project to prepare the report.

[87] See generally Water Quality Enforcement Policy and implementing guidance, State Water Board Res. No. 96-030, as amended by Resolution No. 97-085.

[88] Wat. Code §§ 13399-13399.2.

[89] *Id.* §§ 13300, 13308.

[90] *Id.* § 13304.

[91] *Id.* § 13301.

[92] *Id.* §§ 13261, 13265, 13268, 13323-13327, 13350, 13385, 13399.33.

[93] *Id.* §§ 13261, 13264, 13265, 13268, 13271, 13272, 13304, 13331, 13340, 13350, 13385-13387.

[94] *Ibid.*

[95] See *id.* §§ 13385 & 13386.

[96] See *id.* § 13320(c).

[97] See *id.* § 13399.2.

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C. Other Programs

In addition to the specific planning and waste discharge control provisions discussed above, Porter-Cologne contains other water quality control programs. Chapter 5.6 establishes a program to identify and cleanup toxic hot spots in the state's bays, estuaries, and coastal waters.[98] Toxic hot spots include sites impaired by nonpoint, as well as point, sources of toxic pollution.[99] Plans to remediate these sites can include, in addition to remedial actions, measures to prevent toxic pollution, such as best management practices to address nonpoint pollution sources.

Porter-Cologne addresses a variety of other subjects, including: onsite, subsurface disposal systems;[100] drainage from abandoned mines;[101] storm water enforcement;[102] discharges of methyl tertiary-butyl ether (MTBE) to drinking water sources;[103] regulation of the use of recycled water;[104] waste discharges from houseboats;[105] and the construction and abandonment of water wells, cathodic protection wells and groundwater monitoring wells.[106] Porter-Cologne also contains several programs to provide grants or loans for water quality facilities and programs.[107]

D. Clean Water Act Authority

The State Water Board is "the state water pollution control agency" for all purposes stated in the Clean Water Act.[108] Thus, the State Water Board is authorized to fulfill the state's responsibilities to adopt water quality standards for surface waters, to develop a nonpoint source management program, and to establish total maximum daily loads (TMDLs) for impaired waterbodies.[109]

While the Regional Water Boards typically adopt water quality control plans for waters within their regions, Porter-Cologne specifically authorizes the State Water Board to adopt plans for surface waters that supersede any conflicting regional plans. In

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[98] See *id.* §§ 13390-13396.5.

[99] See *id.* § 13391.5(e); State Water Board's Water Quality Control Policy for Guidance on the Development of Regional Toxic Hot Spot Cleanup Plans (1998).

[100] See Wat. Code §§ 13280-13284.

[101] See *id.* §§ 13397-13398.9.

[102] See *id.* §§ 13399.25-13399.43.

[103] See *id.* § 13285.

[104] See *id.* §§ 13500-13554.3.

[105] See *id.* §§ 13800-13806.

[106] See *id.* §§ 13900-13908.

[107] See *id.* §§ 13400-13433, 13475-13485.

[108] *Id.* § 13160.

[109] See 33 U.S.C. §§ 1313, 1329; Wat. Code §§ 13170, 13170.2, 13240-13247.

addition, the State Water Board can issue water quality certifications under section 401[110] of the act.[111] The State Water Board can accept federal capitalization grants for a state/federal revolving fund loan program to finance construction of publicly owned sewage treatment works,[112] implement the state's nonpoint source management program under section 319,[113] and develop and implement the national estuary program under section 320[114] of the Clean Water Act.[115]

Chapter 5.5 of Porter-Cologne authorizes the State and Regional Water Boards to carry out the NPDES permit program.[116] Chapter 5.5 applies to point source discharges to surface waters, introduction of pollutants into publicly owned treatment works, use and disposal of sewage sludge, and disposal of pollutants into wells.[117]

III. QUESTIONS

A. Question: Can Porter-Cologne be used to (1) prevent nonpoint source pollution and (2) require the implementation of management measures?

Response: Yes, Porter-Cologne can be used to generally prevent nonpoint source pollution and to specifically implement, either directly or indirectly, the (g) guidance management measures. The following discussion describes the State and Regional Water Boards' authority to prevent pollution, methods that they can use to both prevent pollution and require management measure implementation, and the potential impacts of Water Code section 13360.

1. Authority to Prevent Pollution

Porter-Cologne can unquestionably be used to prevent nonpoint source pollution. Under the Dickey Act,[118] the predecessor to Porter-Cologne, the Regional Water Boards' jurisdiction to regulate waste discharges, depended, in part, on whether the discharge created or threatened to create a "condition of pollution".[119] "Pollution" meant a water quality impairment that "does not create an actual hazard to the public health" but that does "adversely and unreasonably affect such waters" for beneficial use, or that

[110] 33 U.S.C. § 1341.

[111] *Ibid.*; see Cal. Code Regs., tit. 14, §§ 3855-3859.

[112] See 33 U.S.C. §§ 1381-1387.

[113] *Id.* § 1329.

[114] *Id.* § 1330.

[115] See Wat. Code §§ 13475-13485.

[116] See *id.* §§ 13370-13388.

[117] See *id.* §§ 13370, 13370.5, 13373, 13376, 13377, 13382, 13383.

[118] Stats. 1949, ch. 1549, as amended. The Dickey Act, originally called the "Water Pollution Control Act", became the "Water Quality Control Act" in 1965. Stats. 1965, ch. 1657.

[119] See 48 Ops.Cal.Atty.Gen. 30, 33-34 (1966), construing former Water Code § 13053.

"adversely and unreasonably affect[s] the ocean waters and bays of the state devoted to public recreation."[120]

The Regional Water Boards'[121] jurisdiction to regulate waste discharges under Porter-Cologne is much broader. The Regional Water Boards do not have to find that a discharge, if unregulated, would create or threaten to create pollution. They can regulate any actual or proposed waste discharge that "could affect" the quality of state waters.[122] Further, they do not have to authorize use of the full waste assimilation capacities of the receiving waters.[123] Rather, they can maintain a margin of safety in waste discharge requirements to assure protection of all beneficial uses.[124]

2. Methods

The State and Regional Water Boards can use Porter-Cologne to generally prevent nonpoint source pollution and to specifically require management measure implementation. There are several ways that this can be done.

(a) Nonpoint Source Management Plan

Under its Porter-Cologne authority, the State Water Board has adopted a Nonpoint Source Management Plan (1988) (NPS Plan). The plan describes a three-tiered management approach to address nonpoint source pollution. The plan focuses on implementation of best management practices as the primary way to meet water quality standards.

The first management tier relies on the dischargers' voluntary implementation of best management practices. The second tier is regulatory encouragement of best management practices. "Encouragement" is through two mechanisms. The State and Regional Water Boards can waive waste discharge requirements on condition that dischargers comply with best management practices. Alternatively, where other agencies can require implementation of best management practices, the boards can enter into agreements with those agencies in which the agencies agree to exercise their authority. In the third tier, the State and Regional Water Boards adopt waste discharge requirements.

The NPS Plan's intent is to prevent nonpoint source pollution through the three-tiered approach. The plan can be used to directly implement the (g) guidance

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120 Former Wat. Code § 13005, Stats. 1919, ch. 1549, as amended.

121 References to the Regional Water Boards in Part III of this statement include the State Water Board, where appropriate. See Part II of this statement for a discussion of the respective authorities of the State and Regional Water Boards.

122 See Wat. Code §§ 13260, 13263.

123 See *id.* § 13263(b).

124 Final Report, *supra*, fn. 58, App. A, p. 59.

management measures in the first and second tiers. The third tier, likewise, can be used to directly or indirectly implement the measures.

To the extent authorized by Water Code section 13360, as discussed below, waste discharge requirements can directly require implementation of the management measures if the management measures implement applicable water quality standards. Waste discharge requirements can also indirectly implement the measures by prohibiting or regulating a nonpoint source activity in such a manner that the discharger must implement the management measures in order to comply. Additionally, waste discharge requirements can, in lieu of establishing effluent limitations, require a discharger to develop and implement a plan, such as a stormwater pollution prevention plan, containing best management practices or other measures, to ensure compliance with applicable water quality standards. The requirements can mandate that the discharger consider the (g) guidance management measures, along with other relevant material, in developing the plan.

(b) Waste Discharge Requirements

Waste discharge requirements issued under Porter-Cologne prevent pollution by implementing applicable water quality control plans and policies. Under Porter-Cologne, "pollution" is an alteration of water quality by waste that unreasonably affects the waters for beneficial uses.[125] Waste discharge requirements must implement the applicable water quality control plan, including the designated beneficial uses and the water quality objectives required to protect those uses.[126] Thus, a discharge that complies with waste discharge requirements should not alter water quality in a manner that causes pollution.

Nonpoint source discharges can be regulated under waste discharge requirements, either individually or as a group. The requirements can directly or indirectly implement the (g) guidance management measures, as described in the above discussion on the NPS Plan.

(c) Waivers

The Regional Water Boards can also use their waiver authority to prevent pollution and implement the management measures. The Regional Water Boards can waive regulation of nonpoint source discharges, either on an individual basis or for a category of discharges.[127] A waiver must be in the public interest, and it is conditional and may be terminated at any time.[128] The Regional Water Boards can waive waste discharge requirements for nonpoint source discharges, either individually or as a group,

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[125] See Wat. Code § 13050(l)(1). "Pollution" also includes water quality alterations that unreasonably affect facilities that serve beneficial uses.

[126] *Id* § 13263(a).

[127] *Id.* § 13269(a).

[128] *Ibid.*

on condition that the dischargers comply with specified best management practices designed to achieve water quality standards. In particular, a waiver for a nonpoint source category could be conditioned on compliance with the applicable (g) guidance management measures, provided that the management measures implemented applicable water quality standards.

(d) Water Quality Certification

The State Water Board certifies activities requiring a water quality certification under section 401 of the Clean Water Act. This section requires applicants for federal licenses or permits to obtain state certification that any discharge of pollutants to surface waters from a proposed activity will comply with the Clean Water Act, including applicable water quality standards. As long as an activity will result in a discharge to surface waters, the State Water Board can use its certification authority to prevent nonpoint source pollution associated with the activity. The State Water Board can include conditions on the entire activity to protect water quality standards, including beneficial uses.[129] In particular, in appropriate cases the State Water Board can condition a section 401 certification on compliance with management measures implementing water quality standards.

(e) Plans and Policies

In addition, the State Water Board and Regional Water Boards can use their planning authority to prevent nonpoint source pollution and to implement the management measures. The State Water Board can adopt state policy for water quality control, and both the State and Regional Water Boards can adopt water quality control plans that address this type of pollution. Both policies and plans are binding on other state agencies.

Water quality control plans must include an implementation program to achieve water quality objectives. Implementation programs can prevent nonpoint source pollution and implement the management measures through several approaches. The programs can recommend that nonpoint source dischargers carry out specific best management practices, including the management measures, in order to achieve water quality standards. The programs can also waive regulation of categories of nonpoint source discharges on condition that the dischargers implement specific best management practices, such as the measures. Alternatively, an implementation program can prohibit nonpoint source discharges, either entirely or partially, in certain areas or under certain conditions. The conditions can include compliance with appropriate best management practices, including the applicable management measures.

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[129] See *PUD No. 1 of Jefferson County v. Washington Dept. of Ecology* (1994) 511 U.S. 700, 114 S. Ct. 1900.

(f) Investigatory Powers

The State and Regional Water Boards can use their broad investigatory authority to foster nonpoint source pollution prevention. Both the State and Regional Water Boards can investigate the scope, causes, and sources of nonpoint source pollution, and potential practices or control measures to prevent it. They can also require that state or local agencies or dischargers conduct this type of investigation. The State and Regional Water Boards can use information obtained from these investigations to, for example, encourage voluntary implementation of best management practices by dischargers, to encourage state or local agencies that regulate nonpoint source activities to require best management practices, or to develop appropriate planning or regulatory programs addressing nonpoint source pollution.

In addition, the State and Regional Water Boards can use their investigatory powers to directly require implementation of several of the management measures. As discussed below, some management measures requires plans, such as erosion control plans.

(g) Enforcement Authority

The Regional Water Boards can use their enforcement authority to require cleanup, abatement, and remediation of sites adversely impacted by nonpoint source pollution, including wetlands and riparian areas.[130] They can also impose administrative civil liability on this basis.[131] The Regional Water Boards can encourage dischargers to consider, as environmental credit projects reducing an administrative civil liability assessment, projects that protect and restore sensitive areas, such as wetlands and riparian areas.[132]

(h) Regulations

As an additional tool, the State Water Board can adopt regulations covering categories of nonpoint source discharges. The State Water Board, for example, has adopted regulations covering waste discharges from confined animal facilities[133] and mining activities.[134] To the extent authorized by Water Code section 13360, as discussed below, the State Water Board can adopt regulations for categories of nonpoint source dischargers, requiring implementation of measures that are appropriate to implement applicable water quality standards.

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[130] See *id.* § 13304.

[131] See *id.* §§ 13350, 13385.

[132] See Guidance to Implement the Water Quality Enforcement Policy, State Water Board (April 1996), pp. 22-23.

[133] See Cal. Code Regs., tit. 27, §§ 22560 - 22565.

[134] See *id.*, §§ 22470-22510.

(i) Other programs

Finally, Porter-Cologne is currently being used to prevent or to remediate nonpoint source pollution in two specific programs. The Regional Water Boards are developing TMDLs for impaired waterbodies within their regions. Many of the TMDLs address ongoing nonpoint source pollution, and these TMDLs include implementation programs to bring the nonpoint source dischargers into compliance with water quality standards. The North Coast Regional Water Board, for example, adopted a sediment TMDL that prohibits the discharge of controllable sources of sediment unless the discharger agrees to implement certain best management practices, to monitor, and to comply with other requirements. In appropriate cases, a TMDL could require that affected nonpoint source dischargers implement applicable management measures in order to achieve water quality standards.

The Bay Protection and Toxic Cleanup Program also addresses nonpoint, as well as point, source pollution. Some of the Regional Water Boards have proposed best management practices as the recommended action to remediate ongoing nonpoint source pollution. The Regional Water Boards could implement the (g) guidance management measures in appropriate cases under this program.

3. Water Code section 13360

(1) Section 13360

Under certain circumstances, Porter-Cologne restricts the State and Regional Water Boards' ability to require dischargers to implement specific practices. Under Water Code section 13360, the boards may not "specify the design, location, type of construction, or particular manner" of compliance with waste discharge requirements or other orders, and dischargers can comply "in any lawful manner."[135] This restriction "is a shield against unwarranted interference with the ingenuity of the party subject to waste discharge requirements", who can "elect between available strategies to comply with the standard."[136]

On the other hand, section 13360 is not violated if, under present technology and the laws of nature, there is only one way to comply with the standard.[137] Thus, for example, a water quality control plan could legally prohibit surface runoff from new development in amounts exceeding the runoff that would occur if certain impervious

[135] Wat. Code § 13360.

[136] *Tahoe-Sierra*, *supra*, fn. 11, 210 Cal.App.3d at 1438-1439, 259 Cal.Rptr. 132.

[137] *Ibid.*; see *Pacific Water Conditioning assn., Inc. v. City Council* (1977) 73 Cal.App.3d 546, 554, 140 Cal.Rptr. 812, 816-17.

coverage limitations were met.[138] It did not matter that the only practical way to comply with the prohibition was to comply with the coverage limitations.[139]

Water Code section 13360 also contains several exceptions. It does not apply to discharges of waste to injection wells.[140] Likewise, the restrictions do not apply to the discharge of solid waste to disposal sites. Waste discharge requirements for these sites can require the construction of dikes, installation of drainage facilities, and other similar measures.[141]

(2) Application to Management Measures

Water Code section 13360 does not restrict management measure implementation. The extent of its applicability depends on the type of measure in question. The management measures fall into several categories. They range from measures requiring plans on how to control nonpoint source pollution to measures that are more prescriptive.

Some management measures require plans. For example, nutrient management plans are required for agricultural activities and erosion and sediment control plans and chemical control plans for construction sites less than 5 acres.[142] Water Code section 13360's restrictions do not apply to this type of management measure. The measures do not dictate the manner of compliance with waste discharge requirements or other board orders, but rather require dischargers to submit plans addressing specific pollution problems. The Regional Water Boards can directly implement this type of management measure under their investigative authority. As discussed previously,[143] they can require anyone who has discharged, discharges, proposes to discharge, or is suspected of discharging waste to file technical or monitoring program reports. They can also require state and local agencies to submit technical reports on water quality control, even though those entities are not waste dischargers. The only restriction is that the burden of preparing the reports bear a reasonable relationship to the need for and the benefits to be obtained from the reports.[144]

Some management measures specify an end result to be achieved. To illustrate, an urban management measure for new development requires that, after construction is completed and a site is permanently stabilized, average annual total suspended solids (TSS) loadings be reduced by 80 percent or to a level no greater than predevelopment

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[138] *Tahoe-Sierra, supra*, fn. 11.

[139] *Ibid.*

[140] Wat. Code § 13360(a)(2).

[141] *Id.* § 13360(a)(1).

[142] Management Measure Guidance, *supra*, fn. 4, pp. 2-52, 4-63, 4-83.

[143] See Part II, B.2 of this Statement.

[144] Wat. Code §§ 13165, 13225(c), 13267(b).

loadings.[145] This can be accomplished by either design or performance. The Regional Water Boards can ensure that this type of management measure is implemented without violating Water Code section 13360 because the measure dictates the end result but leaves the method of compliance up to the site developer.

Other management measures prescribe both the end result and the means of achieving it. This is typified by the agricultural management measure for grazing.[146] Part of this measure seeks to protect sensitive areas, such as streambanks and wetlands, from physical disturbance and direct loading of animal wastes and sediment, by one or more of five options. These include excluding livestock, providing stream crossings or hardened watering access for drinking, and others. The Regional Water Boards can require implementation of this measure, by adding a sixth option allowing a discharger to demonstrate that some other alternative would achieve the same end result, i.e. protection of sensitive areas from adverse, water quality-related, grazing impacts. Alternatively, the Regional Water Boards could indirectly ensure implementation of the management measure by adopting a prohibition against waste discharge in sensitive areas.

Still other management measures require development of watershed protection programs. For example, an urban management measure requires development of a watershed protection program for new development.[147] The program aims at avoiding the conversion, to the extent practicable, of areas particularly susceptible to erosion and sediment loss, preserving areas that provide important water quality benefits, and siting development to protect, to the extent practicable, the natural integrity of waterbodies and natural drainage systems. This type of management measure does not violate Water Code section 13360. It dictates only the end result, e.g., a watershed protection program that achieves several goals. Also, the State and Regional Water Boards would likely implement this management measure by promoting local or regional watershed efforts. Alternatively, the State Water Board could adopt state policy or the State and Regional Water Board could adopt water quality control plan provisions implementing this management measure. Water Code section 13360, on the other hand, only applies to waste discharge requirements or orders issued to waste dischargers.[148]

B. Question: Please describe any other aspect of state law, either contained in Porter-Cologne or in other authorities, that would limit or preclude the use of Porter-Cologne to regulate nonpoint source pollution. Is Porter-Cologne limited in its application to particular sources or geographic areas? Is it otherwise limited?

Response: The nonpoint sources for which California seeks to use Porter-Cologne as a backup authority are subject to Porter-Cologne. Porter-Cologne is not

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[145] Management Measure Guidance, *supra*, fn. 4, p. 4-12.

[146] *Id.* at p. 2-73.

[147] *Id.* at p. 4-36.

[148] See *People v. Barry* (1987) , 194 Cal.App.3d 158, 180-181, 239 Cal.Rptr. 349, 363-364.

limited in its application, geographically or otherwise, to these sources. Under Porter-Cologne, the State and Regional Water Boards can regulate any activity that results in a waste discharge that can affect water quality. Activities that affect water quality, but that do not involve a waste discharge, can be addressed under the State and Regional Water Board's broad planning authority. The five nonpoint sources for which the state intends to use Porter-Cologne as a backup authority are discussed below.

(1) Agricultural Activities

The (g) guidance lists pollutants that cause agricultural nonpoint source pollution. These include: nutrients, sediments, animal wastes, salts, pesticides, and habitat impacts due to grazing.[149] The Regional Water Boards can clearly regulate the discharge of pollutants from agricultural activities, including those listed, that can affect water quality. Likewise, the Regional Water Boards can regulate grazing or other agricultural activities that directly or indirectly cause the release of pollutants, such as sediments or animal wastes, that can affect water quality.

Porter-Cologne's legislative history indicates that the act was not meant to limit the Regional Water Boards' preexisting authority under the Dickey Act to regulate the discharge of agricultural wastes.[150] Further, "waste" for purposes of regulation under Porter-Cologne was meant to include all materials that the Attorney General had concluded were "waste" under the Dickey Act.[151] These materials included irrigation return flows and drainage water from agricultural activities, pesticides, herbicides, and other agricultural chemicals. The legislative history also indicates that, while these wastes are clearly subject to regulation, the Regional Water Boards can choose to waive waste discharge requirements, either with or without conditions, for agricultural operations where a waiver is not against the public interest.[152]

In addition to regulating waste discharges, the State and Regional Water Boards can address any activity or factor affecting water quality in their planning capacities.[153] They are not restricted to addressing only the impacts of waste discharge. State agencies, departments, and boards must comply with state policy for water quality control and statewide and regional water quality control plans, unless otherwise directed by statute. In addition, water quality control plans can contain recommendations for action by any entity, public or private. Before implementing any agricultural water quality control plan, however, the Regional Water Boards have to indicate an estimate of the total cost of the program and identify potential sources of financing.[154]

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[149] Management Measure Guidance, *supra*, fn. 4, pp. 2-4 through 2-11.

[150] Journal of the California Assembly 2679 (Reg. Sess. 1969).

[151] See discussion in Section II. B. 1. of this statement.

[152] See fn. 150, *supra*.

[153] See discussion in Section II.A. of this statement.

[154] Wat. Code § 13141.

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(2) Urban Sources

The (g) guidance addresses six major categories of urban nonpoint pollution.[155] These include runoff from developing areas, construction sites, and existing development. Onsite disposal systems; general sources, such as households, commercial sites and landscaping; and roads, highways and bridges are also included. The principal pollutants found in urban runoff are sediments, nutrients, oxygen-demanding substances, pathogens, salts, hydrocarbons, heavy metals, and toxic substances.[156]

Urban runoff containing wastes, such as those listed, is clearly subject to regulation under Porter-Cologne. "Waste" is broadly defined in Porter-Cologne, and the term has specifically been construed to include these types of waste.[157] The State and Regional Water Boards have already adopted NPDES permits for some types of urban runoff; and the State Water Board has adopted general waste discharge requirements for small domestic wastewater systems.

In addition, the State and Regional Water Boards can use their planning authority to address urban runoff on a watershed basis. This authority has been used, for example, to regulate activities causing erosion that add silt to Lake Tahoe and its tributaries.[158]

(3) Marinas

The (g) guidance also contains management measures for nonpoint source pollution from marinas and recreational boating.[159] Nonpoint source pollution identified with this category includes water column toxicity, low dissolved oxygen, metals and petroleum hydrocarbons, as well as disruption of sediment and habitat, and shoaling and shoreline erosion.[160]

As stated previously, the Porter-Cologne definition of "waste" is broad. It would include any pollutants from marinas that enter surface waters through boat discharges, spills, or storm water runoff.[161] Shoreline erosion caused by the construction or

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[155] Management Measure Guidance, *supra*, fn. 4, pp. 4-1 through 4-2.

[156] *Id.* at 4-7 through 4-9.

[157] See discussion in Section II.B.1 of this statement. See also *Lake Madrone*, *supra*, fn. 11, 209 Cal.App.3d at 168-171, 256 Cal.Rptr. 894 (concentrated silt and sediment associated with human habitation); 16 Ops.Cal.Atty.Gen. 112 (1950) (sewage from privately-operated sewage disposal devices, such as septic tanks and cesspools); 16 Ops.Cal.Atty.Gen. 125 (1950) (drainage of wastewater from construction sites); 27 Ops.Cal.Atty.Gen. 182 (1956) (drainage, flow, or seepage into surface waters of materials from completed operations).

[158] See *Tahoe-Sierra*, *supra*, fn. 11.

[159] Porter-Cologne is not listed as a backup authority for the boat operation management measure.

[160] Management Measure Guidance, *supra*, fn. 4, pp. 5-3 through 5-7.

[161] See discussion in Section II.B.1 of this Statement.

expansion of a marina is also subject to regulation as a waste discharge because the activity causes the release of sediments. Additionally, if marina construction requires a federal permit, such as a dredge and fill permit under section 404 of the Clean Water Act,[162] the applicant will have to obtain a section 401 certificate from the state. The State Water Board can condition a certification, if appropriate, to address both the point and nonpoint source impacts of the project.

In addition, state law specifically authorizes the Regional Water Boards to require marinas to install vessel pumpout facilities.[163] State law also requires that vessel pumpout facilities be operated and maintained to prevent sewage discharges to state waters.[164] They must be maintained in good working order and regularly cleaned.[165]

In addition to regulating waste discharges, the State and Regional Water Boards can address any marina or boating activities that affect water quality but that do not involve a waste discharge under their planning authority.[166] For example, they could address the marina flushing management measure in a water quality control plan and include recommendations for appropriate action by affected agencies.

(4) Hydromodification

The hydromodification management measure addresses nonpoint source pollution from channelization and channel modifications, dams, and streambank and shoreline erosion.[167] The state has identified Porter-Cologne as a backup authority for channelization and channel modification and streambank and shoreline erosion.

In general, channelization and channel modifications can change sediment supply, reduce freshwater availability, accelerate the delivery of pollutants, cause a loss of contact with overbank areas, and adversely impact instream and riparian habitat.[168] Streambank and shoreline erosion can likewise adversely impact instream and riparian habitat and contribute to increased levels of turbidity and nutrients.[169]

Under Porter-Cologne, the Regional Water Boards can regulate any channelization or channel modification projects that cause a waste discharge, either as a result of construction or operation.[170] Similarly, they can regulate any activities that

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162 33 U.S.C. § 1344.

163 Harb. & Nav. Code §§ 775-786; see Cal. Code Regs., tit. 23, §§ 2831-2836.

164 Harb. & Nav. Code § 777; see Cal. Code Regs., tit. 23, §§ 2827-2829.

165 *Ibid.*

166 See discussion in Section II.A. of this Statement.

167 Management Measure Guidance, *supra*, fn. 4, p. 6-2.

168 *Id.*, pp. 6-4 through 6-7.

169 *Id.*, pp. 6-57 through 6-58.

170 See discussion in Section II.B.1 of this Statement.

cause streambank or shoreline erosion, resulting in the release of sediments or other wastes to state waters. The State Water Board can condition a section 401 water quality certificate for a federally-permitted activity involving a surface water discharge to address both the activity's point and nonpoint source impacts. The State and Regional Water Boards can address any other activities that affect water quality, but that do not entail a waste discharge, under their broad planning authority.[171]

(5) Wetlands

The (g) guidance contains management measures for categories of nonpoint sources. The management measures for wetlands promote protecting and restoring wetlands and riparian areas and using vegetated treatment systems to control nonpoint source pollution from these sources. The Regional Water Boards can use their Porter-Cologne authority to regulate any activities that result in a waste discharge to wetlands or riparian areas.[172] Where past waste discharges have adversely impacted wetland areas, they can issue enforcement orders requiring restoration.[173] The Regional Water Boards can also promote the protection and restoration of wetlands and the use of engineered vegetated treatment systems as supplemental environmental credit projects mitigating administrative civil liability assessments.[174] Finally, the State and Regional Water Boards can use their broad planning authority to address the protection and restoration of wetlands and to promote the use of vegetated treatment systems.[175]

C. Question: Will it be necessary for the state to issue regulations prior to using its Porter-Cologne authority to ensure implementation of the management measures?

Response: No, regulations are not necessary. The (g) guidance management measures vary from requirements for reports and watershed management plans to more prescriptive requirements. The appropriate Porter-Cologne response will also vary. If the State or Regional Water Boards choose to implement one or more of the management measures through their planning authority or regulations, they will have to comply with the state Administrative Procedure Act (APA).[176] Unlike the adoption of formal regulations, however, the APA contains special, abbreviated procedures for the adoption or amendment of plans, policies and guidelines.[177] If the State or Regional Water Boards choose other implementation alternatives, they will not have to comply with the APA.

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[171] See discussion in Section II.A. of this Statement.

[172] See discussion in Section II.B.1 of this Statement.

[173] See, e.g., Wat. Code § 13304. See also State Water Board Order WQ 90-5, upholding a San Francisco Bay Regional Water Board order requiring a discharger to mitigate for losses of wetland habitat.

[174] See discussion in Guidance to Implement the Water Quality Enforcement Policy, State Water Board (April 1996), pp. 22-23.

[175] See discussion in Section II.A. of this Statement.

[176] See Gov. Code § 111340 et seq.

[177] Compare Gov. Code § 11353 with § 11346 et seq.

As explained previously, the State Water Board's Nonpoint Source Management Plan lays out a three-tiered management approach to nonpoint pollution regulation.[178] In the first tier, the State and Regional Water Boards will encourage affected discharger groups to voluntarily implement applicable management measures. This can be done through, for example, funding and education. These activities are voluntary and can be accomplished without formal rulemaking.

The second tier is regulatory encouragement - through adoption of conditional waivers or management agency agreements with other enforcement agencies. Waivers may be either individual or general. The Regional Water Boards can waive waste discharge requirements for an individual discharger, on condition that the discharger comply with appropriate management measures; and this does not require a water quality control plan amendment.[179] Typically, the Regional Water Boards adopt waivers for classes of dischargers, and these waivers are included in the applicable water quality control plans. As stated previously, the adoption or amendment of water quality control plans, policies, or guidelines is subject to abbreviated, APA rulemaking procedures.[180] Alternatively, the State and Regional Water Boards can enter into management agency agreements with agencies with enforcement authority over the nonpoint sources. These agreements can ensure management measure implementation, and they do not require a water quality control plan amendment.

In the third tier, the State and Regional Water Boards adopt waste discharge requirements. The adoption of waste discharge requirements, either individual or general, is not subject to the APA's rulemaking requirements.[181] Waste discharge requirements can directly or indirectly require compliance with applicable management measures in appropriate cases.[182] If appropriate, general waste discharge requirements can be adopted to ensure management measure implementation on a regionwide or statewide basis.

Some management measures require submission of plans, such as erosion and sediment control plans. The Regional Water Boards can implement these measures under their existing Porter-Cologne investigative powers, without undertaking a rulemaking.[183] Likewise, if the Regional Water Boards choose to adopt enforcement orders to address, for example, wetland or riparian areas degraded by waste discharges, the Regional Water Boards will not have to undertake formal rulemaking.

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[178] See discussion in Section III.A.2.(a) of this Statement.

[179] See Gov. Code § 11352.

[180] See *id.* § 11353, which contain special procedures for State and Regional Water Board plans, policies, and guidelines.

[181] See *id.* § 11352(b).

[182] See discussion in Section III.A.2.(a) & (b).

[183] See Wat. Code §§ 13165, 13225(c), 13267, 13383. See also Gov. Code § 11342(g), defining "regulation" as a rule, regulation, order, or standard of general application.

On the other hand, the Regional Water Boards are currently engaged in developing TMDLs for impaired waterbodies, many of which are impaired by nonpoint sources. These TMDLs can be used as a vehicle to implement appropriate management measures. The TMDLs have to be included in the state's water quality management plan under the Clean Water Act; they will, therefore, necessarily result in water quality control plan amendments.[184]

IV. Conclusion

In sum, the State and Regional Water Boards have broad-reaching power under Porter-Cologne to prevent nonpoint source pollution. In their planning capacity, they can address all activities and factors that may affect water quality, including nonpoint source activities. They can also directly regulate all waste discharges, both point and nonpoint source, that may affect the quality of state waters. In addition to preventing nonpoint source pollution, the State and Regional Water Boards can ensure implementation of the management measures through several mechanisms. Finally, the State and Regional Water Boards are not required to undertake rulemaking before implementing the measures.

Date: 10/22/99

William R. Attwater

William R. Attwater
Chief Counsel
California State Water Resources
Control Board

[184] 33 U.S.C. § 1313(d).

CALIFORNIA COASTAL COMMISSION
CHIEF COUNSEL'S STATEMENT
FOR THE
CALIFORNIA'S NONPOINT SOURCE POLLUTION CONTROL PROGRAM

NOVEMBER 1999

R0018800

STATE OF CALIFORNIA – THE RESOURCES AGENCY

GRAY DAVIS, Governor

CALIFORNIA COASTAL COMMISSION
45 FREMONT STREET, SUITE 2000
SAN FRANCISCO, CA 94105-2219
VOICE AND TDD (415) 904-5200

MEMORANDUM

October 21, 1999

TO: Peter Douglas, Executive Director
Jaime Kooser, Deputy Director

FROM: Ralph Faust, Chief Counsel
Dorothy Dickey, Deputy Chief Counsel D. Dickey

SUBJECT: **Enforceability of Nonpoint Source Pollution Control Program**

We are writing to address the scope of the Coastal Commission's authority to enforce the nonpoint source pollution control provisions of the Coastal Zone Management Act. (16 U.S.C. § 1451 *et seq.*) Section 6217 of that Act provides that each state "for which a management program has been approved pursuant to section 306 of the Coastal Zone Management Act … shall prepare and submit to the Secretary and the Administrator a Coastal Nonpoint Pollution Control Program for approval pursuant to this section." (16 U.S.C. § 1455b.) The Coastal Zone Management Act explains that the "purpose of the program shall be to develop and implement management measures for nonpoint source pollution to restore and protect coastal waters, working in conjunction with other State and local authorities." (16 U.S.C. § 1455b(a)(1).) You have asked whether the Commission can enforce those nonpoint pollution control provisions.

The Coastal Commission implements the policies of California's Coastal Act. (Public Resources Code § 30000 *et seq.*) A central focus of the Coastal Act is the protection and, where feasible, restoration, of coastal water quality. The Act includes numerous enforceable policies that are directed toward that objective. For example, section 30230 provides that:

> *Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.*

The Commission is required specifically to control runoff in section 30231:

> *The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum*

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> *populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface water flow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.*

In addition, Coastal Act policies limit development in numerous other ways to protect water quality. (See Attachment 1.)

The Commission implements these protective policies as it undertakes its three major regulatory tasks. Its first regulatory responsibility is to review and certify plans that address how development will occur along the California coast. Most of those plans are developed by local governments and are called "local coastal programs". (Public Resources Code § 30500 *et seq.*) Plans are also prepared by port districts (Public Resources Code § 30711 *et seq.*), colleges and universities (Public Resources Code § 30605) and proponents of public works projects (*id.*).

The Commission reviews those plans to determine whether they are consistent with applicable policies of the Coastal Act, including those related to water quality. If the Commission determines that a plan is not consistent with the policies of the Coastal Act, it is required to deny certification of the plan. In that event the Commission generally suggests modifications to the plan that the local government or other plan proponent could adopt.[1] Once the plan has been modified to incorporate the changes identified by the Commission, it can be resubmitted to the Commission for certification. Following certification by the Commission of a plan, any amendments to the plan must be submitted to the Commission. Until the Commission certifies an amendment, the measure has no legal effect for purposes of the Coastal Act.

The Commission has the authority to enforce Coastal Act provisions relating to water quality, including nonpoint source pollution. As described above, the Commission is required to refuse to certify plans and amendments which it determines do not meet the Coastal Act's water quality requirements. The Commission is additionally authorized to identify appropriate changes to those plans and amendments to bring them into conformity with the Coastal Act's water quality provisions. Such changes may include nonpoint source pollution management measures necessary to bring a plan or amendment into conformity with Coastal Act provisions relating to water quality.

The Commission's second regulatory task is to review applications for coastal development permits. The Coastal Act provides that any person who wishes to pursue

[1] The procedures for processing those modifications differ depending on the type of plan reviewed by the Commission. A discussion of the specific procedural mechanisms involved is beyond the scope of this memo.

"development" in the coastal zone must obtain a coastal development permit. (Public Resources Code § 30600.) "Development" is broadly defined in Public Resources Code § 30106 to mean:

> *"... on land, in or under water, the placement or erection of any solid material or structure; discharge or disposal of any dredged material or of any gaseous, liquid, solid, or thermal waste; grading, removing, dredging, mining, or extraction of any materials; change in the density or intensity of use of land, including, but not limited to, subdivision pursuant to the Subdivision Map Act (commencing with Section 66410 of the Government Code), and any other division of land, including lot splits, except where the land division is brought about in connection with the purchase of such land by a public agency for public recreational use; change in the intensity of use of water, or of access thereto; construction, reconstruction, demolition, or alteration of the size of any structure, including any facility of any private, public, or municipal utility; and the removal or harvesting of major vegetation other than for agricultural purposes, kelp harvesting, and timber operations which are in accordance with a timber harvesting plan submitted pursuant to the provisions of the Z'berg-Nejedly Forest Practice Act of 1973 (commencing with Section 4511).*
>
> *As used in this section, "structure" includes, but is not limited to, any building, road, pipe, flume, conduit, siphon, aqueduct, telephone line, and electrical power transmission and distribution line."*

The Commission performs its permit review function with respect to development within the coastal zone until the Commission has certified a local coastal program for each coastal city and county or a port master plan for that jurisdiction. (Public Resources Code §§ 30600(c), 30715(a).) In determining whether or not to approve a particular coastal development permit application, the Commission applies the Coastal Act's policies concerning coastal protection, which include the policies to protect coastal water quality that are cited above. (Public Resources Code §§ 30604, 30715(a).) As a condition of approving coastal development permit applications, the Commission may impose conditions to prevent and mitigate nonpoint source pollution in order to implement those water quality requirements.[2]

After the Commission has certified a local coastal program, it delegates coastal development permitting authority to the local government. (Public Resources Code § 30519(a).) The Commission retains permitting jurisdiction over development proposed on tidelands,

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[2] The Coastal Act does not authorize the Commission to require a coastal development permit for the "removal or harvesting of major vegetation ... for agricultural purposes, kelp harvesting and timber operations which are in accordance with a timber harvesting plan submitted pursuant to the provisions of the Z'berg-Nejedly Forest Practice Act of 1973...." (Public Resources Code § 30106.) Nevertheless, the Commission is authorized to regulate other development activities related to agriculture and forestry. As a condition of approval of such development, the Commission may require that nonpoint source pollution control measures be undertaken in order to find that the development meets Coastal Act water quality standards.

submerged lands and public trust lands. (Public Resources Code § 30519(b).) Similarly, the Commission delegates coastal development authority to a port once the Commission has certified the port's master plan. (Public Resources Code § 30519(b).)

Local governments' and ports' decisions concerning applications for coastal development permits may be appealed to the Coastal Commission in certain instances. (Public Resources Code §§ 30603, 30715.) The standard of review for permit decisions after the Commission has certified a local coastal program or a port master plan is the certified program or plan. (Public Resources Code §§ 30604(b), 30715.5.) The Commission's actions on appeals are also governed by the certified program or plan. (*Id.*) As noted above, those planning documents must meet the Coastal Act's standards concerning water quality, including nonpoint source pollution. Thus, when the Commission, a local government or a port makes a decision on whether to issue a coastal development permit after the Commission has certified such a plan or program, the permitting agency must determine whether the proposed development will comply with the policies and standards set forth in its plan or program, including those related to water quality. If the Commission or other permitting agency determines that the proposed development will not comply with those standards, it may impose conditions on the project to bring it into compliance with the standards in the plan or program, including any management measures to prevent or mitigate nonpoint source pollution. Alternatively, the Commission or other permitting agency may deny the development.

The applicable requirements concerning water quality are found in the Coastal Act. Thus, a coastal development permit application may not be approved unless it complies with the water quality requirements contained in the Coastal Act or in certified plans and programs.

The Coastal Commission's third major regulatory responsibility is federal consistency review under the Coastal Zone Management Act. (16 U.S.C. § 1451 *et seq.*) The Commission reviews activities conducted by the federal government, federally issued licenses and permits, plans for exploration and production of the outer continental shelf, and federally funded activities. (16 U.S.C. § 1456.) The Commission reviews each proposed activity to determine whether it is consistent with the California Coastal Management Program. The Program includes the Coastal Act and those local coastal programs that have been formally approved by the Office of Ocean and Coastal Resource Management for incorporation into the State's program. The Commission must determine that the proposed activity is consistent with those policies and standards, including any required nonpoint source pollution control measures.

As noted above, the Coastal Act includes policies to protect coastal water quality. Therefore, in performing federal consistency review, the Commission is authorized to apply those water quality standards and to "disagree" or "object" as appropriate to those activities and projects that do not comply with those standards. (*Id.*, 15 C.F.R. §§ 930.32(a), 930.39, 930.42, 930.79.)

For the reasons set forth above, we conclude that the Coastal Commission has adequate legal authority under the Coastal Act to enforce water quality requirements related to nonpoint source pollution.

Attachment

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APPENDIX C. SCHEDULE OF TMDLS BY CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARDS

(NOTE: The following tables were developed from information submitted by the RWQCBs for inclusion in the CWA section 303(d) TMDL priority list and their respective chapters of the 1999 WMI Integrated Plan. The tables represent those TMDLs that the RWQCBs have identified with initial development or completion occurring during the first five-year implementation cycle (1998-2003) of the Program Plan.)

Table C1. Scheduled Development of TMDLs by North Coast Regional Water Quality Control Board (RWQCB1)

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
Noyo River	Sediment	1999	1999			x				
Estero Americano	Nutrients	1997			x					
Garcia River	Sediment	2000	2000		x	x	x			
	Temperature						x			
Navarro River	Sediment		2000							
	Temperature		2000							
Americano Creek	Nutrients	1997			x					
Mattole River	Sediment	2001	2002			x				
	Temperature		2002							
Ten Mile River	Sediment		2000							
Redwood Creek	Sediment		1998							
Elk River	Sediment	2009				x				
Albion River	Sediment	2000	2001			x				
Big River	Sediment	2001				x				
South Fork Trinity River	Sediment		1998							
Beaughton Creek	Unpermitted discharge of waste		1998							
Eel River	Sediment		1999-2006							
	Temperature		1999-2006							
Van Duzen River	Sediment		1999							
Trinity River	Sediment	2001								
Gualala River	Sediment	1999	2000			x				

Table C2. Scheduled Development of TMDLs by San Francisco Bay Regional Water Quality Control Board (RWQCB2)

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
South San Francisco Bay	Exotic Species		2001					x		
	Mercury		2003							x
	PCBs		2003							
Central San Francisco Bay	Exotic Species		2001					x		
	Mercury		2003							x
	PCBs		2003							
Lower San Francisco Bay	Exotic Species		2001					x		
	Mercury		2003							x
	PCBS		2003							
Carquinez Strait	Exotic Species		2001					x		
	Mercury		2003							x
	PCBs		2003							
Napa River	Siltation		2003		x		x			
San Pablo Bay	Exotic Species		2001					x		
	Mercury		2003							x
	PCBs		2003							
Suisun Bay	Exotic Species		2001					x		
	Mercury		2003							x
	PCBs		2003							
Richardson Bay	Exotic Species		2001					x		
	Mercury		2003							x
	PCBs		2003							x
Delta	Exotic Species		2001					x		
	Mercury		2003							x

R0018808

Table C3. Scheduled Development of TMDLs by Central Coast Regional Water Quality Control Board (RWQCB3)

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
Morro Bay	Metals	2000						x		
	Pathogens	2000			x		x			
	Sedimentation/ Siltation	1999			x		x			
Old Salinas River Estuary	Nutrients	2003	2006		x					
	Pesticides	2003	2006		x					
Las Tablas Creek	Mercury	2000			x					
Salinas River Lagoon (North)	Nutrients	2003	2006							x
	Pesticides	2003	2006		x					
	Siltation	2001	2004		x					
Salinas River Lagoon (South)	Nutrients	2003	2006		x					
	Pesticides	2003	2006		x					
	Salinity/TDS/ Chlorides	2003	2006		x					
Tembladero Slough	Nutrients	2003	2006		x					
	Pesticides	2003	2006		x					
Pajaro River	Nutrients	2001	2004		x					
	Siltation	2001	2004		x					
Las Tablas Creek, North Fork	Mercury	2000								
Salinas River	Siltation	2001	2004		x		x			
	Nutrients	2003	2006		x					
	Pesticides/	2003	2006		x					
	Salinity	2003	2006		x					
	Priority Pollutants									
Espinosa Slough	Nutrients	2003	2006		x					
	Pesticides/Priority Organics	2003	2006		x					
Carbonera Creek	Pathogens	2001	2004							x
	Siltation	2000	2003		x					
	Nutrients	2000								x
Lompico Creek	Pathogens	2001	2004				x			
	Siltation	2000	2003		x					
	Nutrients	2000					x			

R0018809

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
San Lorenzo River Estuary	Pathogens	2001	2004							
	Siltation	2000	2003						x	
Hernadez Reservoir	Mercury	2003	2006							
Lompico Creek	Nutrients						x			
Llagas Creek	Nutrients	2001	2004		x					
	Siltation	2001	2004		x				x	
Pajaro River	Nutrients	2001	2004		x		x			
	Siltation	2001	2004		x		x		x	
Rider Gulch Creek	Siltation	2001	2004		x					
San Benito River	Siltation	2001	2004		x					
Shingle Mill Creek	Nutrients	2001	2004				x			
	Siltation	2001	2004				x			
Watsonville Slough	Oil and Grease	2003	2006							x
	Pathogens	2003	2006							x
	Pesticides	2003	2006				x			
	Siltation	2001	2004				x			
	Metals	2003								
Chorro Creek	Metals	2000								
	Nutrients	2000			x					
	Siltation	2000			x		x		x	
San Luis Obispo Creek	Nutrients	2000	2003		x					
	Pathogens	2000								
	Priority Pollutants	2001								
Arroyo Burro Creek	Pathogens	2011	2014							
Las Tablas Creek, South Fork	Mercury	2000								
Nacimiento Reservoir	Mercury	2000								
Los Osos Creek	Nutrients	2000			x					
	Siltation	1999			x		x		x	
	Priority Organics	2000								
Valencia Creek	Siltation	2001								
Salinas River	Nutrients	2003								
Salinas River	Pesticides/Priority Organics	2003								
	Salinity	2003								
	Siltation	2001								
Clear Creek	Mercury	2003								
Hernandez Reservoir	Mercury	2003								
San Benito River	Siltation	2001								

R0018810

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
San Lorenzo River	Nutrients	2000					x			
	Siltation	2000								
	Pathogens	2001					x			
San Lorenzo Creek	Nutrients						x			
	Siltation	2000	2003			x				

Table C4. Scheduled Development of TMDLs by Los Angeles Regional Water Quality Control Board (RWQCB4)

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromodification	Not identified
Arroyo Conejo North Fork	Nitrogen	00/01	01/02	01/02						x
Arroyo Las Posas (Reaches 1&2)	Pesticides	02/03	03/04	03/04						x
Arroyo Simi (Reach 1)	Metals	04/05	05/06	05/06						x
Ballona Creek	Trash	00/01	01/02	02/03						x
	Metals	02/03	03/04	03/04						x
	Pesticides	02/03	03/04	03/04						x
Ballona Estuary	Coliform	02/03	03/04	03/04						x
Cabrillo Pier area	Pathogens	00/01	02/03	03/04						x
Conejo Creek	Nitrogen	00/01	01/02	01/02						x
Fox Barranca	Salts	04/05	05/06	05/06						x
Lake Calabasas	Nutrients	00/01	01/02	02/03						x
Los Angeles River (Reaches 1 - 5)	Nitrogen (effects)	01/02	02/03	02/03						x
	Trash	99/00	00/01	00/01						x
Los Angeles River (Reaches 1,2,4, & 6)	Coliform	00/01	01/02	01/02						x
Los Angeles River (Rchs 1,2, & 4)	Metals	02/03	03/04	03/04						x
Los Angeles River (Reach 5)	Pesticides	04/05	05/06	05/06						x
Marina del Rey Harbor – Back Basins	PCBs	03/04	04/05	04/05						x
	Pesticides	03/04	04/05	04/05						x
	Metals	03/04	04/05	04/05						x
Marina del Rey Harbor Beach	Coliform	01/02	02/03	02/03						x
McGrath Beach	Coliform	99/00	01/02	02/03						x
Medea Creek (Reaches 1 & 2)	Coliform	00/01	01/02	02/03						x

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromodi-fication	Not identified
Revlon Slough	Pesticides	01/02	02/03	02/03						x
San Gabriel River East Fork	Trash	99/00	99/00	99/00						x
San Gabriel River(Reach 2)	Coliform	02/03	03/04	04/05						x
San Gabriel River (Reaches 1,2, & 3)	Nitrogen	01/02	02/03	02/03						x
San Jose Creek (Reach 1)	Metals	04/05	05/06	05/06						x
Santa Clara River (Reaches 3,7, & 8)	Chloride	99/00	99/00	99/00						x
	Nitrogen	99/00	01/02	02/03						x
Santa Monica Bay (Greater) beaches	Pathogens	00/01	01/02	02/03						x
Santa Monica Bay Nearshore/Offshore	Metals	02/03	03/04	03/04						x
	Chlordane	04/05	05/06	05/06						x

Table C5. Scheduled Development of TMDLs by Central Valley Regional Water Quality Control Board (RWQCB5)

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
Delta Waterways	Chlorpyrifos	2002	2004		x					
	Diazinon	2002	2004		x					
	Mercury	2002	2004							
Feather River	Diazinon	2002	2004		x					
Sacramento River, Lower	Diazinon	2002	2004		x					
	Mercury	2002	2004							
Berryessa Lake	Mercury	2002	2004							
Cache Creek	Mercury	2002	2004							
Sulfur Creek	Mercury	2002	2004		x					
Harley Gulch	Mercury	2002	2004							
Mud Slough	Selenium	1997	1999		x					
San Joaquin River	Selenium	1997	1999		x					
	Boron				x					
	Electrical Conductivity				x					
	Chlorpyrifos	2002	2004		x					
	Diazinon	2002	2004		x					
Little Grizzly Creek	Copper	2002								
	Zinc	2002								

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
Stanislaus River (Lower)	Diazinon	2002	2004		x					
Clear Lake	Mercury	2002	2004							
Tuolumne River (Lower)	Diazinon	2002	2004		x					

Table C6. Scheduled Development of TMDLs by Lahontan Regional Water Quality Control Board (RWQCB6)

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
Aspen Creek	Metals									x
Bear Creek	Sedimentation/ Siltation								x	
Blackwood Creek	Sedimentation/ Siltation					x	x		x	
Bodie Creek	Metals									x
Bridgeport Res	Nutrients				x					
Bronco Creek	Sedimentation/ Siltation									x
Bryant Creek	Metals									x
Carson River, East Fork	Nutrients				x					
Cottonwood Creek	Water/Flow Variability									
Eagle Lake	Org. enrichment/ Low D.O.				x		x			
East Walker River	Sedimentation/ Siltation				x		x			
Gray Creek	Sedimentation/ Siltation									x
Heavenly Valley Creek.	Sediment						x			
Indian Creek	Habitat Alterations				x					
Lake Tahoe	Nutrients					x	x	x	x	
Lee Vining Creek	Flow Alterations									
Mammoth Creek	Metals									x
Mill Creek	Flow Alterations									

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
Monitor Creek	Metals									
Mono Lake	Salinity/TDS/ Chlorides									x
Owens River	Habitat Alterations									
Pine Creek	Siltation				x					
Pleasant Valley Reservoir	Org. Enrichment/ Low D.O.				x					
Snow Creek	Habitat Alterations						x			
Squaw Creek	Siltation	2002					x			
Susan River	Unknown Toxicity				x		x			
Topaz Lake	Sedimentation/ Siltation				x					
Ward Creek	Sedimentation/ Siltation						x			
West Walker River	Sedimentation/ Siltation				x					
Wolf Creek	Sedimentation/ Siltation				x					

Table C7. Scheduled Development of TMDLs by Colorado River Regional Water Quality Control Board (RWQCB7)

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
Alamo River	Siltation	2000	2001		x					
Imperial Valley Drains	Silt	2000	2011		x					
New River	Silt	2002	2003		x					
Salton Sea	Salt	2001								

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Table C8. Scheduled Development of TMDLs by Santa Ana Regional Water Quality Control Board (RWQCB8)

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
Big Bear Lake and tributaries	Metals	07/03	01/04	12/04						x
	Nutrients	07/03	01/04	12/04			x			
Canyon Lake	Nutrients	06/02	01/03	12/03						x
	Pathogens	06/02	01/03	12/03						x
Lake Elsinore	Nutrients	06/02	01/03	12/03						x
	Siltation	06/02	01/03	12/03						x
Newport Bay (Lower)	Metals	01/01	01/01	12/01				x		
	Nutrients	12/98	12/98	12/98	x					
	Pathogens	12/98	03/99	12/99						x
	Pesticides	01/01	01/01	12/01	x					
	Pr. Organics	01/01	01/01	12/01						x
	Sediment	12/98	12/98	12/98	x		x		x	
Newport Bay (Upper)	Metals	01/01	01/01	12/01						x
	Nutrients	12/98	12/98	12/98	x					
	Pathogens	12/98	03/99	12/99						x
	Pesticides	01/01	01/01	12/01	x					
	Sediment	12/98	12/98	12/98	x		x		x	
San Diego Creek (Reach 1 & 2)	Metals	01/01	01/01	12/01						x
	Pesticides	01/01	01/01	12/01						x
	Sediment	12/98	12/98	12/98	x		x		x	

Table C9. Scheduled Development of TMDLs by San Diego Regional Water Quality Control Board (RWQCB9)

Waterbody	Stressor	Completion Date: Technical Report	Completion Date: Implementation Plan	Implement Actions	Stressor Source Category: Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
Aliso Creek	Coliform	07/02	07/02	07/02						x
Aqua Hedionda Lagoon	Coliform	07/03	07/09	07/09						x
	Sediment	07/03	07/07	07/07						x
Buena Vista Lagoon	Sediment	07/03	07/07	07/07						x
Chollas Creek	Coliform	07/00	07/03	07/03						x
	Metals	05/00	07/00	12/00						x
	Toxicity	05/00	07/00	12/00						x
Formosa Slough	Nutrients	07/03	07/08	07/08						x
Guajome Lake	Nutrients	07/05	07/11	07/11						x
Loma Alta Slough	Coliform	07/03	07/09	07/09						x
	Nutrients	07/03	07/09	07/09						x
Los Penasquitos Lagoon	Sediment	07/03	07/08	07/08						x
Mission Bay	Coliform	07/03	07/08	07/08						x
	Lead	07/03	07/08	07/08						x
	Nutrients	07/03	07/08	07/08						x
Pacific Ocean (Laguna Beach)	Coliform	07/10	07/10	07/10						x
Pacific Ocean (Aliso HAS)	Coliform	07/02	07/02	07/02						x
Pacific Ocean (Dana Point HSA)	Coliform	07/10	07/10	07/10						x
Pacific Ocean (L. San Juan Ck.)	Coliform	07/10	07/10	07/10						x
Pacific Ocean (Sn Clemente HA)	Coliform	07/10	07/10	07/10						x
Pacific Ocean (San Luis Rey HU)	Coliform	07/03	07/09	07/09						x
Pacific Ocean (Loma Alta Ck HA)	Coliform	07/03	07/09	07/09						x
Pacific Ocean (Bna Vsta Ck HA)	Coliform	07/03	07/09	07/09						x
Pacific Ocean (San Marcos Ck HA)	Coliform	07/03	07/09	07/09						x
Pacific Ocean (Escondido Ck HA)	Coliform	07/03	07/09	07/09						x
Pacific Ocean (San Dieguito HU)	Coliform	07/03	07/09	07/09						x
Pacific Ocean (San Marcos Ck HA)	Coliform	07/03	07/09	07/09						x
Pacific Ocean (San Diego HU)	Coliform	07/03	07/09	07/09						x
Pacific Ocean (Coronado HA)	Coliform	07/03	07/09	07/09						x
Pacific Ocean (Tijuana HU)	Coliform	07/11	07/11	07/11						x
Rainbow Creek	Nutrients	03/00	05/00	10/00						x
San Diego Bay (Nr. 24th Street)	Toxicity	07/03	07/03	07/03						x
San Diego Bay (Shoreline)	Coliform	07/03	07/09	07/09						x
San Diego Bay (Nr. Chollas Crk.)	Toxicity	05/00	07/00	12/00						x
San Diego Bay (Naval Air Station)	Toxicity	07/03	07/03	07/03						x
San Diego Bay (7th St. Channel)	Toxicity	06/00	11/00	06/01						x

Waterbody	Stressor	Completion Date		Implement Actions	Stressor Source Category					
		Technical Report	Implementation Plan		Agriculture	Forestry	Urban	Marinas	Hydromod-ification	Not identified
San Diego Bay (Nr. Coronado Br.)	Toxicity	07/03	07/03	07/03						x
San Diego Bay (Submarine Base)	Toxicity	07/03	07/03	07/03						x
San Diego Bay (Shelter Island)	Toxicity	06/00	11/00	06/01						x
San Diego Bay (Nr. Grape Street)	Toxicity	07/03	07/03	07/03						x
San Diego Bay (Downtown Pier)	Toxicity	07/03	07/03	07/03						x
San Elijo Lagoon	Nutrients	07/03	07/09	07/09						x
	Coliform	07/03	07/09	07/09						x
	Sediment	07/03	07/07	07/07						x
San Juan Creek (Lower)	Coliform	07/10	07/10	07/10						x
San Juan Creek (Mouth)	Coliform	07/10	07/10	07/10						x
Santa Margarita Lagoon	Nutrients	07/05	07/05	07/05						x
Tecolote Creek	Coliform	07/03	07/09	07/09						x
	Metals	07/03	07/08	07/08						x
	Toxicity	07/03	07/08	07/08						x
Tijuana River	Coliform	07/11	07/11	07/11						x
	Metals	07/11	07/11	07/11						x
	Nutrients	07/11	07/11	07/11						x
	Organics	07/11	07/11	07/11						x
	Pesticides	07/11	07/11	07/11						x
	Trash	07/11	07/11	07/11						x
Tijuana River Estuary	Coliform	07/11	07/11	07/11						x
	Metals	07/11	07/11	07/11						x
	Nutrients	07/11	07/11	07/11						x
	Pesticides	07/11	07/11	07/11						x
	Trash	07/11	07/11	07/11						x

R0018817

APPENDIX D: LETTERS FROM THE CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY AND THE CALIFORNIA RESOURCES AGENCY TO LEAD AND ENFORCING STATE AGENCIES WITH RESPECT TO DEVELOPMENT OF THE FIVE-YEAR NONPOINT SOURCE IMPLEMENTATION PLANS

California Environmental Protection Agency
Winston H. Hickox
Agency Secretary

GRAY DAVIS
GOVERNOR

Resources Agency
Mary D. Nichols
Agency Secretary

MEMORANDUM

TO: William Lyons, Jr., Secretary
Department of Food and Agriculture

Diana Bontá, Director,
Department of Health Services

José Medina, Director
Department of Transportation

FROM: Winston H. Hickox — Winston H. Hickox
Agency Secretary
California Environmental Protection Agency

Mary D. Nichols — Mary D. Nichols
Agency Secretary
Resources Agency

DATE: February 2, 2000

SUBJECT: CALIFORNIA'S NONPOINT SOURCE POLLUTION CONTROL PROGRAM

By this memorandum, we are requesting your assistance in addressing nonpoint source (NPS) pollution by implementing the attached Plan for California's Nonpoint Source Pollution Control Program (Program Plan). NPS pollution, also known as polluted runoff, is the leading cause of water quality impairments in California and nationally. Nonpoint sources are the major contributor of pollution to impacted water bodies including surface, ground, and coastal waters in California. Your participation is needed if we are going to protect and restore the myriad of beneficial uses our water resources support and the economic benefit derived from these uses.

This memorandum underscores the commitment of both the California Environmental Protection Agency (Cal/EPA) and Resources Agency to protect the beneficial uses and restore the quality of California's waters. In order to achieve measurable improvements, we are requesting your agencies to use your respective authorities to implement the Program Plan to prevent and control NPS pollution affecting State surface, ground, and coastal waters.

We commend those agencies that have worked with the State Water Resources Control Board (SWRCB) and California Coastal Commission (CCC) in the development of the Program Plan's Fifteen-Year Program Strategy and Five-Year Implementation Plan (Volume I) and the California Management Measures for Polluted Runoff (Volume II). Effective implementation of the Program Plan requires continued collaboration among all responsible State agencies as well as coordination among federal and local agencies and public groups.

The SWRCB and CCC, in conjunction with the nine Regional Water Quality Control Boards, are the lead agencies in coordinating implementation of the Program Plan. To ensure success of the Program Plan, we are requesting your agencies to undertake several important program actions.

- Each agency is requested to designate a lead staff person to be responsible for coordinating with the SWRCB and CCC on NPS issues.
- Each agency is requested to identify through a five-year plan appropriate actions to implement management measures for which they have authorities and are targeted in the first Five-Year Implementation Plan.
- Each agency is requested to ensure that actions to implement its respective portions of the Program Plan are tracked, monitored, assessed, and reported to the SWRCB and CCC consistent with State law (Water Code sections 13165 and 13369 [AB 227]) and in accordance to the Program Plan.
- Each agency in consultation with the SWRCB and CCC shall consider the need to establish or revise existing formal agreements with the SWRCB and CCC to ensure successful implementation of the Program Plan.

In addition, we encourage each agency to adopt policies that support the Program Plan.

Please reply to William Vance, Ph.D., Assistant Secretary for Policy and Regulations, Cal/EPA or Maria Rea, Assistant Secretary for Watershed and Salmon Restoration, Resources Agency, by February 25, 2000 with the name, telephone number, and e-mail address of your designated lead staff person. If you have any questions, please call Dr. Vance, at (916) 324-7584 or Ms. Rea, at (916) 653-5656.

Attachment

cc: See next page

cc:

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California Environmental Protection Agency
Winston H. Hickox
Agency Secretary

Resources Agency
Mary D. Nichols
Agency Secretary

GRAY DAVIS
GOVERNOR

MEMORANDUM

TO: Distribution List

FROM: Winston H. Hickox Winston H. Hickox
Agency Secretary
California Environmental Protection Agency

Mary D. Nichols
Agency Secretary
Resources Agency

DATE: February 2, 2000

SUBJECT: CALIFORNIA'S NONPOINT SOURCE POLLUTION CONTROL PROGRAM

By this memorandum, we are requesting your assistance in addressing nonpoint source (NPS) pollution by implementing the Plan for California's Nonpoint Source Pollution Control Program (Program Plan) (see attachment). NPS pollution, also known as polluted runoff, is the leading cause of water quality impairments in California and nationally. Nonpoint sources are the major contributor of pollution to impacted water bodies including surface, ground, and coastal waters in California. Your participation is needed if we are going to protect and restore the myriad of beneficial uses our water resources support and the economic benefit derived from these uses.

This memorandum underscores the commitment of both the California Environmental Protection Agency (Cal/EPA) and Resources Agency to protect the beneficial uses and restore the quality of California's waters. In order to achieve measurable improvements, we are directing all Boards, Departments, and Regional Water Quality Control Boards (RWQCBs) within our Agencies to use their respective authorities to implement the Program Plan to prevent and control NPS pollution affecting State surface, ground, and coastal waters.

We commend those Departments and Boards that have worked with the State Water Resources Control Board (SWRCB) and California Coastal Commission (CCC) in the development of the Program Plan's Fifteen-Year Program Strategy and Five-Year Implementation Plan (Volume I) and the California Management Measures for Polluted Runoff (Volume II). Effective implementation of the Program Plan requires continued collaboration among all responsible State agencies as well as coordination among federal and local agencies and public groups.

The SWRCB and CCC, in conjunction with the nine RWQCBs, are the lead agencies in coordinating implementation of the Program Plan. To ensure success of the Program Plan, we are directing our Boards, Departments, and RWQCBs to undertake several important program actions.

- Each Board or Department shall designate a lead staff person to be responsible for coordinating with the SWRCB and CCC on NPS issues.
- Each Board or Department shall identify through a five-year plan appropriate actions to implement management measures for which they have authorities and are targeted in the first Five-Year Implementation Plan.
- Each Board or Department shall ensure that actions to implement its respective portions of the Program Plan are tracked, monitored, assessed, and reported to the SWRCB and CCC consistent with State law (Water Code sections 13165 and 13369 [AB 227]) and the requirements of the Program Plan.
- Each Board or Department in consultation with the SWRCB and CCC shall consider the need to establish or revise existing formal agreements with the SWRCB and CCC to ensure successful implementation of the Program Plan.

In addition, we encourage each Board or Department to adopt policies that support the Program Plan.

Please reply to William Vance, Ph.D., Assistant Secretary for Policy and Regulations, Cal/EPA, or Maria Rea, Assistant Secretary for Watershed and Salmon Restoration, Resources Agency, by February 25, 2000 with the name, telephone number, and e-mail address of your designated lead staff person. If you have any questions, please call Dr. Vance, at (916) 324-7584 or Ms. Rea, at (916) 653-5656.

Attachment

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APPENDIX E. MEMORANDUM OF UNDERSTANDING BETWEEN THE STATE WATER RESOURCES CONTROL BOARD AND THE CALIFORNIA COASTAL COMMISSION

This Memorandum of Understanding (MOU) is between the State Water Resources Control Board (SWRCB) and the California Coastal Commission (CCC). The SWRCB is part of the California Environmental Protection Agency (Cal/EPA), and the CCC is part of the California Resources Agency.

AGENCIES AGREE AS FOLLOWS:

A. PURPOSE

The purpose of this MOU is to promote protection of (1) water quality and (2) the uses and resources dependent on clean water from the potential adverse effects of nonpoint source (NPS) pollution. The SWRCB and CCC concur that the State will benefit from a unified and cooperative program to protect and restore water quality.

B. AUTHORITY

The authority of the SWRCB and CCC are defined by federal and State law described as follows:

1. The SWRCB and CCC, in coordination with the nine Regional Water Quality Control Boards (RWQCBs), are the lead State agencies in California for the development and implementation of the *Plan for California's Nonpoint Source Pollution Control Program: 1998-2013* (Program Plan) which has been prepared pursuant to the Federal Clean Water Act section 319 (33 U.S.C. §1329) and Coastal Zone Management Act section 6217 (16 U.S.C. §1455b).

2. The SWRCB and the RWQCBs are the State agencies with primary responsibility for coordination and control of water quality throughout California. The SWRCB and RWQCBs are the State agencies authorized under the Clean Water Act and State law to designate beneficial uses of the State's waters and establish water quality objectives for protecting those uses. The SWRCB and RWQCBs have a variety of regulatory powers under which they investigate water quality issues; adopt water quality control plans, regulations, and policies; prohibit waste discharges in certain areas; and issue permits regulating waste discharges affecting water quality. The SWRCB is required to provide information to the public regarding water quality issues. The SWRCB also administers several loan and grant programs for the protection of water quality, including the NPS grant program under the Federal Clean Water Act section 319 (33 U.S.C. §1329). RWQCBs also have the authority to order cleanup of waste discharges and to take enforcement actions against waste dischargers, including imposing administrative civil liability.

3. The CCC has the primary responsibility for implementation of the California Coastal Act and has been designated the State coastal zone planning and management agency for any and all purposes and may exercise any and all powers set forth in the Federal Coastal Zone Management Act of 1972 (16 U.S.C. §1451, et seq.) and any amendments thereto or other federal laws that relate to the planning or management of the coastal zone. The California Coastal Act mandates the protection and restoration of coastal waters. The CCC certifies local coastal programs and approves coastal development permits, energy projects, and federal projects within the Coastal Zone in accordance with water quality policies in the California Coastal Act. The CCC protects water quality through the management of development that generates runoff, creates spills, or otherwise affects water quality. The CCC also implements educational and technical assistance programs and coordinates with other agencies to address land-use and development activities that may generate polluted runoff.

4. According to Public Resources Code section 30400, in the absence of specific authorization by law or by agreement with the CCC, no State agency shall exercise any powers or carry out any duties or responsibilities established by the California Coastal Act or by the Federal Coastal Zone Management Act of 1972 or any amendment thereto.

5. According to Public Resources Code section 30412, the CCC, subject to limited exceptions regarding wastewater treatment plants, shall not modify, adopt conditions, or take any action in conflict with any determination by the SWRCB or any RWQCB in matters relating to water quality or the administration of water rights.

C. IMPLEMENTATION

Effective implementation of the Program Plan requires continued collaboration between the SWRCB and CCC. The SWRCB and the CCC therefore agree to:

1. To continue to work cooperatively to implement the Program Plan;
2. To be partners in the administrative coordination of California's Nonpoint Source Pollution Control Program (NPS Program);
    a. The SWRCB and CCC will be joint partners in developing, implementing, and participating in interagency coordinating committees;
    b. The SWRCB will act as the lead coordinating agency with Cal/EPA members; the CCC will act as the lead coordinating agency with Resources Agency members;
    c. The SWRCB will serve as the liaison with the U.S. Environmental Protection Agency (USEPA); the CCC will serve as the liaison with the National Oceanic and Atmospheric Administration (NOAA);

3. To implement and to track the implementation of applicable management measures and management practices related to NPS pollution prevention and control;

4. To modify or add to the Program Plan, including the actions identified in the Five-Year Implementation Plans (Volume 1) and the management measures in *California Management Measures for Polluted Runoff* (CAMMPR) (Volume 2), in a joint effort;

5. To meet on a regular basis (quarterly) to assess Program implementation, to discuss existing and proposed projects of mutual interest, and to consider changes to the Program Plan or MOU;

6. To have staff and management actively participate in regular updates on implementation of the Plan and identify concerns regarding the coordination and control of water quality due to changes in laws, regulations, policies, water quality control plans, or local coastal programs;

7. To work cooperatively through the legislative process to the extent permitted by law and Governor's Office procedures to further the NPS Program;

8. To work cooperatively in the budgetary process to support NPS Program activities;

9. To jointly convene public workshops to develop the next Five-Year Implementation Plan, no later than three years after the effective date of each Five-Year Implementation Plan;

10. To report biennially on program effectiveness;

11. To improve communication with the members of the CCC, SWRCB, and RWQCBs by:

    a. SWRCB staff and CCC staff jointly presenting an annual status report to the CCC and the SWRCB Members regarding the NPS program;

    b. SWRCB and RWQCB staffs consulting with CCC staff regarding NPS projects implemented or ordered by the SWRCB or a RWQCB requiring a coastal development permit issued or reviewed by the CCC. CCC staff will brief Commission Members in advance and take other actions needed to expedite a decision on the project. CCC staff will consult with SWRCB and RWQCB staffs regarding any of their projects that require SWRCB approval; and SWRCB and RWQCB staffs will brief SWRCB Members in advance and take other actions needed to expedite a SWRCB decision on the project.

D. RESERVATION OF AUTHORITY

Nothing herein shall be construed in any way as limiting the authority of the SWRCB or CCC in carrying out their respective legal responsibilities for management, regulation, coordination, and control of water quality or land uses affecting water quality.

Nothing herein shall be construed to prohibit the establishment of MOUs/Management Agency Agreements/Memoranda of Agreements with State or other agencies by either the SWRCB or CCC.

E. MODIFICATION OR RECISION

This MOU shall become effective upon the date of final signature and shall continue in effect until modified by the mutual written consent of both parties or until terminated by either party upon a 30-day advance written notice to the other party.

State Water Resources Control Board
Approves

Walt Pettit

Walt Pettit, Executive Director
February 2, 2000

California Coastal Commission
Approves

Peter Douglas

Peter M. Douglas, Executive Director
February 2, 2000

California Environmental Protection Agency
Concurs

Winston H. Hickox

Winston Hickox
Agency Secretary
February 2, 2000

California Resources Agency
Concurs

Mary D. Nichols

Mary Nichols
Secretary for Resources
February 2, 2000

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APPENDIX F. LIST OF ACRONYMS

1988 Plan – Nonpoint Source Management Plan, November 1988
AB – Assembly Bill
ACL – Administrative Civil Liability
ADMP – Agriculture Drainage Management Plan
AFO – Animal Feeding Operations
AG – Attorney General
AMBAG - Association of Monterey Bay Area Governments
ARS – Agricultural Research Service
ASBS – Areas of Special Biological Significance
Basin Plan – Regional Water Quality Control Plans
BASMAA – Bay Area Stormwater Management Agencies Association
BAWPG – Bay Area Wetlands Planning Group
BCGC – Boating and Clean Green Campaign
BCP – Budget Change Proposal
BIOS – Biologically Integrated Orchard Systems
BLM – U.S. Bureau of Land Mangement
BMP – Best Management Practices
BOF – Board of Forestry
BPTCP – Bay Protection and Toxic Cleanup Program
Cal/EPA – California Environmental Protection Agency
CALFED – CALFED Bay-Delta Program
Cal/RA – California Resources Agency
Cal/Trans – California Department of Transportation
CAMMPR – Volume II: California Management Measures for Polluted Runoff
CAO – Cleanup and Abatement Orders
CARCD – California Association of Resource Conservation Districts
CBC – California Biodiversity Council
CCA – Critical Coastal Area
CCBN – California Clean Boating Network
CCC – California Coastal Commission
CCR – California Code of Regulations
CCMP – California Coastal Management Program
CDF – California Department of Forestry and Fire Protection
CDO – cease and desist orders
CDP – Coastal Development Permit
CDPR – Department of Pesticide Regulation
CEEIN – California Environmental Education Interagency Network
CEQA – California Environmental Quality Act
CERCLA – Comprehensive Environmental Response and Compensation Liability Act
CERPI – California Ecological Restoration Projects Inventory
CESA – California Endangered Species Act
CFB – California Farm Bureau
CFR – Code of Federal Regulations
CIWMB – California Integrated Waste Management Board
CNPCP – Coastal Nonpoint Source Pollution Control Program
Coastal Act – California Coastal Act
CPR Plan –*Plan for Controlling Polluted Runoff*
CRMP – Coordinated Resource Management and Planning Program
CRWQMP – California Rangeland Water Quality Management Plan
CTR – California Toxics Rule
CVA – Clean Vessel Act
CWA - Clean Water Act
CWAP – Clean Water Action Plan
CWC – California Water Code
CWPI – California Watershed Project Inventory
CZARA Coastal Zone Act Reauthorization Amendments of 1990
CZM – Coastal Zone Management
CZMA – Coastal Zone Management Act
CZTA – Coastal Zone Treatment Areas
DA – District Attorney
DBW – Department of Boating and Waterways
DFA – Department of Food and Agriculture
DFG – Department of Fish and Game
DHS – Department of Health Services
DOC – Department of Conservation
DPR - Department of Parks and Recreation
DTSC – Department of Toxic Substance Control
DWR – Department of Water Resources
DWSAP – Drinking Water Source Assessment and Protection
EBEP – Enclosed Bays and Estuaries Plan
EIR – Environmental Impact Report
EQIP – Environmental Quality Incentives Program
ESA – Endangered Species Act
ESHA – Environmentally Sensitive Habitat Area
FACT – Functioning Assessment Criteria Test
FERC – Federal Energy Regulatory Commission
FOTG – Field Office Technical Guide

FPR – Forest Practice Rules
FSA – Farm Services Agency
FY – Fiscal Year
g-Guidance – Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (CZARA §6217[g])
GeoWBS – Geographically-based Water Body System
GIS – Geographic Information System
GRTS – Grants Reporting and Tracking System
HHW – Household Hazardous Waste
HTB – Heal the Bay
IACC – Interagency Coordinating Committee
Implementation Plan – Five-Year Implementation Plan (1998-2003)
IPM – Integrated Pest Management
ISWP – Inland Surface Waters Plan
LCP – Local Coastal Program
LCPA – Local Coastal Program Amendment
LEA – local enforcement agency
LUP – land use plan
MAA – Management Agency Agreement
MBNMS - Monterey Bay National Marine Sanctuary
MM – management measure
MOA - Memorandum of Agreement
MOU – Memorandum of Understanding
MP – management practices
MPA – MacAteer-Petris Act
MSG – Monitoring Study Group
MURP – Model Urban Runoff Program
NAWQA – National Water Quality Assessment Program
NEP - National Estuary Program
NEPA – National Environmental Policy Act
NERR - National Estuarine Research Reserve
NGO – non-governmental organization
NMS - National Marine Sanctuary
NOAA – National Oceanic and Atmospheric Administration
NOV – Notice of violation
NPDES – National Pollutant Discharge Elimination System
NPS – nonpoint source
NPS MIS – NPS Management Information System
NRCS – Natural Resources Conservation Service
NRDC – Natural Resources Defense Council
NRPI – Natural Resources Project Inventory
OAL – State Office of Administrative Law
Ocean Plan – California Ocean Plan
OCWD – Orange County Water District
OSDS – On-site Disposal System
OSPR – DFG/Oil Spill Prevention and Response
PCA – Program Cost Account
PIPP – Public Information Public Participation Committee of the SWQTF
PMP – portmaster plan
PMZ – Pesticide Management Zone
Policy – Policy for Implementation of Toxics Standards for Inland Surface Water, Enclosed Bays, and Estuaries of California
Porter-Cologne Act - Porter Cologne Water Quality Control Act
POTWs – publicly owned treatment works
PRC – Public Resources Code
Program – NPS Pollution Control Program
Program Plan – *Plan for California's Nonpoint Source Pollution Control Program 1998-2013*
PROSIP – Volume I: Nonpoint Source Program Strategy and Implementation Plan, 1998-2013
PTS – Permit Tracking System
QA/QC – Quality Assessment/Quality Control
RCDs –Resource Conservation Districts
RCRA – Resource Conservation and Recovery Act
ReCAP – CCC's Regional Cumulative Assessment Program
RFP – Request for Proposal
RIFA – red imported fire ants
RMS – Resource Management Systems
RWQCB – Regional Water Quality Control Board
SbMA – Subdivision Map Act

SCC – State Coastal Conservancy
SFB – San Francisco Bay
SFBCDC - San Francisco Bay Conservation and Development Commission
SFEP – San Francisco Estuary Project
SJVDIP – San Joaquin Valley Drainage Implementation Program
SLC – State Lands Commission
SMA – Streamside Management Areas
SMARA – Surface Mining and Reclamation Act
SMB – Santa Monica Bay
SRF – State Revolving Fund
Strategy – Fifteen-Year Program Strategy
SWIM – System for Water Information Management
SWPPP – Storm Water Pollution Prevention Program
SWQTF – Stormwater Quality Task Force

SWRCB – State Water Resources Control Board
TAC – Technical Advisory Committee
TBT - tributyltin
THP – Timber Harvesting Plan
TMDL – Total Maximum Daily Load
TSCA Toxic Substances Control Act
TSS – Total Suspended Solids

UC – University of California
UCCE University of California Cooperative Extension
UCD ICE – University of California, Davis, Information Center for the Environment
USBR – U. S. Bureau of Reclamation
USC – United States Code
USCG – U.S. Coast Guard
USACOE – U.S. Army Corps of Engineers
USDA – U. S. Department of Agriculture
USEPA – U. S. Environmental Protection Agency
USFS – U.S. Forest Service
USFWS - U.S. Fish and Wildlife Service
USGS – U. S. Geological Survey
WATER – Watershed Analysis Tool for Environmental Review
WCB – Wildlife Conservation Board
WCL – Wildlife Conservation Law of 1947
WDR – Waste Discharge Requirement
WLPZ – Watercourse and Lake Protection Zone
WMA – Watershed Management Areas
WMI – Watershed Management Initiative
WQA – Water Quality Assessment
WQCP – Water Quality Control Plans
WQCrP – Water Quality Certification Program
WQMP – Water Quality Management Plan
WQPP - Water Quality Protection Program
WRAS – Watershed Restoration Action Strategy
WRP – Wetlands Research Project

APPENDIX G. BIBLIOGRAPHY

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Plan for California's Nonpoint Source Pollution Control Program

Volume II: California Management Measures for Polluted Runoff

State Water Resources Control Board
California Coastal Commission
January 2000

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VOLUME II

CALIFORNIA MANAGEMENT MEASURES FOR POLLUTED RUNOFF (CAMMPR)

State Water Resources Control Board
California Coastal Commission

January 2000

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VOLUME II

CALIFORNIA'S MANAGEMENT MEASURES FOR POLLUTED RUNOFF (CAMMPR)

I. INTRODUCTION

A. Background

California's Management Measures for Polluted Runoff (CAMMPR) is designed to assist California in improving implementation of the California's Nonpoint Source (NPS) Pollution Control Program (Program). Management measures (MMs) form the core of the State's Plan for California's Nonpoint Source Pollution Control Program 1998-2013 (Program Plan) and provide goals for the management of NPS pollution to which various management practices are applied.[1] The measures are organized into six categories or sectors, all of which are present in California:

1. Agriculture;
2. Forestry (Silviculture);
3. Urban Areas;
4. Marinas and Recreational Boating;
5. Hydromodification Activities; and
6. Wetlands, Riparian Areas, and Vegetated Treatment Systems.

To help states develop sound and effective NPS programs, the U.S. Environmental Protection Agency (USEPA) developed a guidance document pursuant to the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) section 6217(g) titled the *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (g-Guidance)* (USEPA[1993]). USEPA and the National Oceanic and Atmospheric Administration (NOAA) expect state programs to implement MMs "in conformity" with the *g-Guidance*.[2] This MM approach is technology-based rather than water-quality based. Because NPSs of pollution are so diverse and since each individual source may contribute only a small quantity of contaminants, identifying the exact sources of NPS pollution can be very expensive and time-consuming. Implementation of technology-based MMs allows states to concentrate their resources initially on implementing measures that are proven to be effective in preventing and controlling NPS pollution.

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[1] MMs are defined in CZARA section 6217(g)(5) as "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives."

[2] USEPA's g-Guidance identifies 56 MMs to control or prevent NPS pollution. The management measures and related practices can be viewed on the Internet at http://www.epa.gov/OWOW/NPS/MMGI.

Pursuant to the Clean Water Act (CWA) and CZARA, the Program Plan addresses two types of MMs:

1. **Minimum Management Measures**

   These measures are based on the federal guidance and will apply to the land use activities known to be major causes of NPS pollution. For example, keeping grazing animals out of streams is a minimum MM for agricultural sources of NPS pollution. State programs will ensure that people and organizations conducting these specified land use activities implement the appropriate MMs. The goal of implementing these measures is to protect water quality and habitat.

2. **Additional Management Measures**

   Where NPS pollution continues to prevent critical areas from meeting CWA requirements, even when minimal MMs are used, additional MMs may be necessary. These measures will be targeted directly at reducing the NPS pollution activities that prevent State waters from meeting appropriate water quality standards, such as ensuring the water is safe for drinking, fishing, or swimming.

Implementation of MMs can be achieved through the implementation of management practices (MPs). MPs are structural and nonstructural solutions, used singularly or in combination, that are aimed at reducing the input of particular NPS contaminants into surface waters. An example of a structural MP is an infiltration basin (a structure that is built to hold runoff and filter contaminants from that runoff before the water is absorbed into the ground). Nonstructural MPs include buffer strips (areas of natural vegetation) that are left as protection between streams or other surface water bodies and farmlands or construction sites.

B. Development and Use of CAMMPR

CAMMPR is divided into sections for each of the major categories of NPS pollution: (1) agriculture; (2) forestry; (3) urban areas; (4) marinas and recreational boating; (5) hydromodification; and (6) wetlands, riparian areas, and vegetated treatment systems. Each section identifies:

- Individual MMs appropriate for implementation in California;
- The various State and local agencies with authorities and programs to implement and/or enforce each MM;
- State and local backup authorities that can be used to assure implementation when self-determined programs are not followed;
- Program implementation locations; and
- Notes to clarify how the programs operate.

In developing CAMMPR, the Program has emphasized consensus building and flexibility to the extent feasible while also ensuring that California's MMs remain in conformity with federal guidance.

In January 1998, staffs of the State Water Resources Control Board (SWRCB), Regional Water Quality Control Boards (RWQCB), and California Coastal Commission (CCC) began preparing CAMMPR by evaluating the *g-Guidance* MMs for their appropriateness for implementation in California. To assist in this evaluation, the agencies reviewed recommendations made in 1995 by the ten Technical Advisory Committees (TACs) established by the SWRCB to assist in the upgrade of the Program. In March 1998, the staffs completed their initial review and submitted a preliminary draft to USEPA and NOAA for comment. Revisions were subsequently made based on the federal review, and in July 1998, the revised draft of CAMMPR was circulated for review by each State agency that was designated in the document.

CAMMPR retains the original *g-Guidance* MM language for nearly all of California's NPS MMs. Language in the MM has been modified only slightly, and in most cases the modifications have made the MMs more protective of the environment. Other specific changes to the federal guidance were made to reach a total of 61 NPS MMs that will be implemented in California.

- Two agriculture MMs for small and large confined animal facilities were combined into a single MM because California law does not differentiate between small and large animal facilities.
- Additional MMs were added for Forestry (Post-Harvest Evaluation) and Marinas and Recreational Boating (Waste Facilities Management) to address perceived needs.
- Education/Outreach MMs were added to the agriculture, forestry, hydromodification, and wetlands NPS categories to reflect the State's intention to promote public awareness and involvement in controlling NPS pollution. The *g-Guidance* included education MMs for the urban and marinas sectors only. Nearly all of the TACs recommended that public education be enhanced so that individuals can take responsibility and make the cooperative approach to problem solving work.

Not all of the identified MMs may be needed to address the NPSs at a specific site. For example, forestry and construction operations that do not use chemicals would not need to implement chemical-control MMs. Similarly, farms or other agriculture enterprises that do not have animals as part of the enterprise would not need to implement the MMs that address confined animal facilities or grazing. Other operations that have more than one source to address may need to employ two or more measures to address the multiple sources. Application of the measures should be coordinated to produce an overall system that adequately addresses all sources for the site in a cost-effective manner.

In addition, many operations may already be in compliance with the MMs needed to address the associated NPSs. Existing NPS pollution control activities will be recognized and appropriate credit given for practices that are in existence and operational. Existing practices, plans, and systems should be viewed as building blocks for the MMs and may need no additional improvement. For cases where existing source control is inadequate to achieve conformity with the needed MMs, only one or two more practices may need to be added to achieve conformity.

Finding solutions to NPS pollution poses unique challenges. While increased use of regulatory authorities can help to address certain categories of NPS pollution (such as the relatively recent effort to issue permits for the most significant municipal storm water discharges), California will need to rely on a wide range of tools, activities, and authorities to address NPS pollution statewide. In particular, these efforts need to focus on better integration and coordination at the State level and collaborative approaches to establish ongoing community-based stewardship.

IMPLEMENTING AGENCIES FOR CZARA MANAGEMENT MEASURES

Agencies	Management Measures*					
	AGR	FOR	URB	MAR	HYD	WET
California Environmental Protection Agency						
1. State Water Resources Control Board (SWRCB)	✓	✓	✓	✓	✓	✓
2. Regional Water Quality Control Boards (9) (RWQCB)	✓	✓	✓	✓	✓	✓
3. California Integrated Waste Management Board (CIWMB)			✓	✓		
4. Department of Pesticide Regulation (CDPR)	✓	✓	✓			
5. Department of Toxic Substances Control (DTSC)			✓	✓		
California Resources Agency						
6. California Coastal Commission (CCC)	✓	✓	✓	✓	✓	✓
7. Delta Protection Commission	✓					
8. Department of Boating and Waterways (DBW)				✓		
9. Department of Conservation (DOC)	✓					
10. Department of Fish and Game (DFG)	✓	✓	✓	✓	✓	✓
11. DFG, Office of Spill Prevention and Response (OSPR)				✓		
12. Department of Forestry and Fire Protection		✓				
13. Board of Forestry and Fire Protection		✓				
14. Department of Parks and Recreation (DPR)	✓	✓	✓	✓	✓	✓
15. Department of Water Resources (DWR)	✓		✓		✓	✓
16. San Francisco Bay Conservation and Development Commission (SFBCDC)			✓	✓	✓	✓
17. Santa Monica Mountains Conservancy			✓			✓
18. State Coastal Conservancy					✓	✓
19. State Lands Commission (SLC)	✓	✓		✓		✓
20. Wildlife Conservation Board					✓	✓
Other State						
21. Department of Food and Agriculture (DFA)	✓					
22. Department of Health Services (DHS)	✓	✓	✓	✓	✓	✓
23. Department of Transportation (Cal/Trans)			✓			
Other						
Local Governments	✓	✓	✓	✓	✓	✓
California Resource Conservation Districts	✓	✓	✓		✓	✓
Monterey Bay National Marine Sanctuary (MBNMS)	✓		✓	✓	✓	✓

* In this table, AGR = Agriculture; FOR = Forestry; URB = Urban; MAR = Marinas and Recreational Boating; HYD = Hydromodification; WET = Wetlands and Riparian Areas

The SWRCB, CCC, and other State agencies have identified seven management measures (MMs) to address agricultural nonpoint sources of pollution that affect State waters. The agricultural MMs include practices and plans installed under various NPS programs in California, including systems of practices commonly used and recommended by the U.S. Department of Agriculture (USDA) as components of Resource Management Systems (RMS), Water Quality Management Plans and Agricultural Waste Management Systems. These RMSs are planned by individual farmers and ranchers using an objective-driven planning process outlined in the NRCS National Planning Procedures Handbook. The RMSs are designed to achieve sustainable use of the different natural resource areas—Soil, Water, Air, Plants, Animals, and Human considerations.

California's MMs to address agricultural sources of NPS pollution in California:

1A. Erosion and Sediment Control
1B. Facility Wastewater and Runoff from Confined Animal Facilities
1C. Nutrient Management
1D. Pesticide Management
1E. Grazing Management
1F. Irrigation Water Management
1G. Education/Outreach

According to the USEPA (1993), agriculture contributes more than half of the pollution entering the Nation's water bodies; recent studies have identified it as the greatest source of water pollution in the United States. The primary agricultural NPS pollutants are nutrients, sediment, animal wastes, pesticides, and salts. Agricultural activities may also affect habitat through physical disturbances caused by livestock or equipment, or through the management of water.

Management Measures:

Erosion and Sediment Control. MM 1A addresses NPS problems associated with soil erosion and sedimentation. Where erosion and sedimentation from agricultural lands affects coastal waters and/or waterbodies listed as impaired by sediment, landowners shall design and install or apply a combination of practices to reduce solids and associated pollutants in runoff during all but the larger storms. Alternatively, landowners may apply the erosion component of an RMS as defined in the NRCS Field Office Technical Guide (FOTG). The NRCS FOTG contains standards and specifications for installing these practices.

Facility Wastewater and Runoff from Confined Animal Facilities. Pursuant to MM 1B, facility wastewater and contaminated runoff from confined animal facilities must be contained at all times. Storage facilities should be of adequate capacity to allow for proper waste water use and should be constructed so they prevent seepage to ground water, and stored runoff and accumulated solids from the facility shall be managed through a waste use system that is consistent with MM 1C or removed from the site.

Nutrient Management. MM 1C addresses the development and implementation of comprehensive nutrient management plans for areas where nutrient runoff is a problem affecting coastal waters and/or water bodies listed as impaired by nutrients. Such plans would include a plant tissue analysis to

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determine crop nutrient needs; crop nutrient budget; identification of the types, amounts, and timing of nutrients necessary to produce a crop based on realistic crop yield expectations; identification of hazards to the site and adjacent environment; soil sampling and tests to determine crop nutrient needs; and proper calibration of nutrient equipment. When manure from confined animal facilities is to be used as a soil amendment and/or is disposed of on land, the plan shall discuss steps to assure that subsequent irrigation of that land does not leach excess nutrients to surface or ground water.

Pesticide Management. Implementation of MM 1D is intended to reduce contamination of surface water and ground water from pesticides. Implementation of this measure will primarily occur through cooperation with the Department of Pesticide Regulation as provided in a Management Agency Agreement with the SWRCB. Elements of this measure include development and adoption of reduced risk pest management strategies (including reductions in pesticide use); evaluation of pest, crop, and field factors; use of Integrated Pest Management (IPM); consideration of environmental impacts in choice of pesticides; calibration of equipment; and use of anti-backflow devices. IPM is a key component of pest control. IPM strategies include evaluating pest problems in relation to cropping history and previous pest control measures, and applying pesticides only when an economic benefit will be achieved. When used, pesticides should be selected based on their effectiveness to control target pests and environmental impacts such as their persistence, toxicity, and leaching potential.

Grazing Management. MM 1E is intended to protect sensitive areas (including streambanks, lakes, wetlands, estuaries, and riparian zones) by reducing direct loadings of animal wastes and sediment. This may include restricting or rotationally grazing livestock in sensitive areas by providing fencing, livestock stream crossings, and by locating salt, shade, and alternative drinking sources away from sensitive areas. Upland erosion can be reduced by, among other methods: (1) maintaining the land consistent with the California Rangeland Water Quality Management Plan or Bureau of Land Management and Forest Service activity plans or (2) applying the range and pasture components of a Resource Management System (NRCS FOTG). This may include prescribed grazing, seeding, gully erosion control, such as grade stabilization structures and ponds, and other critical area treatment.

Irrigation Water Management. MM 1F promotes effective irrigation while reducing pollutant delivery to surface and ground waters. Pursuant to this measure, irrigation water would be applied uniformly based on an accurate measurement of cropwater needs and the volume of irrigation water applied, considering limitations raised by such issues as water rights, pollutant concentrations, water delivery restrictions, salt control, wetland, water supply and frost/freeze temperature management. Additional precautions would apply when chemicals are applied through irrigation.

Education/Outreach. The goals of MM 1G are to implement pollution prevention and education programs to reduce NPS pollutants generated from the following activities where applicable:

a. Activities that cause erosion and loss of sediment on agricultural land and land that is converted from other land uses to agricultural land;
b. Activities that cause discharge from confined animal facilities to surface waters;
c. Activities that cause excess delivery of nutrients and/or leaching of nutrients;
d. Activities that cause contamination of surface water and ground water from pesticides;
e. Grazing activities that cause physical disturbance to sensitive areas and the discharge of sediment, animal waste, nutrients, and chemicals to surface and ground waters;
f. Irrigation activities that cause NPS pollution of surface waters.

1. AGRICULTURE

IMPLEMENTATION AUTHORITIES

Agriculture Management Measures

1A. Erosion and Sediment Control

1B. Facility Wastewater and Runoff from Confined Animal Facilities (All Units)

1C. Nutrient Management

1D. Pesticide Management

1E. Grazing Management

1F. Irrigation Water Management

1G. Education/Outreach

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Management Measure 1A Erosion and Sediment Control Management Measure

Apply the erosion component of a CMS as defined in the Field Office Technical Guide of the U.S. Department of Agriculture – Natural Resources Conservation Service (NRCS) to minimize the delivery of sediment from agricultural lands to surface waters, *or*
Design and install a combination of management and physical practices to settle the settleable solids and associated pollutants in runoff delivered from the contributing area for storms of up to a 25-year, 24-hour frequency.

Agency	Authority	Programs	Implementation Location	Notes
Local governments	PZL (Gov. Code §§ 65000 et seq.) and California Coastal Act (CCA) §30500	• General Plans/GP updates • Local Coastal Programs(LCP)/LCP amendments • Permits pursuant to above • Enforcement	Statewide (LCP policies/ordinances apply in coastal zone)	Local gov'ts adopt ordinances and rules and make land-use decisions consistent with State law. Installation of practices may require a permit.
Local irrigation, water and drainage districts	Water Code Div 11 and Div 17	Drainage of irrigation water	Local areas	Provides for drainage of irrigation waters
California Association of Resource Conservation Districts (CARCDs)/University of California Cooperative Extension (UCCE). NRCS.	Public Resources Code (PRC) Div 9	• NRCS Field Office Technical Guide • Watershed Protection and Flood Prevention Program	Statewide	• Field Guide is incorporated into local management plans • Technical and financial assistance
CCC	CCA (PRC §§30000 et seq.) and CA California Coastal Management Program (CCMP) pursuant to Coastal Zone Management Act (CZMA) [16 United States Code (USC) §§1451 et seq.]	• LCP certification/ amendment • Coastal development permits • Federal consistency: review of federal actions affecting land or water uses or natural resources of the coastal zone • Enforcement	Coastal zone	• CCC certifies LCPs prepared by coastal cities/counties. • Installation of practices may require a permit. • Federal projects, permits and licenses must be found consistent with the CCMP before they are implemented.
DOC, Office of Land Conservation	? 1987	Conserving the Wealth of the Land: A Plan for Soil Conservation	Statewide	This document provides guidance to Resource Conservation Districts (RCDs) on soil conservation efforts.
SCC	PRC Chapter 6, Div 21	Coastal Resource Enhancement Program (CREP)	Coastal zone and coastal watersheds, Statewide	The SCC implements measures to control erosion and reduce sedimentation of coastal wetlands.
SWRCB/RWQCB	California Code of Regulations (CCR) Title 27, Subdivision 1, Chapter 7,	Confined Animals Facility Program	Statewide	

	Subchapter 2, Article 1, §§22560-22565			
USEPA via SWRCB	CWA § 402	Stormwater Quality Management Program	Statewide	
SLC	• PRC §§6000 et seq. (includes lease authority)	• SLC leases (PRC §6501.1 and 6505.5) Grazing lease program • SLC leases (PRC §6501.1 Agricultural leasing program	• School Lands	• Grazing and agricultural lease activity is contingent upon applicant's compliance with permits, recommendations, or limitations issued by federal, State, and local governments including compliance with CEQA.

The following are BACKUP AUTHORITIES that pertain to the Erosion and Sediment Control Management Measure.

Agency	Authority	Programs	Implementation Location	Notes
DOC	PRC Div 9	Watershed Grant Program	Statewide	Provides small grants to local RCDs to promote watershed restoration projects.
DFG	Fish and Game Code (FGC) § 5650	Discharge violations to waters of the State	Statewide	
DHS	Health and Safety Code (HSC) §116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25; Div. V, PRC §5000 et seq.		State Park System/State Parks (SPS)	DPR operates and maintains units of the SPS in areas of agriculture.
DWR	Water Code	Drinking Water Protection	Watershed	Reservoir sampling program
SWRCB/RWQCB	Porter-Cologne Water Quality Control Act (PCWQCA), California Water Code (CWC)	• Nonpoint Source Management Plan (NPSMP) • Basin Plans • Water Quality Standards • Waste Discharge Requirements (WDRs) • Cleanup & Abatement Orders • Cease and Desist Orders • Admin. Civil Liability	Statewide	

USDA Agricultural Research Service	?	Research on new technologies and practices on erosion control	Statewide	
USDA Consolidated Farm Service	Various, ending with the Energy Security Act 1980	Agricultural Conservation Program	Statewide	Provides financial assistance for erosion control
USDA Cooperative State Research, Education, and Extension Service	?	Various	Statewide	
Other efforts that pertain to Agriculture Management Measure 1A				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
State/local/federal agency participation in MBNMS	MPRSA (16 USC §1431 et seq.)	MBNMS WQPP Action Plan for Agriculture	MBNMS	The MBNMS WQPP is a collaborative effort of federal, State, and local agencies and public and private groups initiated with an MOA among State and federal agencies. The agricultural plan focuses on the development of industry networks, technical assistance, educational programs, and financial incentives.

Management Measure : 1B Facility Wastewater and Runoff from Confined Animal Facility Management (All Units) Limit the discharge from the confined animal facility to surface waters by Management Measure Component (1): Containing both facility wastewater and the contaminated runoff from confined animal facilities at all times up to and including storms exceeding a 25-yr, 24-hr frequency event [storage facilities should be of adequate capacity to allow for proper waste water utilization and should be constructed so they prevent seepage to ground water]; and				
Agency	Authority	Programs	Implementation Location	Notes
Local governments	Planning and Zoning Law (PZL) (Gov. Code §§65000 et seq.) and CCA §30500	• General Plans/GP updates • LCPs/LCP amendments • Permits pursuant to above • Enforcement	Statewide (LCP policies/ordinances apply in coastal zone)	Local gov'ts adopt ordinances and rules and make land-use decisions consistent with State law. Installation of practices may require a permit
RCDs	PRC Div. 9	Various	Countywide	
UCCE	?	• Farm Advisors • Watershed Management Education Programs • Ranch Planning Short Courses • Waste Management Workshop	Statewide	
SWRCB/RWQCB	CCR Title 27, Subdivision 1, Chapter 7, Subchapter 2, Article 1, Sections 22560-22565	Confined Animal Facilities Program	Statewide	• § 2562 pertains to storage • § 22563-22564 pertain to waste utilization
SWRCB/RWQCB	CCR Title 14, Chapt. 13, Art. 6	Dead Animal Disposal	Statewide	
SWRCB/RWQCB	40 Code of Federal Regulations (CFR) 122.23	National Pollutant Discharge Elimination System (NPDES) Permits ≥1000 animal units	Statewide	
USDA/NRCS	Food Securities Act 1985	• Conservation Technical Assistance Program • Soil and Water Conservation Program • Hydrological Unit Area Grant Program	Statewide	

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Management Measure component (2): Managing stored runoff and accumulated solids from the facility through an appropriate waste utilization system that is consistent with MM 1C.				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
The following are BACKUP AUTHORITIES that pertain to the Confined Animal Facilities Management Measure				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
SWRCB/RWQCB	Porter-Cologne CWC Div 7 and CCR Title 23 Div 3 and 4	• Basin Plans • Water Quality Standards • WDRs • Cleanup and Abatement Orders • Cease and Desist Orders • Admin. Civil Liability	Statewide	
Consolidated Farm Service	?	Cost sharing on installation of waste management units for confined animals	Counties	
DFG	FGC § 5650	Discharge violations to State's water		
DPR	Div. I, Chapter 1.25; Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in areas where animals are confined.
DHS	HSC §116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs of drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DOC	PRC Div 9	Watershed Grant Program	Statewide	Provides small grants to local RCDs to promote watershed restoration projects.

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Management Measure (MM) 1C Nutrient Management Measure

Develop, implement, and periodically update a nutrient management plan to: (1) apply nutrients at rates necessary to achieve realistic crop yields, (2) improve the timing of nutrient application, and (3) use agronomic crop production technology to increase nutrient use efficiency. When the source of the nutrients is other than commercial fertilizer, determine the nutrient value and the rate of availability of the nutrients. Determine and credit the nitrogen contribution of any legume crop. Soil and plant tissue testing should be used routinely. Nutrient management plans contain the following core components:

Management Measure Component (1): Farm and field maps showing acreage, crops, soils, and water bodies.

Management Measure Component (2): Realistic yield expectations for the crop(s) to be grown, based primarily on the producer's actual yield history, State Land Grant University yield expectations for the soil series, or NRCS Soils-5 information for the soil series.

Management Measure Component (3): A summary of the nutrient resources available to the producer, which at a minimum include: (a) soil test results for pH, phosphorus, nitrogen and potassium; (bnutirnet analysis of manure, sludge, mortality compost (birds, pigs, etc.), or effluent (if applicable); (c) nitrogen contribution to the soil from legumes grown in the rotation (if applicable); and (d) other significant nutrient sources (e.g., irrigation water).

Management Measure Component (4): An evaluation of field limitations based on environmental hazards or concerns such as: (a) sinkholes, shallow soils over fractured bedrock, and soils with high leaching potential, (b) lands near surface water, (c) highly erodible soils, and (d) shallow aquifers.

Management Measure Component (5): Use of the limiting nutrient concept to establish the mix of nutrient sources and requirements for the crop based on a realistic yield expectation.

Agency	Authority	Programs	Implementation Location	Notes
Local governments Water Resource Management Agencies	PZL (Gov. Code §§65000 et seq.) and CCA §30500	• General Plans/GP updates • LCPs/LCP amendments • Permits pursuant to above Enforcement	Statewide (LCP policies/ordinances apply in coastal zone)	Local gov'ts adopt ordinances and rules and make land-use decisions consistent with State law. Installation of practices may require a permit
RCDs	PRC §9000 et seq.	Technical Assistance Program	Statewide	Provides individual and group guidance on crop fertilization and prevention of NPS pollution.
DFA	FAC §14583 and §14611(b)	Fertilizer Research and Education Program	Statewide	• Annual Conference on Fertilizer Research • Extensive outreach with a web site, publications and videos • Publications include crop-specific management practices and environment issues • Conducts demonstration projects • Sponsor research and conferences by other organizations
SWRCB	?	Biologically Integrated Orchard Systems (BIOS)	Statewide at local level in orchards	Promotes reduction in pesticide and fertilizer use.
UCCE, Farm Advisors	?	Technical Assistance	Statewide	Provides crop-specific fertilizer guidance and does research on nutrient application, promotes soil and plant tissue testing.

Agricultural Water Supplier delivering > 50,000 ac-ft	Assembly Bill (AB) 3616	Water Management Plans and Implementation Measures	Local	
American Society of Agronomy	?	Certified Crop Advisor Program	Statewide at local level	Voluntary certification for individuals who make soil and nutrient recommendations. Recommendations include: nutrient management plans, soil/ plant tissue testing, yield/fertilizer application rates and methods.
California Fertilizer Association DFA	Food and Agriculture Code (FAC) §1461	• Nutrient Seminar Series • Community Outreach Program • Quarterly News Letter "From the Ground Up" • Crop-specific reports and videos • Western Fertilizer Handbook • Anhydrous Ammonia Transportation Safety Program • Environmental/Site Operations	Statewide at local level	• The annual seminar series is conducted at four sites in State • Education of communities on fertilizers • Newsletter gives the most recent information on crop fertilization • Reports and videos provides current crop-specific guidance • The Handbook provides thorough, complete methods for applying fertilizers • Environmental/Site Operations helps members comply with laws and regulations for air and water quality and safety.

Management Measure Component (6): Identification of timing and application methods for nutrients to: (a) provide nutrients at rates necessary to achieve realistic crop yields, (b) reduce losses to the environment; and (c) avoid applications as much as possible to frozen soil and during periods of leaching or runoff.

Agency	Authority	Programs	Implementation Location	Notes
DFA	FAC §14631 and CCR 2300-2312	Fertilizer Labeling	Statewide	
SWRCB/RWQCB	Water Code 1058 CCR 27, subch. 2 Art. 1, § 2256a,b PRC § 43103	Confined Animal Facilities Program	Local	Reasonable soil amendment rate. Run-off and percolation
AND SAME AS FOR MM COMPONENT (1)				

Management Measure Component (7): Provisions for the proper calibration and operation of nutrient application equipment.

Agency	Authority	Programs	Implementation Location	Notes
DFA	FAC §14681	Fertilizer Labeling	Statewide	

Management Measure Component (8): When manure from confined animal facilities is to be used as a soil amendment and/or is disposed of on land, take steps to assure that subsequent irrigation of that land does not leach excess nutrients to surface or ground waters.

Agency	Authority	Programs	Implementation Location	Notes
SAME AS FOR MM COMPONENT 1				

The following are BACKUP AUTHORITIES that pertain to the Nutrient Management Measure.

Agency	Authority	Programs	Implementation Location	Notes
DOC	PRC Div 9	Watershed Grant Program	Statewide	Provides small grants to local RCDs to promote watershed restoration projects.
DFA	FAC § 14551, 14561, 14591, 14563	• Fertilizer Licensing • Register special fertilizers • Fertilizer labeling • Fertilizer cancellation	Statewide	
DFG	FGC § 5650	Discharge to waters of the State violations	Statewide	
DHS	HSC §116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25; Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in areas where animals are confined
SWRCB/RWQCB	PCWQCA	• Basin Plans • NPSMP • Inland Surface Waters Plan (ISW Plan)	Statewide	
NRCS, U.S. Geological Survery (USGS), U.S. Bureau of Reclamation (USBR), UCCE, Farm Services Agency (FSA)	?	Financial/technical assistance	Statewide	

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Other efforts that pertain to Agriculture Management Measure IC				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
State/local/federal agency participation in MBNMS	MPRSA (16 USC §1431 et seq.)	MBNMS WQPP Action Plan for Agriculture	MBNMS	The MBNMS WQPP is a collaborative effort of federal, State, and local agencies and public and private groups initiated with an MOA among State and federal agencies. The agricultural plan focuses on the development of industry networks, technical assistance, educational programs, and financial incentives.

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Management Measure: 1D Pesticide Management To reduce contamination of surface water and ground water from pesticides. Management Measure Component (1): Evaluate the pest problems, previous pest control measures, and cropping history:				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
CDPR	FAC §12811-12829 3CCR §6170-6193	Registration of pesticide products	Statewide	CDPR evaluates data to support registration of pesticide products.
CDPR	FAC §11501F	Pest Management Grants Program	Statewide	Investigation of innovative pest management practices that will lead to the development of reduced-risk pest management systems
CDPR	FAC §11501F	Pest Management Alliance Program	Statewide	Create alliances targeted at reducing pesticide risks and serving as practical models for adoption of new practices throughout an industry and across the state
CDPR	FAC §11501F	San Francisco IPM Project	San Francisco	Working with city and county in the development and implementation of innovative reduced-risk pest management strategies for the urban environment
CDPR	FAC §11501F	Biologically Integrated Farming Systems Project	San Joaquin Valley	Study comparing (BIOS) with conventional pest management systems
CDPR	FAC §11501F	IPM Innovators Program	Statewide	Encouragement and recognition of groups providing leadership and creativity in integrated pest management
CDPR	FAC §11501F	Pesticide Use Report Analysis	1996 Pesticide Use Report Analysis	Annual analysis of Pesticide Use Report data to interpret use changes and trends
CDPR	FAC § 11501F	Suppliers of Beneficial Organisms	Sacramento	Annual publication listing beneficial organisms sold for use as biological controls and suppliers
CDPR	FAC §11501F	Pest Management Survey Project	Sacramento	Removed database of current pest management alternatives for the major pests of agricultural

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				commodities, based upon survey of University of California (UC) Farm Advisors
CDPR and County Agricultureal Commissioner (CAC)	3 CCR §6622-6628	Pesticide Use Reporting	Statewide	An extensive program of reporting and database management.
CDPR and SWRCB	PCWQCA	MAA: Pesticide Management Plan for Water Quality: Reduced Risk Practices	Statewide	Reduced Risk Practices include all management practices in this management measure.
SWRCB	?	BIOS	?	
Management Measure Component (2): Evaluate the soil and physical characteristics of the site including mixing, loading, and storage areas for potential leaching or runoff of pesticides. If leaching or runoff is found to occur, steps should be taken to prevent further contamination:				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
CDPR	3CCR §6170-6193 FAC §12811-12829	Registration of pesticide products	Statewide	CDPR evaluates data to support registration of pesticide products.
CDPR and CAC	FAC §13143-13152	Ground Water Protection Program: Prevention	Statewide	CDPR implements a prevention program consisting of the identification of potential contaminants, annual continuing education, and a wellhead stewardship program with CACs.
CDPR and CAC	FAC §13149-13152	Ground Water Protection Program: Response	Statewide	CDPR implements a program that requires CDPR to respond, within 90 days, to pesticide detections in ground water and determine whether or not the detection resulted from agricultural use.
CDPR and CAC	FAC §14004.5 3 CCR § 6400, 6432	Rice Pesticides Program	Central Valley	
CDPR and CAC	FAC §14005	Dormant Spray Program	Central Valley	CDPR stated it will use this authority if toxicity associated with dormant spray runoff is not mitigated with self-determined measures.
CAC	FAC §11701, 12973	Mix/load applications	Statewide	CAC staff make on-site inspections.
CDPR	FAC §14005	Surface Water Protection Program	Statewide	CDPR monitors concentrations and evaluates the environmental fate of those pesticides with the potential to run off.

Management Measure Component (3): Use integrated pest management (IPM) strategies that: (a) apply pesticides only when an economic benefit to the producer will be achieved(i.e., applications based on economic thresholds); and (b) apply pesticides efficiently and at times when runoff losses are unlikely;				
Agency	Authority	Programs	Implementation Location	Notes
CDPR	FAC § 14005	Dormant Spray Program	Central Valley	CDPR stated it will use this authority if toxicity associated with dormant spray runoff is not mitigated with self-determined measures.
CDPR	FAC §11501F	Pest Management Grants Program	Statewide	Investigation of innovative pest management practices that will lead to the development of reduced-risk pest management systems
CDPR	FAC §11501F	Pest Management Alliance Program	Statewide	Create alliances targeted at reducing pesticide risks and serving as practical models for adoption of new practices throughout an industry and across the state
CDPR	FAC §11501F	IPM Innovators Program	Statewide	Encouragement and recognition of groups providing leadership and creativity in integrated and reduced-risk pest management
CDPR	FAC § 13150 3 CCR § 6400, 6486.1-6486.6 6570, 6458, 6800(a), 6802	Management of ground water contaminants	Statewide	CDPR regulates the use of aldicarb, atrazine, simazine, diuron, bromacil, prometon, and bentazon to prevent ground water contamination.
CAC	3CCR §6600	General standards of care	Statewide	CAC staff enforce these regulations.
UCCE	?	IPM Innovator Outreach Program	Statewide	
SWRCB	?	BIOS	Statewide	

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Management Measure Component (4): When pesticide applications are necessary and a choice of registered materials exists, consider the persistence, toxicity, runoff potential, and leaching potential of products in making a decision:

Agency	Authority	Programs	Implementation Location	Notes
CDPR	FAC §12811-12829 3 CCR § 6170-6193	Registration of pesticides	Statewide	CDPR evaluates pesticide products and considers restrictions on the use of those with the potential to pollute.
CDPR and CAC	3 CCR § 6432	Conditions on Permits for Restricted Use Pesticides	Statewide	
CAC	PRC § 21080.5	Pesticide Permit Process	Statewide	
CAC	FAC §14006.5 3 CCR § 6426, 6432	Permit evaluation, alternatives and mitigation measures	Statewide	
RCDs with UCCE	?	IPM Innovator Outreach Program	Statewide	

Management Measure Component (5): Periodically calibrate pesticide spray equipment:

Agency	Authority	Programs	Implementation Location	Notes
CAC	FAC §11701-11732	Pest Control Operator License	Statewide	
CAC	3 CCR § 6630, 6460, 6600 FAC §11732	Proper identification and maintenance of application equipment	Statewide	
USEPA	FIFRA	Pesticide Labeling	Statewide	

Management Measure Component (6): Use anti backflow devices on hoses used for filling tank mixtures:

Agency	Authority	Programs	Implementation Location	Notes
CAC	3 CCR § 6610	Backflow Protection	Statewide	

The following are BACKUP AUTHORITIES that pertain to the Pesticide Management Measure

Agency	Authority	Programs	Implementation Location	Notes
CAC	FAC § 11896 and 13101	Cease and Desist Orders	Statewide	
CAC	FAC § 6432	Restricted Use Pesticide Permits	Statewide	
CAC	FAC § 11701 and 11732	Pest Control Operators License	Statewide	
CDPR	FAC Div 6 and 7	• Pesticide Registration/ Cancellation/Modification • Environmental Fate Data	Statewide	

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		Review • Restricted Materials List • Criminal/Civil Liability		
CDPR, with authorities delegated from USEPA	Federal Insecticide, Fungicide, Rodenticide Act (FIFRA)	• Pesticide Registration • Labeling • Application • Regulation • Prohibition • Certify Applicators	Statewide	
CDPR, with funding from USEPA	FIFRA 23(a)	Pest Management Grants	Statewide	
DOC	PRC Div. 9	Watershed Grant Program	Statewide	Provides small grants to local RCDs to promote watershed restoration projects.
DFG	FGC §5650	Discharge to waters of the State violations	Statewide	
DHS	HSC §116275 et seq	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Ch. 1.25, Div. V: PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in areas where pesticides are used.
SWRCB/RWQCB	PCWQCA CWC Div 7 and CCR Title 23	• Basin Plans • Cease and Desist Orders • Cleanup and Abatement Orders • Civil Liability • BPTC • NPDES	Statewide	
SWRCB/RWQCB	CWA §319(h) Grants	Grants to implement pesticide projects	Statewide	

Other efforts that pertain to Agriculture Management Measure 1D

Agency	Authority	Programs	Implementation Location	Notes
State/local/federal agency participation in MBNMS	MPRSA (16 USC §1431 et seq.)	MBNMS WQPP Action Plan for Agriculture	MBNMS	The MBNMS WQPP is a collaborative effort of federal, State, and local agencies and public and private groups initiated with an MOA among State and federal agencies. The agricultural plan focuses on the development of industry networks, technical assistance, educational programs, and financial incentives.

Management Measure 1E Grazing Management Measure				
Protect range, pasture and other grazing lands: MM Component (1): By implementing one or more of the following to protect sensitive areas (such as streambanks, wetlands, estuaries, ponds, lake shores, and riparian zones): (a) exclude livestock, (b) provide stream crossings or hardened watering access for drinking, (c) provide alternative drinking water locations away from surface waters, (d) locate salt and additional shade, if needed, away from sensitive areas, or (e) use improved grazing management (e.g., herding) to reduce the physical disturbance and reduce direct loading of animal waste and sediment caused by livestock; and MM Component (2): By achieving either of the following on all range, pasture, and other grazing lands not addressed under (1) above: (a) implement the range and pasture components of a CMS as defined in the Field Office Technical Guide of the USDA-NRCS by applying the progressive planning approach of the USDA-NRCS to reduce erosion, or (b) maintain range, pasture, and other grazing lands in accordance with activity plans established by either the Bureau of Land Management of the U.S. Department of the Interior or the Forest Service of USDA or the California Rangeland Water Quality Management Plan.				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
California Association of Resource Conservation Districts/RCDs UCCE NRCS	PCWQCA	California Rangeland Water Quality management Plan (CRWQMP)	Statewide—private lands	Training and technical assistance in range management and ranch plan development; research; development of monitoring protocols
SCC	PRC Chapter 6, Div 21	CREP	Coastal zone and coastal watersheds, statewide	SCC implements measures to reduce impacts of grazing on wetlands, streams and other natural resource areas.
The Following are BACKUP AUTHORITIES that pertain to the Grazing Management Measure.				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
DOC	PRC Div 9	Watershed Grant Program	Statewide	Provides small grants to local RCDs to promote watershed restoration projects.
DFG	FGC § 5650	Discharge to waters of the State violations		
DHS	HSC §116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.

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DPR	Div. I, Chapter 1.25, Div. V:PRC §5000 et. seq.		SPS	DPR operates and maintains units of the SPS in grazing areas.
SWRCB/RWQCB	PCWQCA	• NPSMP • Basin Plans • Cease and Desist Orders • Cleanup and Abatement Orders • Admin. Civil Liability	Statewide	
Other efforts that pertain to Agriculture Management Measure 1E				
Agency	Authority	Programs	Implementation Location	Notes
State/local/federal agency participation in MBNMS	MPRSA (16 USC §1431 et seq.)	MBNMS WQPP Action Plan for Agriculture	MBNMS	The MBNMS WQPP is a collaborative effort of federal, State, and local agencies and public and private groups initiated with an MOA among State and federal agencies. The agricultural plan focuses on the development of industry networks, technical assistance, educational programs, and financial incentives.

Management Measure 1F Irrigation Water Management To reduce nonpoint source pollution of surface and ground waters caused by irrigation. Management Measure Component (1): Operate the irrigation system so that the timing and amount of irrigation water applied match crop water needs. This will require, as a minimum: (a) the accurate measurement of soil-water depletion volume and the volume of irrigation water applied, and (b) uniform application of water. *				
Agency	Authority	Programs	Implementation Location	Notes
NRCS (lead)	?	Coordinated Resource Management and Planning (CRMP) Program	Statewide at local level	Direct, local public participation for planning, outreach, technology transfer, implementation, financial assistance, research, and monitoring.
DWR	? 1980	• Agricultural Water Conservation Program • California Irrigation Management Information System (CIMIS) • Mobile Irrigation Management Laboratories	Statewide	
DWR	AB 3616	Agricultural Efficient Water Management Practices	Statewide	
DWR	?	Agricultural Drainage Reduction Program	Statewide	
DWR	AB 658	Agricultural Water Management Planning	Statewide	
SWRCB/RWQCB	AB 3603	San Joaquin River Management Program	San Joaquin Valley	
CDPR/CAC	• CCR 3 § 6800-6806,6557 • FAC § 13141	Ground Water Pesticide Contamination Prevention	Statewide	Enforced by CAC staff
DFG	?	San Joaquin Valley Drainage Implementation Program	San Joaquin Valley	DFG works with USBR, U.S. Fish and Wildlife Service (USFWS), USGS

Management Measure Component (2): When chemigation is used, include backflow preventers for wells, minimize the harmful amounts of chemigation waters that discharge from the edge of the field, and control deep percolation. In cases where chemigation is performed with furrow irrigation systems, a tailwater management system may be needed. *				
Agency	Authority	Programs	Implementation Location	Notes
CDPR/CAC	• FAC §11501 • CCR 3 § 6610	Chemigation Program, Backflow Requirements	Statewide	Enforced by CAC staff

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The following are BACKUP AUTHORITIES that pertain to the Irrigation Water Management Measure.

Agency	Authority	Programs	Implementation Location	Notes
CDPR/CAC	FAC	Pesticide Water Quality Management Plan and MAA with SWRCB	Statewide	management practices on chemigation
CDPR/USEPA	FIFRA	Pesticide Labeling	Statewide	Labeling may permit or ban chemigation with a particular pesticide
California State University: California Polytechnical University	?	Irrigation Training Research Center	?	
California State University: Fresno State University	?	Center for Irrigation Technology	?	
DOC	PRC Div 9	Watershed Grant Program	Statewide	Provides small grants to local RCDs to promote watershed restoration projects.
DHS	HSC §116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Ch. 1.25, Div. V:PRC §5000 et. seq.		SPS	DPR operates and maintains units of the SPS in agricultural areas.
DWR	Agricultural Water Suppliers Efficient Water Management Practices Act (1990)	Cooperative studies on effectiveness and efficiency of agricultural water management practices	Statewide	
DWR	?	Agriculture Training and Education Program	Statewide	
SWRCB/RWQCB	1986 Water Conservation and Water Quality Bond Law	Agricultural Drainage Water Management Loan Program	Statewide	

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SWRCB/RWQCB	PCWQCA	• Basin Plans • NPSMP • Drainage Operation Plans • WDRs • Subsurface Agricultural Drainage Program • Water Rights • ISW Plan	Statewide	Water Rights: Frost Control and Central Valley Project which regulates amount of water for irrigation
SWRCB/RWQCB	Clean Water Act	• State Revolving Fund • 319(h) Grant Program	Statewide	Grant/loan programs for irrigation projects
UCCE	?	Research, Education, Training and NPS workshops	Statewide	
USDA/NRCS	?	River Basin Survey and Investigation Program	Statewide	
USDA/FSA	Farm Bills of 1936, '73, '77, '79, and '80	• Agricultural Conservation Program • Water Quality Incentive Program	Statewide	
USDA/Agricultural Research Service (ARS)	Farm Bill	• Water Management Research Laboratory • US Salinity Laboratory	Statewide	
U.S. Department of Interior (USDI)/USBR	Central Valley Project Improvement Act	Water Conservation Plans	Statewide	All federal water contractors must submit a water conservation plan to DWR before contracts can be reviewed

* The following limitations and special conditions apply:

(1) In some locations, irrigation return flows are subject to other water rights or are required to maintain stream flows. In these special cases, on-site reuse could be precluded and would not be considered part of the management measure for such locations.

(2) By increasing the water use efficiency, the discharge volume from the system will usually be reduced. While the total pollutant discharge load may be reduced somewhat, there is the potential for an increase in the concentration of pollutants in the discharge. In these special cases, where other management measures (nutrients and pesticides) do not reduce concentrations in the discharge, increasing water use efficiency would not be considered part of the management measure.

(3) In some irrigation districts, the time interval between the order for the delivery of irrigation water to the farm may limit the irrigator's ability to achieve the maximum on-farm application efficiencies that are otherwise possible.

(4) In some locations, leaching is necessary to control salt in the soil profile. Leaching for salt control should be limited to the leaching requirement for the root zone.

(5) Where leakage from delivery systems or return flows supports wetlands or wildlife refuges, it may be preferable to modify the system to achieve a high level of efficiency and then divert the "saved water" to the wetland or wildlife refuge. This will improve the quality of water delivered to wetlands or wildlife refuges by preventing the introduction of pollutants from irrigated lands to such diverted water.

(6) In some locations, sprinkler irrigation is used for frost or freeze protection, or for crop cooling. In these special cases, applications should be limited to the amount necessary for crop protection and applied water should remain on-site.

Management Measure 1G Education/Outreach

Implement educational programs to provide greater understanding of watersheds, and to raise awareness and increase the use of applicable agricultural management measures and practices where needed to control and prevent adverse impacts to surface and ground water. Public education, outreach, and training programs should involve applicable user groups and the community.

[Refer to the Agriculture Management Measures 1A – 1F listed in this document.]

Agency	Authority	Programs	Implementation Location	Notes
RCDs/UCCE /NRCS/	PRC Div 9	• NRCS Field Office Technical Guide • Watershed Protection and Flood Prevention Program	Statewide	• Field Guide is incorporated into local management plans • Technical and financial assistance
RCDs	PRC §9000 et seq.	Technical Assistance Program	Statewide	Provides individual and group guidance on crop fertilization and prevention of NPS pollution.
California Environmental Protection Agency (Cal/EPA), California Resources Agency (Cal/RA), USDA (NRCS), USDA Animal Health Inspection Service, UC, Western United Dairyman, CA Farm Bureau Federation, DFA, SWRCB, USDA Farm Services Agency, DFG, CA Manufacturing Milk Advisory Board, Milk Producers Council, CA Dairy Quality Assurance Program	Partnership Agreement 1998	California Dairy Quality Assurance Program	Statewide	Provides guidance on environmental stewardship on dairies to meet CZARA requirements
DFA	FAC §14583 and §14611(b)	Fertilizer Research and Education Program	Statewide	• Annual Conference on Fertilizer Research • Extensive outreach with a web site, publications and videos • Publications include crop-specific management practices and environment issues • Conducts demonstration projects • Sponsors research and conferences by other organizations

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DWR	?1980	• Agricultural Water Conservation Program • CIMIS • Mobile Irrigation Management Laboratories	Statewide	
DWR	?	Agriculture Training and Education Program	Statewide	
SWRCB/RWQCB	CCR Title 23, Chapt. 15, Art. 6 and CCR Title 15 §2560-2565	Confined Animals Facility Program	Statewide	
UCCE NRCS California Association of Resource Conservation Districts (CARCD)/RCDs	PCWQCA	CRWQMP	Statewide--private lands	Training and technical assistance in range management and ranch plan development; research; development of monitoring protocols
UCCE, Farm Advisors	?	Technical Assistance	Statewide	Provides Crop-specific fertilizer guidance and does research on nutrient application, promotes soil and plant tissue testing.
UCCE	?	• Farm Advisors • Watershed Management Education Programs • Ranch Planning Short Courses • Waste Management Workshop	Statewide	
UCCE	?	Research, Education, Training and NPS workshops	Statewide	
California State University: California Polytechnical University	?	Irrigation Training Research Center	?	
USDA Agricultural Research Service	?	Research on new technologies and practices on erosion control	Statewide	
USDA Consolidated Farm Service	Various, ending with the Energy Security Act 1980	Agricultural Conservation Program	Statewide	Provides financial assistance for erosion control
USDA Cooperative State Research, Education, and Extension Service	?	various	Statewide	
USDA/NRCS	Food Securities Act 1985	• Soil and Water Conservation Program		

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American Society of Agronomy	?	Certified Crop Advisor Program	Statewide at local level	Voluntary certification for individuals who make soil and nutrient recommendations. Recommendations include: nutrient management plans, soil/plant tissue testing, yield/fertilizer application rates and methods.
California Fertilizer Association	?	• Nutrient Seminar Series • Community Outreach Program • Quarterly News Letter "From the Ground Up" • Crop-specific reports and videos • Western Fertilizer Handbook • Anhydrous Ammonia Transportation Safety Program • Environmental/Site Operations	Statewide at local level	• The annual seminar series is conducted at four sites in State • Education of communities on fertilizers • Newsletter gives the most recent information on crop fertilization • Reports and videos provide current crop-specific guidance • The Handbook provides thorough, complete methods for applying fertilizers • Environmental/Site Operations help members comply with laws and regulations for air and water quality and safety.
Coalition for Urban/Rural Environmental Stewardship (CURES)		Delta Water Quality Project	San Francisco Bay-Delta Region	
Other efforts that pertain to Agriculture Management Measure 1G				
Agency	Authority	Programs	Implementation Location	Notes
State/local/federal agency participation in MBNMS	MPRSA (16 USC §1431 et seq.)	MBNMS WQPP Action Plan for Agriculture	MBNMS	The MBNMS WQPP is a collaborative effort of federal, State, and local agencies and public and private groups initiated with an MOA among State and federal agencies. The agricultural plan focuses on the development of industry networks, technical assistance, educational programs, and financial incentives.

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Forestry (Silviculture) Management Measures

The SWRCB, CCC, and other State agencies have identified 12 MMs to address various phases of forestry operations relevant to controlling nonpoint sources of pollution that affect State waters. The forestry MMs are for the most part a system of practices used and recommended by the Board of Forestry and Department of Forestry and Fire Protection in rules or guidance.

California's MMs to address silvicultural sources of nonpoint pollution:

- 2A. Preharvest Planning
- 2B. Streamside Management Areas
- 2C. Road Construction/Reconstruction
- 2D. Road Management
- 2E. Timber Harvesting
- 2F. Site Preparation/Forest Regeneration
- 2G. Fire Management
- 2H. Revegetation of Disturbed Areas
- 2I. Forest Chemical Management
- 2J. Wetlands Forest
- 2K. Postharvest Evaluation
- 2L. Education/Outreach

On a national level, silviculture contributes approximately 3 to 9% of NPS pollution to the Nation's waters (USEPA, 1992a). Without adequate controls, forestry operations may degrade the characteristics of waters that receive drainage from forest lands. For example (1) sediment concentrations can increase due to accelerated erosion, (2) water temperatures can increase due to removal of overstory riparian shade, (3) dissolved oxygen can be depleted due to the accumulation of slash and other organic debris, and (4) concentrations of organic and inorganic chemicals can increase due to harvesting and fertilizers and pesticides.

<u>Management Measures</u>:

Preharvest Planning. Pursuant to MM 2A, silvicultural activities shall be planned to reduce potential delivery of pollutants to surface waters. Components of MM 2A address aspects of forestry operations, including: the timing, location and design of harvesting and road construction; site preparation; identification of sensitive or high-erosion risk areas; and the potential for cumulative water quality impacts.

Streamside Management Areas (SMAs). SMAs protect against soil disturbance and reduce sediment and nutrient delivery to waters from upland activities. MM 2B is intended to safeguard vegetated buffer areas along surface waters to protect the water quality of adjacent streams.

Road Construction/Reconstruction. Pursuant to MM 2C, road construction/reconstruction shall be conducted so as to reduce sediment generation and delivery. This can be accomplished by, among other means, following preharvest plan layouts and designs for road systems, incorporating adequate drainage structures, properly installing stream crossings, avoiding road construction in SMAs, removing debris from streams, and stabilizing areas of disturbed soil such as road fills.

Road Management. MM 2D describes how to manage roads to prevent sedimentation, minimize erosion, maintain stability, and reduce the risk that drainage structures and stream crossings will fail or become less effective. Components of this measure include inspections and maintenance actions to prevent erosion of road surfaces and to ensure the effectiveness of stream-crossing structures. The also addresses appropriate methods for closing roads that are no longer in use.

Timber Harvesting. MM 2E addresses skidtrail location and drainage, management of debris and petroleum, and proper harvesting in SMAs. Timber harvesting practices that protect water quality and soil productivity also have economic benefits by reducing the length of roads and skidtrails, reducing equipment and road maintenance costs, and providing better road protection.

Site Preparation & Forest Regeneration. Impacts of mechanical site preparation and regeneration operations—particularly in areas that have steep slopes or highly erodible soils, or where the site is located in close proximity to a waterbody—can be reduced by confining runoff onsite. MM 2F addresses keeping slash material out of drainageways, operating machinery on contours, timing of activities, and protecting ground cover in ephemeral drainage areas and SMAs. Careful regeneration of harvested forest lands is important in protecting water quality from disturbed soils.

Fire Management. Prescribed fire practices for site preparation and methods to suppress wildfires should as feasible be conducted in a manner that limits loss of soil organic matter and litter and that reduces the potential for runoff and erosion. Prescribed fires on steep slopes or adjacent to streams and that remove forest litter down to mineral soil are most likely to impact water quality.

Revegetation of Disturbed Areas. MM 2H addresses the rapid revegetation of areas disturbed during timber harvesting and road construction—particularly areas within harvest units or road systems where mineral soil is exposed or agitated (e.g., road cuts, fill slopes, landing surfaces, cable corridors, or skidtrails) with special priority for SMAs and steep slopes near drainageways.

Forest Chemical Management. Application of pesticides, fertilizers, and other chemicals used in forest management should not lead to surface water contamination. Pesticides must be properly mixed, transported, loaded, and applied, and their containers disposed of properly. Fertilizers must also be properly handled and applied since they also may be toxic depending on concentration and exposure. Components of MM 2I include applications by skilled workers according to label instructions, careful prescription of the type and amount of chemical to be applied, use of buffer areas for surface waters to prevent direct application or deposition, and spill contingency planning.

Wetland Forest Management. Forested wetlands provide many beneficial water quality functions and provide habitat for aquatic life. Activities in wetland forests shall be conducted to protect the aquatic functions of forested wetlands.

Postharvest Evaluation. The goals of MM 2K are to incorporate postharvest monitoring, including: a) implementation monitoring to determine if the operation was conducted according to specifications, and b) effectiveness monitoring after at least one winter period to determine if the specified operation prevented or minimized discharges.

Education/Outreach. The goals of MM 2L are to implement pollution prevention and education programs to reduce NPS pollutants generated from applicable silvicultural activities.

2. FORESTRY

IMPLEMENTATION AUTHORITIES

2A. Preharvest Planning

2B. Streamside Management Areas (SMAs)

2C. Road Construction and/or Reconstruction

2D. Road Management

2E. Timber Harvesting

2F. Site Preparation and Forest Regeneration

2G. Fire Management

2H. Revegetation of Disturbed Areas

2I. Forest Chemical Management

2J. Wetlands Forest

2K. Postharvest Evaluation

2L. Education/Outreach

Management Measure 2A Preharvest Planning
Component I. Perform advance planning for forest harvesting that includes the following elements where appropriate:

Agency	Authority	Programs	Implementation Location	Notes
Board of Forestry (BOF)/ California Department of Forestry and Fire Protection (CDF)	Forest Practice Act (Z'Berg Nejedly) (FPA)[1]; Forest Practice Rules (FPRs)[2]	CDF Resource Management Program, Forest Practice Regulation	Statewide--Non-federal lands	[1] FPA is in PRC, Division 4, Chapter 8, § 4511 *et seq.* [2] FPRs are in Title 14, CCR, § 895 *et seq.* The authorities set forth on this page are the general informational requirements for each program document. On subsequent pages, more specific informational requirement authorities are given. These general requirements are not repeated, even where they specify relevant information.
	FPA 4551.3; FPR 1091.4-1091.7	Sustained Yield Plan	Same as above	Tiered landscape-scale option available to industrial timberland owners; may reduce issues to be addressed in subordinate Timber Harvesting Plans (THPs).
	FPA 4581, 4582; FPR 898, 1034	THP	Same as above	Required for all commercial timber harvesting not otherwise exempt.
	FPA 4581, 4582; FPR 1051.1	Modified THP (MTHP)	Same as above	Option for small low-impact operations meeting specified criteria
	FPA 4581, 4582; FPR 1092.9	Program THP (PTHP)	Same as above	THP tiered to a Program Timberland Environmental Impact Report (EIR). FPR 1092 requires that PTHPs comply with most operational and some informational requirements for THPs.
	FPA 4593.3, 4594; FPR 1090.5, 1090.7	Nonindustrial Timber Management Plan (NTMP) and Notice	Same as above	Option for uneven-age silviculture on nonindustrial parcels smaller than 2,500 acres. FPR 1090 requires that NTMPs comply with most operational and some informational requirements for THPs.
	FPR 921.1 (b)	THP	Coastal Zone Special Treatment Areas (CZSTA)	THP requirements are somewhat different and more stringent in Special Treatment Areas designated by CCC
	FPA 4516.5; 4516.8; FPR 927.2 4584	THP Exemption	Marin Co.	These counties have slightly different planning requirements.

Agency	Authority	Programs	Implementation Location	Notes
Element (1): Identify (a) the area to be harvested including location of waterbodies and sensitive areas such as wetlands, threatened or endangered aquatic species habitat areas, or high-erosion-hazard areas (landslide-prone areas) within the harvest unit, and (b) the hydrologic unit where the project is located and name the waterbodies the project is tributary to.				
BOF/CDF	Same as Component; plus FPR 895.1; 912.5, Tech. Rule Addendum #1; 912.9, Tech. Rule Addendum # 2; FPR 914; 914.2(d), (f); 916.4(a), (b); 939.15	THP, MTHP, PTHP, NTMP	Statewide	
	Same as above, plus FPR 926.14	Same as above	Santa Cruz Co.	
	Same as above, plus FPR 965.5(e), (f)	Same as above	Monterey Co.	
	Same as above, plus FPR 921.1(a)	Same as above	CZSTA	
	FPR 1091.6(c)	Sustained Yield Plan (SYP)	Statewide	
Element (2): Time the activity for the season or moisture conditions to avoid degradation of water quality and prevent impacts to beneficial uses. Avoid any activities that cause soil disturbance or discharge from road surfaces during wet weather except for emergency maintenance work.				
BOF/CDF	Same as component I; plus FPR 895.1; 914.6(a), (b), (h); 914.7; 914.8(d); 915.1(b); 916.4(c); 916.7; 917.2(a); 917.3(b); 937.3(a); 957.3(a); 917.4(b), (c); 917.5(b); 923.1(j); 923.2(n), (q), (r), (s), (t); 923.4(d), (e), (f), (g), (o); 923.5(e), (f), (h), 923.6;	THP, MTHP, PTHP, NTMP	Statewide	
	Same as above, plus FPR 927.1; 927.9; 927.11(b); 927.17	Same as above	Marin Co.	
	Same as above, plus FPR 925.1; 926.18; 965.5	Same as above	Santa Clara, Santa Cruz, Monterey Co.	
	Same as above, plus FPR921.3(c); 921.5(c); 961.3(b); 961.5(f)	Same as above	CZSTA	
Element (3): Consider potential water quality impacts and erosion and sedimentation control in the selection of silviculture and regeneration systems, especially for harvesting and site preparation.				
BOF/CDF	FPA 4551.5, 4551.7, 4562.5; FPR 895.1; 912.9, Tech. Rule Addendum #2; 913.1(a); 913.4(a), (b); 913.6(b); 914; 914.7; 915; 915.3; 915.4; 917.3(d), (e)	THP, MTHP, PTHP, NTMP	Statewide	
	Same as above, plus FPR 954.4	Same as above	Southern District	
	Same as above, plus FPR 921.3(c)	Same as above	CZSTA	
	Same as above, plus FPR 913.8(b)	Same as above	Southern subdistrict of Coast District	
	Same as above, plus FPR 927.12(a)	Same as above	Marin Co	

Agency	Authority	Programs	Implementation Location	Notes
Element (4): Reduce the risk of occurrence of landslides and severe erosion by identifying high-erosion-hazard areas and avoiding timber operations where they may exacerbate risk.				
BOF/CDF	Same as component I, plus FPR 912.5, Tech Rule Addendum #1; 912.9, Tech Rule Addendum #2; 913.1(a), 914.2(d), (f), 914.6(c), 914.7, 916.4(a)	THP, MTHP, PTHP, NTMP	Statewide	
	Same as above, plus FPR 921.1(a), 921.5(a), (b), 961.5(d)	Same as above	CZSTA	
	Same as above, plus FPR 913.8(b)	Same as above	Southern Subdistrict of Coast District	
Element (5): Consider cumulative effects from timber operations or roads to any known existing water quality impairments or problems in watersheds.				
BOF/CDF	Same as component; FPR 898; 912.9, Tech. Rule Addendum #2	THP	Statewide	

Management Measure 2A Preharvest Planning Component 2. Perform advance planning for forest road systems that includes the following elements where appropriate:				
Element (1): Locate and design road systems to minimize, potential sediment generation and delivery to surface waters. Key components are: (a) locate roads, andings, and skid trails to avoid steep grades and steep or unstable hillslope areas, and to decrease the number of stream crossings; (b) avoid to the extent racticable locating new roads and landings in SMAs; and (c) determine road usage and select the appropriate road standard.				
BOF/CDF	FPA 4562.7; **4582**; **4593**.3(b) FPR 895.1; **914**, **914**.**2**, **914**.8; 916.3(c); 916.4(a), (d); 923; 923.1; 923.2(v); 923.3; 923.5(a), **(b)**, **(d)**	THP, MTHP, PTHP, NTMP	Statewide	
	Same as above, plus **FPR** 921.1(b); 921.5(a), (b), (c), (d); 961.5	Same as above	CZSTA	
	Same as above, plus **FPR** 926.16	Same as above	Santa Cruz Co	
	Same as above, plus 927.2(e); 965.1	Same as above	Marin, Monterey Co.	
	FPR 1091.6(c)	SYP	Statewide	
Element (2): Locate and design temporary and permanent stream crossings to prevent failure and control impacts from the road system. Key components are: (a) size, design and site crossing structures to prevent failure and minimize diversion potential; (b) for fish-bearing streams, design crossings to facilitate fish passage.				
BOF/CDF	FPA 4562.7(b), (f) FPR 895.1; 914.8; 916.3(c); 916.4(c), (d); 923.2(e); 923.3(a), (c), (e)	THP, MTHP, PTHP, NTMP	Statewide	
	FPR 926.16	Same as above	Santa Cruz Co.	
Element (3): Ensure that the design of road prism and the road surface drainage is appropriate to the terrain and that road surface design is consistent with the road drainage structures.				
BOF/CDF	FPR 914.6(c); 923(c), (f); 923.1(d), (f), (g); 923.2	THP, MTHP, PTHP, NTMP	Statewide	
	FPR 921.5(b)	Same as above	CZSTA	
	FPR 927.11(a)	Same as above	Marin Co	
Element (4): Use suitable materials for surface roads planned for all-weather use to support truck traffic.				
BOF/CDF	FPR 895.1; 923.1(a), 923.2(t); 923.4(h)	THP, MTHP, PTHP, NTMP	Statewide	

Element (5): Design road systems to avoid high erosion or landslide hazard areas. Identify these areas and consult a qualified specialist for design of any roads that must be constructed through these areas.				
BOF/CDF	FPR 898.1(b); 912.5, Tech. Rule Addendum #1; 914.2(d); 923(c), (d), (f), (g); 923.1(c), (d)	THP, MTHP, PTHP, NTMP	Statewide	

The following are BACKUP AUTHORITIES that pertain to the Preharvest Planning Management Measure.

Agency	Authority	Program	Implementation Location	Notes
Local govern-ments	PZL (Gov. Code §§65000 et seq.) and CCA §30500	• General Plans/GP updates • LCPs/LCP amendments • Permits pursuant to above • Enforcement	Statewide (LCP policies/ordinances apply in coastal zone)	Local governments adopt ordinances and rules and make land-use decisions consistent with State law.
SWRCB/ RWQCB	PCWQCA	• NPSMP • Basin Plans • Cease and Desist Orders • Cleanup and Abatement Orders • Admin. Civil Liability	Statewide	
DFG	FGC § 5650	Discharge to waters of the State violations	Statewide	
DHS	HSC § 116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in forested areas.

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Management Measure 2B Streamside Management Areas (SMAs)				
Component 1. Establish and maintain a streamside management area along surface waters that is sufficiently wide and which includes a sufficient number of canop species to buffer against detrimental changes in the temperature regime of the waterbody, to provide bank stability, and to withstand wind damage.				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
BOF/CDF	FPA 4551; 4562.7; FPR 895.1; 912.9, Tech. Rule Addendum # 2; 953.7; 915.2(b); 915.3(a); 916; 916.2; 916.3(d); 916.4(a), (b), (c), (d); 916.5; 917.3(d); 923.1(h)	THP, MTHP, THP, NTMP	Statewide—Nonfederal lands	
	Same as above, plus FPR 961.1(a); 921.5(b); 921.6(c); 921.7	Same as above	CZSTA	
	Same as above, plus FPR 965.6	Same as above	Monterey Co.	
SCC	PRC Chapter 6, Div 21	CREP	Coastal zone and coastal watersheds, statewide	The SCC may acquire fee or less than fee interests in land to protect coastal streams and wetlands.
Component 2. Manage the SMA including flood-prone areas in such a way as to protect against soil disturbance in the SMA and delivery to the stream of sediments and nutrients generated by forestry activities, including harvesting.				
BOF/CDF	FPA 4551; 4562.7; FPR 953.7; 914, 914.1(a), (c); 914.3(e); 915.3(a); 916; 916.2; 916.3(a), (b), (c), (e); 916.4(b), (c), (d); 915.5; 916.7; 923.2(v)	THP, MTHP, THP, NTMP	Statewide	
SCC	PRC Chapter 6, Div 21	CREP	Coastal zone and coastal watersheds, statewide	The SCC may acquire ee or less than fee nterests in land to rotect coastal streams nd wetlands.
Component 3. Manage the SMA canopy species to provide a sustainable source of large woody debris needed for instream channel structure and aquatic species habitat.				
BOF/CDF	FPA 4551; 4562.7; FPR 895.1; 912.9, Tech. Rule Addendum #2; 953.7; 915.3(a); 916; 916.2; 916.3(f), (g); 916.4(b); 916.5; 917.3(d)	THP, MTHP, THP, NTMP	Statewide	
	Same as above, plus FPR 921.6(c)	Same as above	CZSTA	
	Same as above, plus FPR 927.12	Same as above	Marin Co.	
SCC	PRC Chapter 6, Div 21	CREP	Coastal zone and coastal watersheds, statewide	The SCC may acquire ee or less than fee nterests in land to rotect coastal streams nd wetlands.

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The following are BACKUP AUTHORITIES that pertain to the Streamside Management Areas Management Measure				
Agency	Authority	Programs	Implementation Location	Notes
Local govern-ments	PZL (Gov. Code §§65000 et seq.) and CCA §30500	• General Plans/GP updates • LCPs/LCP amendments • Permits pursuant to above • Enforcement	Statewide (LCP policies/ordinances apply in coastal zone)	Local governments adopt ordinances and rules and make land-use decisions consistent with State law.
SWRCB/ RWQCB	PCWQCA	• NPSMP • Basin Plans • Cease and Desist Orders • Cleanup and Abatement Orders • Admin. Civil Liability	Statewide	
DFG	FGC § 5650	Discharge to waters of the State violations	Statewide	
DHS	HSC § 116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		State parks	DPR operates and maintains units of the SPS in forested areas.

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Management Measure 2C: Road Construction/Reconstruction				
Agency	Authority	Programs	Implementation Location	Notes
Component (1): Follow preharvest planning (as described under Management Measure A) when constructing or reconstructing the roadway.				
BOF/CDF	Same as MM 2A, Component 2, plus FPR 923.2	THP, MTHP, PTHP, NTMP	Same as MM 2A, Component 2	
Component (2): Follow designs planned under Management Measure A for road surfacing and shaping..				
BOF/CDF	Same as above	Same as above	Same as above	
Component (3): Install road drainage structures according to designs planned under Management Measure A and regional storm return period and installation specifications. Match these drainage structures with terrain features and with road surface and prism designs.				
BOF/CDF	Same as above, plus FPR 895.1; 923.1(f), (g); 923.2(h), (o)	Same as above	Same as above	
Component (4): Guard against the production of sediment when installing stream crossings.				
BOF/CDF	FPR 916.3; 923; 923.3			
Component (5): Protect surface waters from slash and debris material from roadway clearing.				
BOF/CDF	FPR 914.1(a), (c); 916.3(a), (b), (c), (e); 916.4(b), (c); 923.19(d); 923.2(g), (u)			
Component (6): Use straw bal[illegible]ences, mulching, or other favorable practices on disturbed soils on cuts, fill, etc.				
BOF/CDF	FPR 916.7, 923.4(i), (k)			
Component (7): Avoid constructing new roads in SMAs to the extent practicable.				
BOF/CDF	FPR 916.3(c); 923.1(h); 923.3(v)			

The following are BACKUP AUTHORITIES that pertain to the Road Construction/Reconstruction Management Measure				
Agency	Authority	Programs	Implementation Location	Notes
Local govern-ments	PZL (Gov. Code §§65000 et seq.) and CCA §30500	• General Plans/GP updates • LCPs/LCP amendments • Permits pursuant to above Enforcement	Statewide (LCP policies/ordinances apply in coastal zone)	Local governments adopt ordinances and rules and make land-use decisions consistent with State law.
SWRCB/ RWQCB	PCWQCA	NPSMP Basin Plans Cease and Desist Orders Cleanup and Abatement Orders Admin. Civil Liability		
DFG	FGC § 5650	Discharge to waters of the State violations	Statewide	
DHS	HSC § 116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in forested areas.

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Management Measure 2D Road Management				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
Component (1): Avoid using roads for timber hauling or heavy traffic during wet or thaw periods on roads not designed and constructed for these conditions.				
BOF/CDF	FPR 923.2(t); 923.4(o); 923.6	THP, MTHP, PTHP, NTMP	Statewide	
Component (2): Evaluate the future needs for a road and close roads that will not be needed. Leave closed roads and drainage channels in a stable condition to withstand storms.				
BOF/CDF	FPR 923; 923.4(a), (b), (g); 923.8	Same as above	Statewide	
	FPR 926.17	THP, MTHP, PTHP, NTMP	Santa Cruz Co	
Component (3): Remove drainage crossings and culverts if there is a reasonable risk of plugging or failure from lack of maintenance.				
BOF/CDF	FPR 923.2(i); 923.4(d), (f), (l), (m); 923.8(e)	Same as above	Same as above	
Component (4): Following completion of harvesting, close and stabilize temporary spur roads and seasonal roads to control and direct water away from the roadway. Remove all temporary stream crossings.				
BOF/CDF	FPR 923.3(d); 923.4(b), (f), (g); 923.8	THP, MTHP, PTHP, NTMP	Statewide	
	FPR 926.19; 965.9	Same as above	Santa Cruz/Monterey Co	
Component (5): Inspect roads to determine the need for structural maintenance. Conduct maintenance practices, when conditions warrant, including cleaning and replacement of deteriorated structures and erosion controls, grading or seeding of road surfaces, and, in extreme cases, slope stabilization or removal of road fills where necessary to maintain structural integrity.				
BOF/CDF	FPR 923; 923.4(all); 923.8 PRC 4562.9	Same as above	Same as above	
Component (6): Conduct maintenance activities, such as dust abatement, so that contaminants or pollutants are not introduced into surface waters.				
BOF/CDF	FPR 916.3; 923, 923.4(h)	Same as above	Same as above	
Component (7): Properly maintain permanent stream crossings and associated fills and approaches to reduce the likelihood (a) that stream overflow will divert onto roads, and (b) that fill erosion will occur if the drainage structures become obstructed.				
BOF/CDF	FPR 923.2(h); 923.3(e); 923.4(n)	Same as above	Same as above	
The following are BACKUP AUTHORITIES that pertain to the Road Management Measure.				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
Local govern-ments	PZL (Gov. Code §§65000 et seq.) and CCA §30500	• General Plans/GP updates • LCPs/LCP amendments • Permits pursuant to above Enforcement	Statewide (LCP policies/ordinances apply in coastal zone)	Local governments adopt ordinances and rules and make land-use decisions consistent with State law.
SWRCB/ RWQCB	PCWQCA	• NPSMP • Basin Plans • Cease and Desist Orders • Cleanup and Abatement Orders • Admin. Civil Liability	Statewide	
DFG	D&G Code §5650	Discharge to waters of the State violations	Statewide	

DHS	HSC § 116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in forested areas.

Management Measure 2E Timber Harvesting The timber harvesting management measure consists of implementing the following:				
Agency	Authority	Programs	Implementation Location	Notes
Component 1. General Element (1): Timber harvesting operations with skid trails or cable yarding follow layouts determined under Management Measure 2A.				
BOF/CDF	FPA 4562.7; FPR 914.2(f); 914.3(e);916.3(c); 916.4(d), (e)	THP, MTHP, PTHP, NTMP	Statewide	
	Same as above, plus FPR 921.1(a)	Same as above	CZSTA	
	FPA 4516.5(a); FPR 925.5; 926.16; 927.3; 928.3	Same as above	Santa Clara, Santa Cruz , Marin , San Mateo Co	
Element (2): Install landing drainage structures to minimize erosion and prevent sedimentation.				
BOF/CDF	FPR 923.1(d), (f); 923.5(f)	THP, MTHP, PTHP, NTMP	Statewide	
Element (3): Construct landings away from steep slopes and reduce the likelihood of fill slope failures. Protect landing surfaces used during wet periods. Locate landings outside SMAs.				
BOF/CDF	FPR 914.2(d), (f); 914.7; 916.3(c); 916.4(c), (d), (e); 923; 923.1(c), (d); 923.4(h), (i), 923.5(a), (b), (c), (f), (g); 923.6	THP, MTHP, PTHP, NTMP	Statewide	
Element (4): Protect stream channels and significant ephemeral drainages from logging debris and slash material.				
BOF/CDF	FPR 914.1(a), (c); 914.2(e); 916.3(a), (b) 916.4(c)	THP, MTHP, PTHP, NTMP	Statewide	
Element (5): Use appropriate areas for petroleum storage, equipment maintenance and service. Establish procedures to contain and treat spills. Recycle or properly dispose of all waste materials.				
BOF/CDF	FPR 914.5	THP, MTHP, PTHP, NTMP	Same as above	
Component 2. For cable yarding: Element (1): Limit yarding corridor gouge or soil plowing by properly locating cable yarding landings.				
BOF/CDF	FPR 914.3,(a), (d); 923(c)	THP, MTHP, PTHP, NTMP	Statewide	
Element (2): Locate corridors for SMAs following Management Measure 2B.				
BOF/CDF	Same as above	THP, MTHP, PTHP, NTMP	Statewide	

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Component 3. For groundskidding: Element (1): Within SMAs, operate groundskidding equipment only at stream crossings. In SMAs, fell and endline trees to avoid sedimentation and damage to residual vegetation.				
Agency	Authority	Program	Implementation Location	Notes
BOF/CDF	FPR 914; 914.1(a), (c); 914.2(a); 916.3(c), (e); 916.4(c), (d), (e), (f)	THP, MTHP, PTHP, NTMP	Statewide	
Element (2): Use improved stream crossings for skid trails which cross flowing drainages. Construct skid trails to disperse runoff and with adequate drainage structures.				
BOF/CDF	FPR 914; 914.2(a), (i); 914.6 (c), (e), (f); 914.8(b); 916.3(c); 916.4(d), (f)	THP, MTHP, PTHP, NTMP	Statewide	
Element (3): On steep slopes, use cable systems rather than groundskidding where groundskidding may cause excessive erosion.				
BOF/CDF	FPR 914.2(b), (f); 914.3(e)	THP, MTHP, PTHP, NTMP	Statewide	
	FPR 921.5(a)	Same as above	CZSTA	

The following are BACKUP AUTHORITIES that pertain to the Timber Harvesting Management Measure.				
Agency	Authority	Programs	Implementation Location	Notes
Local governments	PZL (Gov. Code §§65000 et seq.) and CCA §30500	• General Plans/GP updates • LCPs/LCP amendments • Permits pursuant to above • Enforcement	Statewide (LCP policies/ordinances apply in coastal zone)	Local governments adopt ordinances and rules and make land-use decisions consistent with State law.
SWRCB/ RWQCB	PCWQCA	• NPSMP • Basin Plans • Cease and Desist Orders • Cleanup and Abatement Orders • Admin. Civil Liability	Statewide	
DFG	FGC § 5650	Discharge to waters of the State violations	Statewide	

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DHS	HSC § 116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in forested areas.

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Management Measure 2F Site Preparation and Forest Regeneration Confine on-site potential NPS pollution and erosion resulting from site preparation and the regeneration of forest stands. The components of the management measure for site preparation and regeneration are:				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
Component (1): Select a method of site preparation and regeneration suitable for the site conditions.				
BOF/CDF	FPA 4551.5, 4551.7, 4562.5; FPR 895.1; 914, 914.2(d), (e), (f), (j), 915, 915.1(a); 915.2; 915.3	THP, PTHP, NTMP	Statewide	Site preparation using fire is addressed in MM 2.0 G. CA has extensive restocking requirements not included in MMs.
BOF/CDF	Same as above, plus FPR 914.2(k), 954.4	Same as above	Southern District	
BOF/CDF	Same as above, plus FPRA 921.3(b), (c)	Same as above	CZSTA	
BOF/CDF	Same as above, plus FPR 913.8(b)	Same as above	Southern subdistrict of Coast District	
BOF/CDF	Same as above, plus FPR 927.9	Same as above	Marin Co.	
Component (2): Conduct mechanical tree planting and ground-disturbing site preparation activities on the contour of sloping terrain.				
BOF/CDF				CA has no equivalent requirement
Component (3): Do not conduct mechanical site preparation and mechanical tree planting on streamside management areas.				
OF/CDF	FPR 915.3(a), 916.4(c), (d)	THP, PTHP, NTMP	Statewide	
Component (4): Protect surface waters from logging debris and slash material.				
BOF/CDF	FPR 914; 914.2(e), (f), (j); 915; 915.3(a); 916.3(a), (b)	THP, MTHP, PTHP, NTMP	Statewide	
Component (5): Suspend operations during wet periods.				
BOF/CDF	FPR 914.7; 915.1(b)	THP, PTHP, NTMP	Statewide	
Component (6): Locate windrows at a safe distance from drainages and SMAs to control movement of the material during high runoff conditions.				
BOF/CDF	FPR 914.2 (e); 915.3(a)	THP, MTHP, PTHP, NTMP	Statewide	
Component (7): Conduct bedding operations in high-water-table areas during dry periods of the year. Conduct bedding in sloping areas on the contour.				
BOF/CDF	FPR 915; 915.3(a), 916.3(d); 916.4(c), (d)	THP, PTHP, NTMP	Statewide	
Component (8): Protect small ephemeral drainages when conducting mechanical tree planting.				
BOF/CDF	FPR 915; 915.3(a); 916.4(c), (d)	THP, PTHP, NTMP	Statewide	

The following are BACKUP AUTHORITIES that pertain to the Site Preparation and Forest Regeneration Management Measure

Agency	Authority	Programs	Implementation Location	Notes
Local governments	PZL (Gov. Code §§65000 et seq.) and CCA §30500	• General Plans/GP updates • LCPs/LCP amendments • Permits pursuant to above • Enforcement	Statewide (LCP policies/ordinances apply in coastal zone)	Local governments adopt ordinances and rules and make land-use decisions consistent with State law.
SWRCB/ RWQCB	PCWQCA	NPSMP Basin Plans Cease and Desist Orders Cleanup and Abatement Orders Admin. Civil Liability	Statewide	
DFG	FGC § 5650	Discharge to waters of the State violations	Statewide	
DHS	HSC § 116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in forested areas.

Management Measure 2G Fire Management				
Prescribe fire for site preparation and control or suppress wildfire in a manner which reduces potential nonpoint source pollution of surface waters.				
Component (1): Intense prescribed fire should not cause excessive erosion due to the combined effect of removal of canopy species and the loss of soil-binding ability of subcanopy and herbaceous vegetation roots, especially in SMAs, in streamside vegetation for small ephemeral drainages, or on very steep slopes.				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
BOF/CDF	FPA 4551.5, 4551.7; FPR 895.1; 915.2(a), (b); 915.3(a); 916.4(b); 916.5(e); 917.3(d); 937.3(c); 957.3(c)	THP, PTHP, NTMP	Statewide	CA has extensive logging-related fire hazard reduction requirements not in MMs.
	Same as above, plus FPR 921.6(b); 961.6	Same as above	CZSTA	
	Same as above, plus FPA, 4527, 4562; FPR 927.12(a)	Same as above	Marin Co.	
Component (2): Prescriptions for prescribed fire should protect against excessive erosion or prevent sedimentation.				
BOF/CDF	PRC 4423; FPR 915.2; 917.3; 937.3; 957.3	THP, MTHP, PTHP, NTMP	Statewide	
	FPR 917.4(d)	Same as above	Southern Subdistrict of Coast District	
	FPR 957.4(d)	Same as above	High Use Subdistrict of Southern District	
Component (3): All bladed firelines, for prescribed fire and wildfire, should be plowed on contour or stabilized with water bars and/or other appropriate techniques if needed to control excessive sedimentation or erosion of the fireline.				
BOF/CDF	FPR 914; 914.6(c), (e), (g), (h); 915.1	THP, MTHP, PTHP, NTMP	Statewide	
Component (4):. Rehabilitation and salvage logging areas burned by wildfires should be managed to minimize erosion and prevent sedimentation.				
BOF/CDF		CDF Fire Protection Program	Statewide	CA has no BMPs for wildfire suppression as this is an emergency situation, not a land use.

The following are BACKUP AUTHORITIES that pertain to the Fire Management Measure.				
Agency	Authority	Programs	Implementation Location	Notes
SWRCB/ RWQCB	PCWQCA	• NPSMP • Basin Plans • Cease and Desist Orders • Cleanup and Abatement Orders • Admin. Civil Liability	Statewide	
DFG	FGC § 5650	Discharge to waters of the State violations	Statewide	
DHS	HSC § 116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in forested areas.

R0018895

Management Measure 2H Revegetation of Disturbed Areas

Reduce erosion and prevent sedimentation by rapid revegetation of areas disturbed by timber operations.

Agency	Authority	Programs	Implementation Location	Notes
Component (1). Revegetate disturbed areas (using seeding or planting) promptly after completion of earth-disturbing activity. Local growing conditions will dictate the timing for establishment of vegetative cover.				
BOF/CDF	FPR 914; 914.2(I); 914.6(a), (b), (f); 916.7, 923.2(m); 923.3(d); 923.4(i); 923.5(f); 923.8(b)	THP, MTHP, PTHP, NTMP	Statewide	The only pertinent FPRs are statewide.
SCC	PRC Chapter 6, Div 21	CREP	Coastal zone and coastal watersheds, statewide	SCC implements revegetation efforts to enhance coastal streams and wetlands.
Component (2): Use mixes of species and treatments developed and tailored for successful vegetation establishment for the region or area.				
BOF/CDF	FPR 916.7	THP, MTHP, PTHP, NTMP	Statewide	Same as above.
SCC	PRC Chapter 6, Div 21	CREP	Coastal zone and coastal watersheds, statewide	SCC implements revegetation efforts to enhance coastal streams and wetlands.
Component (3): Concentrate rev[illegible]n efforts initially on priority areas such as disturbed areas in SMAs or the steepest areas of disturbance near drainages.				
BOF/CDF	FPR 916.7; 923.3(m) ; 923.5(f)	THP, MTHP, PTHP, NTMP	Statewide	Same as above.
SCC	PRC Chapter 6, Div 21	CREP	Coastal zone and coastal watersheds, statewide	SCC implements revegetation efforts to enhance coastal streams and wetlands.

R0018896

The following are BACKUP AUTHORITIES that pertain to the Revegetation of Disturbed Areas Management Measure.

Agency	Authority	Programs	Implementation Location	Notes
Local governments	PZL (Gov. Code §§65000 et seq.) and CCA §30500	• General Plans/GP updates • LCPs/LCP amendments • Permits pursuant to above • Enforcement	Statewide (LCP policies/ordinances apply in coastal zone)	Local governments adopt ordinances and rules and make land-use decisions consistent with State law.
SWRCB/ RWQCB	PCWQCA	• NPSMP • Basin Plans • Cease and Desist Orders • Cleanup and Abatement Orders • Admin. Civil Liability	Statewide	
DFG	FGC § 5650	Discharge to waters of the State violations	Statewide	
DHS	HSC § 116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in forested areas.

Agency	Authority	Programs	Implementation Location	Notes
Management Measure 21 Forest Chemical Management Use chemicals when necessary for forest management in accordance with the following to reduce nonpoint source pollution impacts due to the movement of forest chemicals off-site during and after application: Component (1): Conduct applications by skilled and, licensed applicators according to the registered use, with special consideration given to impacts to nearby surface waters.				
CDPR[1] and CAC	3CCR § 6530-6534[2]		Statewide, via county farm advisors	[1] BOF/CDF have no authority to regulate pesticide or fertilizer use. [2] Applicable requirements are set forth in FAC, Title 3, Division 6, Pesticides and Pest Control Operations
Component (2): Carefully prescribe the type and amount of pesticides appropriate for the insect, fungus, or herbaceous species.				
CDPR and CAC	3CCR §6550-6557		Same as above	
Component (3): Prior applications of pesticides and fertilizers, inspect the mixing and loading process and the calibration of equipment, and identify the appropriate weather conditions, the spray area, and buffer areas for surface waters and mixing and loading areas.				
CDPR and CAC	3CCR §6600-6620, 6622-6627		Same as above	
Component (4): Establish and identify buffer areas for surface waters to protect beneficial uses. (This is especially important for aerial applications.)				
CDPR and CAC	3CCR § 6800, 6802, 6540, 6544		Same as above	
Component (5): Immediately report accidental spills of pesticides or fertilizers into surface waters to the California Office of Emergency Services (Cal/OES). Develop an effective spill contingency plan to contain spills.				
CDPR and CAC	3CCR §6670-6684		Same as above	

The following are BACKUP AUTHORITIES that pertain to the Forest Chemical Management Measure.				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
Local governments	PZL (Gov. Code §§65000 et seq.) and CCA §30500	• General Plans/GP updates • LCPs/LCP amendments • Permits pursuant to above • Enforcement	Statewide (LCP policies/ordinances apply in coastal zone)	Local governments adopt ordinances and rules and make land-use decisions consistent with State law.
SWRCB/ RWQCB	PCWQCA	NPSMP Basin Plans Cease and Desist Orders Cleanup and Abatement Orders Admin. Civil Liability	Statewide	
DFG	FGC § 5650	Discharge to waters of the State violations	Statewide	
DHS	HSC § 11627 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in forested areas.

R0018899

Management Measure 2.J Wetlands Forest Plan, operate, and manage normal, ongoing forestry activities (including harvesting, road design and construction, site preparation and regeneration, and chemical management) to adequately protect the aquatic functions of forested wetlands.				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
BOF/CDF	FPR 895.1; 912.9, Tech. Rule Addendum #2; 915.1(b); 916.3(c), (d); 923(d); 923.2(r); 923.5(e)	THP, MTHP, PTHP, NTMP	Statewide	FPR 1090 and 1092, respectively, require that NTMPs and PTHPs comply with all operational and some informational THP requirements.
	Same as above, plus FPR 953.7; 939.15; 959.15(b)	Same as above	Northern and Southern Districts	
	Same as above, plus FPR 921.5(c), 961.5(f)	Same as above	CZSTA	
	Same as above, plus FPR 927.11	Same as above	Marin Co.	
The following are BACKUP AUTHORITIES that pertain to the Wetlands Forest Management Measure.				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
Local governments	PZL (Gov. Code §§65000 et seq.) and CCA §30500	• General Plans/GP updates • LCPs/LCP amendments • Permits pursuant to above • Enforcement	Statewide (LCP policies/ordinances apply in coastal zone)	Local governments adopt ordinances and rules and make land-use decisions consistent with State law.
SWRCB/ RWQCB	PCWQCA	• NPSMP • Basin Plans • Cease and Desist Orders • Cleanup and Abatement Orders • Admin. Civil Liability	Statewide	
DFG	FGC § 5650	Discharge to waters of the State violations	Statewide	
DHS	HSC §116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in forested areas.

Management Measure 2K Postharvest Evaluation				
Conduct post-operation evaluation of the effectiveness of the State's forest practices requirements as implemented. The components of this are: a) implementation monitoring to determine if the operation was conducted according to specifications, and b) effectiveness monitoring after at least one winter period to determine if the specified operation prevented or minimized discharges..				
Agency	**Authority**	**Programs**	**Implementation Location**	**Notes**
BOF/CDF	FPR 916.6(a)(1)(E)	THP, MTHP, PTHP, NTMP	Statewide	Requires post-operation evaluation of alternative Watercourse and Lake Protection Zone (WLPZ) practices.
	FPR 016.10	Same as above	Statewide	Allows post-operation evaluation of domestic water supply protection.
	FPR 1050	Same as above	Statewide	Requires post-harvest inspection of erosion control maintenance and functioning.
	FPA 4588	Same as above	Statewide	Requires post-harvest inspection of stock success
	FPA 4588, 5604	Same as above	Statewide	Requires post-operations inspections of timber operation compliance with specifications.
	FPA 4551 3(b); FPR 1091 8	SYP	Statewide	Requires continuous monitoring of SYP compliance and effectiveness.
	All above citations	Long Term Monitoring Program (LTMP)	Statewide	Voluntary program specifically implementing this MM on a randomly selected set of THPs each year.

R0018901

The following are BACKUP AUTHORITIES that pertain to the Postharvest Evaluation Management Measure.

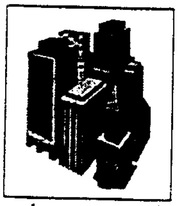
Agency	Authority	Programs	Implementation Location	Notes
SWRCB/ RWQCB	PCWQCA	Forest Activities Program • NPSMP • Basin Plans • Cease and Desist Orders • Cleanup and Abatement Orders • Admin. Civil Liability	Statewide	• Participation in LTMP with CDF • Some surveillance monitoring • Some compliant-driven monitoring.
DFG	FGC § 5650	Discharge to waters of the State violations	Statewide	
DHS	HSC §116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in forested areas.

Management Measure 2L Education/Outreach

Implement educational programs to provide greater understanding of watersheds, and to raise awareness and increase the use of applicable forestry management measures and practices where needed to control and prevent adverse impacts to surface and ground water. Public education, outreach, and training programs should involve applicable user groups and the community.

[Refer to the Forestry Management Measures 2A – 2K listed in this document.]

Agency	Authority	Programs	Implementation Location	Notes



The SWRCB, CCC, and other State agencies have identified 15 MMs to address urban nonpoint sources of pollution that affect State waters. With approximately 80% of the nation's population living in coastal areas, controlling polluted runoff in urban areas is a challenge. Negative impacts of urbanization on coastal and estuarine waters are well documented in a number of sources, including California's CWA §305(b) and §319 reports and the Nationwide Urban Runoff Program.

Major pollutants found in runoff from urban areas include sediment, nutrients, oxygen-demanding substances, road salts, heavy metals, petroleum hydrocarbons, pathogenic bacteria, and viruses. Suspended sediments constitute the largest mass of pollutant loadings to receiving waters from urban areas. Construction is a major source of sediment erosion. Petroleum hydrocarbons result mostly from automobile sources. Nutrient and bacterial sources include garden fertilizers, leaves, grass clippings, pet wastes, and faulty septic tanks. As population densities increase, a corresponding increase occurs in pollutant loadings generated from human activities. Many of these pollutants enter surface waters via runoff without undergoing treatment.

California's MMs to address urban sources of nonpoint pollution:

3.1 **Runoff from Developing Areas**
- A. Watershed Protection
- B. Site Development
- C. New Development

3.2 **Runoff from Construction Sites**
- A. Construction Site Erosion and Sediment Control
- B. Construction Site Chemical Control

3.3 **Runoff from Existing Development**
- A. Existing Development

3.4 **Onsite Disposal Systems (OSDSs)**
- A. New OSDSs
- B. Operating OSDSs

3.5 **Transportation Development (Roads, Highways, and Bridges)**
- A. Planning, Siting, and Developing Roads and Highways
- B. Bridges
- C. Construction Projects
- D. Chemical Control
- E. Operation and Maintenance
- F. Road, Highway, and Bridge Runoff Systems

3.6 **Education/Outreach**
- A. Pollution Prevention/Education: General Sources

Urban runoff management requires that several objectives be pursued simultaneously. These objectives include the following (American Public Works Association, 1981):

- Protection and restoration of surface waters by the minimization of pollutant loadings and negative impacts resulting from urbanization;
- Protection of environmental quality and social well-being;
- Protection of natural resources, e.g., wetlands and other important aquatic and terrestrial ecosystems;
- Minimization of soil erosion and sedimentation problems;
- Maintenance of the predevelopment hydrologic conditions;

- Protection of ground-water resources;
- Control and management of runoff to reduce or prevent flooding; and
- Management of aquatic and riparian resources for active and passive pollution control.

Management Measures:

The control of urban NPS pollution requires the use of two primary strategies: the prevention of pollutant loadings and the treatment of unavoidable loadings. California's urban management measures are organized to parallel the land use development process in order to address the prevention and treatment of NPS pollution loadings during all phases of urbanization; this strategy relies primarily on the watershed approach, which focuses on pollution prevention or source reduction practices. Emphasizing pollution prevention and source reduction practices over treatment practices is favored because conducting education practices and incorporating pollution prevention practices into project planning and design activities are generally more effective, require less maintenance, and are more cost-effective in the long term than treatment strategies. Treatment strategies should only be used to address unavoidable loadings or where they are truly cost-effective.

The major opportunities to control NPS loadings occur during the following three stages of development: (1) the siting and design phase, (2) the construction phase, and (3) the post-development phase. Before development occurs, land in a watershed is available for a number of pollution prevention and treatment options, such as setbacks, buffers, or open space requirements, as well as wet ponds or constructed urban runoff wetlands that can provide treatment of the inevitable runoff and associated pollutants. In addition, siting requirements and restrictions and other land use ordinances, which can be highly effective, are more easily implemented during this period. After development occurs, these options may no longer be practicable or cost-effective. MMs 3.1A through 3.1C address the strategies and practices that can be used during the initial phase of the urbanization process.

The control of construction-related sediment loadings is critical to maintaining water quality. The implementation of proper erosion and sediment control practices during the construction stage can significantly reduce sediment loadings to surface waters. MMs 3.2A and 3.2B address construction-related practices.

After development has occurred, lack of available land severely limits the implementation of cost-effective treatment options. MM 3.6A focuses on improving controls for existing surface water runoff through pollution prevention to mitigate nonpoint sources of pollution generated from ongoing domestic and commercial activities.

3.0 URBAN

IMPLEMENTATION AUTHORITIES

<u>**Urban Management Measures**</u>

3.1 **Runoff from Developing Areas**
- A. Watershed Protection
- B. Site Development
- C. New Development

3.2 **Runoff from Construction Sites**
- A. Construction Site Erosion and Sediment Control
- B. Construction Site Chemical Control

3.3 **Runoff from Existing Development**
- A. Existing Development

3.4 **Onsite Disposal Systems (OSDSs)**
- A. New OSDSs
- B. Operating OSDSs

3.5 **Transportation Development (Roads, Highways, and Bridges)**
- A. Planning, Siting, and Developing Roads and Highways
- B. Bridges
- C. Construction Projects
- D. Chemical Control
- E. Operation and Maintenance
- F. Road, Highway, and Bridge Runoff Systems

3.6 **Education/Outreach**
- A. Pollution Prevention/Education: General Sources

Urban Management Measure 3.1A — Watershed Protection [1]
Develop a watershed protection program to: 1. Avoid conversion, to the extent practicable, of areas that are particularly susceptible to erosion and sediment loss; 2. Preserve areas that provide important water quality benefits and/or are necessary to maintain riparian and aquatic biota; 3. —Protect to the extent practicable the natural integrity of water bodies and natural drainage systems associated with site development—including roads, highways, and bridges; 4. Limit increases of percent impervious surfaces; and 5. Provide education and outreach to address sources or nonpoint pollution.

Agency	Authority	Programs	Implementing Area	Notes
SWRCB/ RWQCBs	• CWA (33 USC § 1251 et seq.) • PCWQCA (WC §§ 13000 et seq.) • CWA §401 • CEQA (PRC §§21000 to 21177)	SWDP (CWA § 402) • General Industrial and Construction Activities Storm Water Permits • MSWP TMDL Program [pursuant to CWA § 303(d)] Water Quality Certification [pursuant to CWA §401 for discharges of dredge and fill materials] CEQA--Environmental Review	SWDP applies to: • cities >100,000 pop. (Phase I) • cities of 50,000 - 100,000 pop. (Phase II) TMDL programs apply in CWA § 303(d)-listed watersheds. Water Quality Certification applies to waters of the U.S. statewide and individual projects. CEQA--Statewide	NPDES Permits (Phase I): • major industrial facilities; • large/medium municipalities separate storm sewer systems • construction sites that disturb 5 or more acres. NPDES Permits (Phase II): • smaller municipalities • construction sites that disturb 1 to 5 acres. TMDL goals include: identify pollution sources in watersheds; allocate pollution control responsibilities where water quality goals are not met. CWA §401--Water quality certification is required for most watershed level developments (e.g., HCPs, planned community developments) CEQA--Comments on general plans, watershed level developments, and project specific impacts.

[1] Sound watershed management requires that both structural and nonstructural measures be employed to mitigate the adverse impacts of storm water. Nonstructural Management Measures 3.1A (Watershed Protection) and 3.1B (Site Development) can be effectively used in conjunction with Management Measure 3.1C (New Development) to reduce both the short-and long-term costs of meeting the treatment goals of this management measure.

Regional Authorities (e.g., ABAG, AMBAG, SCAG, SANDAG)	CWA § 208	Areawide water quality control plans	Regionally	Regional authorities conduct areawide water quality control efforts. Though dated, § 208 plans can provide a starting point for identifying problems in specific watersheds.
SCC	PRC Chapter 6, Div 21	CREP	Coastal zone and coastal watersheds, statewide	SCC (1) implements watershed plans to protect and enhance natural resources and preserve open space and(2) helps to acquire sensitive lands to protect water quality and preserve natural resources.

The following BACKUP AUTHORITIES pertain to Urban Management Measure 3.1A (Watershed Protection)

Agency	Authority	Programs	Implementing Area	Notes
SWRCB/ RWQCB	PCWQCA(WC §§ 13000 et seq.)	• WQCPs (Basin Plans) • WDRs • NPSMP • WMI	Statewide	• Enforcement tools: Cleanup and Abatement Orders; Cease and Desist Orders; Administrative Civil Liability • RWQCBs have primary responsibility for individual permitting, inspection and enforcement. • NPSMP's 3-tier approach to manage NPS pollution: **Tier 1**, Voluntary Implementation of management practices, **Tier 2**, Regulatory-Based Encouragement of management practices, **Tier 3**, Effluent Limitations.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in urban areas.
DHS	HSC §116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.

Other Efforts that pertain to Urban Management Measure 3.1A (Watershed Protection)				
Agency	**Authority**	**Programs**	**Implementing Area**	**Notes**
State/local/federal agency participation in CA's • **NMSs** • **NERRs** • **NEPs**	• MPRSA (16 USC § 1431 et seq.) • CZMA § 315 • CWA § 320 (33 USC § 1330)	• MBNMSWQPP • SMBRP • SFEP	NMSs: • Monterey Bay • Channel Islands • Cordell Bank/ Gulf of the Farallones NERRs: • Elkhorn Slough • Tijuana River NEPs: • SMB, SFB and Morro Bay	• The MBNMS WQPP is a collaborative effort of federal, State, and local agencies, and public and private groups to address NPS pollution in the region's watersheds. A MOA has been signed by: NOAA; USEPA, Region 9; CalEPA; SWRCB; RWQCB 2 (SFB); RWQCB 3 (Central Coast); CCC; and AMBAG.

Urban Management Measure 3.1B — Site Development
Plan, design, and develop sites to: 1. Protect areas that provide important water quality benefits, necessary to main riparian and aquatic biota, and/or are particularly susceptible to erosion and sediment loss; 2. Limit increases of impervious areas; 3. Limit land disturbance activities such as clearing and grading, and cut-and-fill to reduce erosion and sediment loss; and 4. Limit disturbance of natural drainage features and vegetation.

Agency	Authority	Programs	Implementing Area	Notes
SCC	PRC Chapter 6, Div 21	CREP	Coastal zone and coastal watersheds, statewide	The SCC helps to acquire sensitive lands to protect water quality and preserve natural resources.
SWRCB	CWA Title VI	SRF	Statewide	Loans for acquisition of sensitive lands to protect water quality and preserve natural resources.
SWRCB/RWQCB	CEQA (PRC §§21000 to 21177)	Environmental Review	Statewide	Comments on specific project.
SWRCB/RWQCB	CWA §401	WQCrP	Statewide	Regulate specific projects involving dredge or fill materials.

Urban Management Measure 3.1C — New Development
Part (1): By design or performance: (a) After construction has been completed and the site is permanently stabilized, reduce the average annual TSS loadings by 80% (for the purposes of this measure, an 80% TSS reduction is to be determined on an average annual basis); or (b) Reduce the post-development loadings of TSS so that the average annual TSS loadings are no greater than pre-development loadings. Part (2): To the extent practicable, maintain post-development peak runoff rate and average volume at levels that are similar to pre-development levels.

Agency	Authority	Programs	Implementing Area	Notes
SCC	PRC Chapter 6, Div 21	CREP	Coastal zone and coastal watersheds, statewide	The SCC helps to acquire sensitive lands to protect water quality and preserve natural resources.
SWRCB/RWQCB	CWA §402(p)	Storm water municipal and construction permits	Statewide	Post-construction provisions of 402(p)

R0018909

Urban Management Measure 3.2A — Construction Site Erosion and Sediment Control

Part (1): Reduce erosion and, to the extent practicable, retain sediment on site during and after construction; and

Part (2): Prepare and implement, prior to land disturbance, an effective, approved erosion and sediment control plan or similar administrative document that specifies ~~contains~~ erosion and sediment control provisions.

Agency	Authority	Programs	Implementing Area	Notes
Various State and Local	• CEQA (PRC §§ 21000 et seq.) • CEQA Guidelines (Title 14 CCR §§ 15000 et seq.)	Environmental review of "projects" using Initial Study (Environmental Checklists), EIR, or Negative Declaration	Statewide	EIR, or Negative Declaration should identify mitigation measures to control erosion and sedimentation during and after construction.
Cities/Counties(CA contains 58 counties and approximately 468 incorporated cities.)	• PLZ (Gov. Code §§ 65000 et seq.) • SMA (Gov. Code §§ 66410 et seq.) • CCA § 30500	• General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Enforcement	• Statewide • LCP policies/ ordinances apply in coastal zone	Cities/counties can adopt ordinances/ rules and make land-use decisions consistent with State law. Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; and general police powers to protect public health, safety and welfare and declare, prohibit, and abate nuisances.
SWRCB/ RWQCBs	• CWA (33 USC § 1251 et seq.) • PCWQA (WC §§ 13000 et seq.) • CEQA (PRC §§21000 to 21177 • PCWQCA	SWDP (CWA § 402) • General Industrial and Construction Activities Storm Water Permits • MSWP TMDL Program [pursuant to CWA § 303(d)] Water Quality Certification [pursuant to CWA §401 for discharges of dredge and fill materials] CEQA—Environmental Review PCWQCA—WDR §13225	SWDP applies to: • cities >100,000 pop. (Phase I) • cities of 50,000 - 100,000 pop. (Phase II) TMDL programs apply in CWA § 303(d)-listed watersheds. Water Quality Certification applies statewide. CEQA and PCWQCA—Statewide	NPDES Permits (Phase I): • major industrial facilities; • large/medium municipalities separate storm sewer systems • construction sites that disturb 5 or more acres. NPDES Permits (Phase II): • smaller municipalities • construction sites that disturb 1 to 5 acres. TMDL goals include: identify pollution sources in watersheds; allocate pollution control responsibilities where water quality goals are not met. CEQA—Provide comments on construction impacts of projects. PCWQCA—For communities <50,000 also use as suppplement to §402(p).

CCC	• CCA (PRC §§ 30000 et seq.) • CCC Administrative Regulations (Title 14 CCR §§ 13000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Coastal development permits • LCP certification/ amendments • Federal consistency: review of federal actions affecting land or water uses or natural resources of the coastal zone • Enforcement	Coastal zone (includes tidelands, submerged lands, public trust lands).	• Enforcement tools include: issue cease & desist/ restoration orders; file complaint for civil penalties. • CCC certifies LCPs prepared by coastal cities/counties. • Federal projects, permits and licenses must be found consistent with the CCMP before they are implemented.
BCDC	• MPA (Gov. Code §§ 66600 et seq.), including SFB Plan • SMPR (PRC §§ 29000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Designation of priority uses adjacent to SFB • Permitting: development permits and marsh development permits • Federal consistency authority • Enforcement	SFB (shoreline areas within 100 ft. of SFB; tidal areas and specified tributaries; Suisun Marsh)	• Enforcement and federal consistency authorities are similar to those of CCC.
DFG	FGC §§ 1 et seq. ♦ § 1600-1607	• Streambed alteration permits for grading, filling, dredging activities in State waters or stream beds	Statewide: State waters or stream beds	• FGC focuses on problems such as control of erosion and sedimentation from grading, golf courses, road cuts, construction sites, etc.

The following BACKUP AUTHORITIES pertain to Urban Management Measures 3.1B, 3.1C, & 3.2A

Agency	Authority	Programs	Implementing Area	Notes
SWRCB/ RWQCB	PCWQCA (WC §§ 13000 et seq.)	• WQCPs (Basin Plans) • WDRs • NPSMP • WMI	Statewide	• Enforcement tools: cleanup and abatement/cease and desist orders; admin. civil liability • RWQCBs have primary responsibility for individual permitting, inspection and enforcement: may prohibit discharges or place limits on discharge characteristics, volume, area, or timing. • NPSMP's 3-tier approach to manage NPS pollution: **Tier 1**, Voluntary Implementation of management practices, **Tier 2**, Regulatory-Based Encouragement of management practices, **Tier 3**, Effluent Limitations.
DFG	FGC §§ 1 et seq. ♦ § 5650 ♦ §§ 12000-12002	• Enforcement • Reporting	Statewide	• Enforcement: citations by DFG wardens • Reporting: DFG staff report chronic (sublethal, long-term) water pollution conditions to RWQCBs, and cooperate in obtaining corrections or abatements to the condition.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in urban areas.
DHS	HSC §116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.

Urban Management Measure 3.2B — Construction Site Chemical Control	
Part (1):	Limit application, generation, and migration of toxic substances;
Part (2):	Ensure the proper storage and disposal of toxic materials;
Part (3):	Apply nutrients at rates necessary to establish and maintain vegetation without causing nutrient runoff to surface waters; and
Part (4):	Prepare and implement, prior to the use or storage of toxic materials on site, an effective, approved chemical control plan or similar administrative document that contains chemical control provisions (e.g., minimize use of toxic materials; ensure proper containment if toxic materials are to be used/stored on site).

The agencies and authorities for the four components of this MM are the same as the agencies/authorities identified for MMs 3.1B, 3.1C, and 3.2A, with the additional agency/authorities listed below.				
Agency	Authority	Programs	Implementing Area	Notes
DTSC	• HSC §§ 58000 et seq. • HSC §§ 25100 et seq.	• Permits to Operate • Hazardous Waste Facilities Permits • Site Mitigation Program and other hazardous waste cleanup programs	• Statewide	DTSC is lead State agency for hazardous waste management. • DTSC issues permits to operate to any person who stores, treats or disposes of or otherwise manages "hazardous waste." • DTSC manages the cleanup of hazardous waste sites, and regulates the transport, treatment, storage, and disposal of hazardous waste.

The following BACKUP AUTHORITIES pertain to Urban Management Measure 3.2B (Construction Site Chemical Control)
The backup authorities for this MM are the same as the backup authorities identified for MMs 3.1B, 3.1C, and 3.2A.

R0018913

Urban Management Measure 3.3A — Existing Development

Develop and implement watershed management programs to reduce runoff pollutant concentrations and volumes from existing development:

1. Identify priority local and/or regional watershed pollutant reduction opportunities (e.g., improve existing urban runoff control structures);
2. Specify a schedule for implementing appropriate controls;
3. Limit destruction of natural conveyance systems; and
4. Where appropriate, preserve, enhance, or establish buffers along surface water bodies and their tributaries.

Agency	Authority	Programs	Implementing Area	Notes
Cities/Counties (CA contains 58 counties and approximately 468 incorporated cities.)	• PZL (Gov. Code §§ 65000 et seq.) • SMA (Gov. Code §§ 66410 et seq.) • CCA § 30500	• General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Enforcement	• Statewide • LCP policies/ ordinances apply in coastal zone	Cities/counties can adopt ordinances/rules and make land-use decisions consistent with State law. Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; and general police powers to protect public health, safety and welfare and declare, prohibit, and abate nuisances.
SWRCB/ RWQCBs	• CWA (33 USC § 1251 et seq.) • PCWQCA (WC §§ 13000 et seq.)	SWDP (CWA § 402) • General Industrial and Construction Activities Storm Water Permits • MSWP TMDL Program [pursuant to CWA § 303(d)]	SWDP applies to: • cities >100,000 pop. (Phase I) • cities of 50,000 - 100,000 pop. (Phase II) TMDL programs apply in CWA § 303(d)-listed watersheds.	NPDES Permits (Phase I): • major industrial facilities; • large/medium municipalities separate storm sewer systems • construction sites that disturb 5 or more acres. NPDES Permits (Phase II): • smaller municipalities • construction sites that disturb 1 to 5 acres. TMDL goals include: identify pollution sources in watersheds; allocate pollution control responsibilities where water quality goals are not met.
CARB		Congestion Management Plan	Statewide: cities with pop.> 100,000	Reduction in vehicle congestion can reduce pollution
CIWMB	• CIWMA (PRC §§ 40400-49620) • CCR Title 14, Div. 7 and Title 27, Div. 2	Waste Reduction Program	Statewide at local level	UnderCIWMA, 50% of waste generated Statewide must be diverted from landfills by 2000 (using source reduction, hazard-ous waste control, education.)

R0018914

The following BACKUP AUTHORITIES pertain to Urban Management Measure 3.3A (Existing Development)				
Agency	**Authority**	**Programs**	**Implementing Area**	**Notes**
SWRCB/ RWQCB	PCWQCA (WC §§ 13000 et seq.)	• WQCPs (Basin Plans) • WDRs • NPSMP • WMI	Statewide	• Enforcement tools: cleanup and abatement/cease and desist orders; admin. civil liability • RWQCBs have primary responsibility for individual permitting, inspection and enforcement: may prohibit discharges or place limits on discharge characteristics, volume, area, or timing. • NPSMP's 3-tier approach to manage NPS pollution: **Tier 1**, Voluntary Implementation of management practices, **Tier 2**, Regulatory-Based Encouragement of management practices, **Tier 3**, Effluent Limitations.
DFG	FGC §§ 1 et seq. ♦ § 5650 ♦ §§ 12000-12002	• Enforcement • Reporting	Statewide	• Enforcement: citations by DFG wardens • Reporting: DFG staff report chronic (sublethal, long-term) water pollution conditions to RWQCBs, and cooperate in obtaining corrections or abatements to the condition.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq		SPS	DPR operates and maintains units of the SPS in urban areas.
DHS	HSC §116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.

R0018915

Urban Management Measure 3.4A — New Onsite Disposal Systems (OSDSs)	
Part (1):	Ensure that new OSDS are located, designed, installed, operated, inspected, and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into ground water. Where necessary to meet these objectives: (a) discourage the installation of garbage disposals to reduce hydraulic and nutrient loadings; (b) install low-volume plumbing fixtures in new developments or redevelopments as required by State law; and (c) encourage installation of low-volume plumbing fixtures in existing developments. Implement OSDS inspection schedules for pre-construction, construction, and post-construction.
Part (2):	Direct placement of OSDS away from unsuitable areas. Where OSDS placement away from unsuitable areas is not practicable, ensure that the OSDS is designed or sited at a density so as not to adversely affect surface waters or ground water. Unsuitable sites include, but are not limited to, areas (a) with poorly or excessively drained soils; (b) with shallow water tables or high seasonal water tables; (c) within floodplains; or (d) where nutrient and/or pathogen concentrations in the effluent cannot be sufficiently treated or reduced before the effluent reaches sensitive water bodies.
Part (3):	Establish protective setbacks from surface waters, wetlands, and floodplains for conventional as well as alternative OSDS. The lateral setbacks should be based on soil type, slope, hydrologic factors, and type of OSDS. Where uniform protective setbacks can not be achieved, site development with OSDS so as not to adversely affect water bodies and/or contribute to a public health nuisance.
Part (4):	Establish protective separation distances between OSDS system components and groundwater. The separation distances should be based on soil type, distance to ground water, hydrologic factors, and type of OSDS.
Part (5):	Where conditions indicate that nitrogen-limited surface waters may be adversely affected by excess nitrogen loadings from ground water, prohibit the installation of OSDSs or require the installation of OSDS that reduce total nitrogen loadings to meet water quality objectives.

Agency	Authority	Programs	Implementing Area	Notes
Cities/Counties (e.g., local county or city health departments, sanitary districts, planning departments, environmental health departments)	• HSC • UPC • HC • BC • PZL (Gov. Code §§ 65000 et seq.) • SMA (Gov. Code §§ 66410 et seq.) • CCA § 30500	• General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Enforcement	• Municipal areas Statewide • LCP policies/ ordinances apply in coastal zone	Local authorities determine OSDS criteria, and require permits and inspections. Cities/counties can adopt ordinances/rules and make land-use decisions consistent with State law. Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; and general police powers to protect public health, safety and welfare and declare, prohibit, and abate nuisances.
Various State and Local	• (CEQA (PRC §§ 21000 et seq.) • CEQA Guidelines (Title 14 CCR §§ 15000 et seq.)	Environmental review of "projects" using Initial Study (Environmental Checklists), EIR, or Negative Declaration	Statewide	Initial Study, EIR, or Negative Declaration may identify mitigation measures to address OSDS placement, operation, etc.

Special Districts	• HSC § 6950-6981 • Gov. Code § 25210	• Wastewater Disposal Zone • County Service Area	District-wide	Special districts can be established to provide oversight and management of OSDS
SWRCB/ RWQCBs	PCWQCA, CWC Title 23	Basin Plans	Regionwide	Basin Plans can include minimum criteria for siting, operation and maintenance, percolation rates, trenching, prohibition zones, and other requirements.
RWQCBs	PCWQCA § 13269	Establish MOUs with counties or other municipalities	Municipal areas Statewide	Regional Boards can delegate to locals the authority over OSDS
CCC	• CCA (PRC §§ 30000 et seq.) • CCC Administrative Regulations (Title 14 CCR §§ 13000 et seq.)	• Coastal development permits • LCP certification/ amendments • Federal consistency: review of federal actions affecting land or water uses or natural resources of the coastal zone • Enforcement	Coastal zone (includes tidelands, submerged lands, public trust lands).	• Enforcement tools include: issue cease and desist/ restoration orders; file complaint for civil penalties. • CCC certifies LCPs prepared by coastal cities/counties.
BCDC	• MPA (Gov. Code §§ 66600 et seq.), including SFB Plan • SMPA (PRC §§ 29000 et seq.)	• Designation of priority uses adjacent to SFB • Permitting: development permits and marsh development permits • Enforcement	SFB (shoreline areas within 100 ft. of SFB; tidal areas and specified tributaries; Suisun Marsh)	• Enforcement authority similar to that of CCC.

The following BACKUP AUTHORITIES pertain to Urban Management Measure 3.4A (New OSDSs)

Agency	Authority	Programs	Implementing Area	Notes
SWRCB/ RWQCB	PCWQCA (WC §§ 13000 et seq.)	• NPSMP	Statewide	• NPSMP's 3-tier approach to manage NPS pollution: **Tier 1**, Voluntary Implementation of management practices, **Tier 2**, Regulatory-Based Encouragement of management practices, **Tier 3**, Effluent Limitations.
DFG	FGC §§ 1 et seq. • § 5650 • §§ 12000-12002	• Enforcement • Reporting	Statewide	• Enforcement: citations by DFG wardens • Reporting: DFG staff report chronic (sublethal, long-term) water pollution conditions to RWQCBs, and cooperate in obtaining corrections or abatements to the condition.

DHS	CWC (CWC) Title 22	ODW	Statewide	If monitoring indicates groundwater contamination, DHS can order the public water supply purveyor to cease using the contaminated water supply as a source of drinking water.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq		SPS	DPR operates and maintains units of the SPS that have OSDS on site.
DHS	HSC §116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.

R0018918

Urban Management Measure 3.4B — Operating Onsite Disposal Systems (OSDSs)	
Part (1):	Establish and implement policies and systems to ensure that existing OSDSs are operated and maintained to prevent the discharge of pollutants to the surface of the ground and, to the extent practicable, reduce the discharge of pollutants into ground water. Where necessary to meet these objectives, encourage the reduced use of garbage disposals, encourage the use of low-volume plumbing fixtures, and reduce total phosphorus loadings to the OSDS by 15 % (if the use of low-level phosphate detergents has not been required or widely adopted by OSDS users). Establish and implement policies that require an OSDS to be repaired, replaced, or modified where the OSDS fails or threatens or impairs surface waters.
Part (2):	Inspect OSDSs at a frequency adequate to ascertain whether the OSDSs are failing.
Part (3):	Consider replacing or upgrading OSDS to treat influent so that total nitrogen loadings in the effluent are reduced to meet water quality objectives. This provision applies only where: (a) conditions indicate that nitrogen-limited surface waters may be adversely affected by significant ground water nitrogen loadings from an OSDS, and (b) nitrogen loadings from OSDS are delivered to ground water.

Agency	Authority	Programs	Implementing Area	Notes
Cities/Counties (e.g., local county or city health departments, sanitary districts, planning departments, environmental health departments)	• HSC • UPC • HC • BC • PZL (Gov. Code §§ 65000 et seq.) • SMA (Gov. Code §§ 66410 et seq) • CCA § 30500	• General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Enforcement	• Municipal areas Statewide • LCP policies/ ordinances apply in coastal zone	Local authorities determine OSDS criteria, and require permits and inspections. Cities/counties can adopt ordinances/rules and make land-use decisions consistent with State law. Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; and general police powers to protect public health, safety and welfare and declare, prohibit, and abate nuisances.
Various State and Local	• CEQA (PRC §§ 21000 et seq.) • CEQA Guidelines (Title 14 CCR §§ 15000 et seq.)	Environmental review of "projects" using Initial Study (Environmental Checklists), EIR, or Negative Declaration	Statewide	Initial Study, EIR, or Negative Declaration may identify mitigation measures to address OSDS placement, operation, etc.
Special Districts	• HSC § 6950-6981 • Gov. Code § 25210	• Wastewater Disposal Zone • County Service Area	District-wide	Special districts can be established to provide oversight and management of OSDS
SWRCB/ RWQCBs	PCWQCA, CWC Title 23	Basin Plans	Regionwide	Basin Plans can include minimum criteria for siting, operation and maintenance, percolation rates, trenching, prohibition zones, and other requirements.
RWQCBs	PCWQCA § 13269	Establish MOUs with counties or other municipalities	Municipal areas Statewide	RWQCBs can delegate to locals the authority over OSDS

The following BACKUP AUTHORITIES pertain to Urban Management Measure 3.4B (Operating OSDSs)
The backup authorities for this MM are the same as the backup authorities identified for MMs 3.4A (New OSDSs).

Urban Management Measure 3.5A — Planning, Siting, and Developing Roads and Highways
Plan, site, and develop roads and highways to: 1. Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss; 2. Limit land disturbance such as clearing and grading and cut and fill to reduce erosion and sediment loss; and 3. Limit disturbance of natural drainage features and vegetation.

Urban Management Measure 3.5B — Bridges
Site, design, and maintain bridge structures so that sensitive and valuable aquatic ecosystems and areas providing important benefits are protected from adverse effects.

Urban Management Measure 3.5C — Construction Projects [Roads, Highways and Bridges]
Part (1): Reduce erosion and, to the extent practicable, retain sediment on site during and after construction and Part (2): Prior to land disturbance, prepare and implement an approved erosion control plan or similar administrative document that contains erosion and sediment control provisions.

Agency	Authority	Programs	Implementing Area	Notes
• Cal/Trans • SWRCB/ RWQCB • USEPA	CWA § 402 CEQA (PRC §§21000 to 21177)	SWMP CEQA—Environmental Review	Statewide on Cal/Trans roads CEQA—Statewide	• General Construction Activities Storm Water NPDES Permit • Storm Water Quality Handbooks include: ◆ Planning and Design Staff Guide ◆ Construction Staff Guide ◆ Construction Contractors Guide and Specifications ◆ Chapter C6, Maintenance Manual, Volume 1 CEQA—Provide comments on construction impacts of transportation projects.
SWRCB	CWA §401	401 Certification Program	Statewide	
Various State and Local	• CEQA (PRC §§ 21000 et seq.) • CEQA Guidelines (Title 14 CCR §§ 15000 et seq.)	Environmental review of "projects" using Initial Study (Environmental Checklists), EIR, or Negative Declaration	Statewide	Initial Study, EIR, or Negative Declaration may identify mitigation measures to control erosion and sedimentation during and after construction.

Cities/Counties	• CWA § 402 • PZL (Gov. Code §§ 65000 et seq.) • SMA (Gov. Code §§ 66410 et seq.) • CCA § 30500	• SWPPPs • General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Enforcement	• Local areas with pop. >100,000 (Phase I) and bet. 50,000 - 100,000 (Phase II) • Local Governments statewide • LCP policies/ ordinances apply in coastal zone	• General Storm Water NPDES Permits • Cities/counties can adopt ordinances/rules and make land-use decisions consistent with State law. Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; general police powers to protect public health, safety and welfare/declare, prohibit, and abate nuisances.
CCC	• CCA (PRC §§ 30000 et seq.) • CCC Administrative Regulations (Title 14 CCR §§ 13000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Coastal development permits • LCP certification/ amendments • Federal consistency: review of federal actions affecting land or water uses or natural resources of the coastal zone • Enforcement	Coastal zone (includes tidelands, submerged lands, public trust lands).	• Enforcement tools include: issue cease and desist/ restoration orders; file complaint for civil penalties. • CCC certifies LCPs prepared by coastal cities/counties. • Federal projects, permits and licenses must be found consistent with the CCMP before they are implemented.
BCDC	• MPA (Gov. Code §§ 66600 et seq.), including SFB Plan • Suisun Marsh Preservation Act (PRC §§ 29000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Designation of priority uses adjacent to SFB • Permitting: development permits and marsh development permits • Federal consistency authority • Enforcement	SFB (shoreline areas within 100 ft. of SFB; tidal areas and specified tributaries; Suisun Marsh)	• Enforcement and federal consistency authorities are similar to those of CCC.
DFG	FGC §§ 1 et seq. • § 1600-1607	• Streambed alteration permits for grading, filling, dredging activities in State waters or stream beds	Statewide: State waters or stream beds	• FGC focuses on problems such as control of erosion and sedimentation from grading, golf courses, road cuts, construction sites, etc.

R0018921

The following BACKUP AUTHORITIES pertain to Urban Management Measures 3.5A, 3.5B, and 3.5C				
Agency	**Authority**	**Programs**	**Implementing Area**	**Notes**
SWRCB/ RWQCB	PCWQCA (WC §§ 13000 et seq.)	• WQCPs (Basin Plans) • WDRs • NPSMP • WMI	Statewide	• Enforcement tools: cleanup and abatement/cease and desist orders; admin. civil liability • RWQCBs have primary responsibility for individual permitting, inspection and enforcement: may prohibit discharges or place limits on discharge characteristics, volume, area, or timing. • NPSMP's 3-tier approach to manage NPS pollution: **Tier 1**, Voluntary Implementation of management practices, **Tier 2**, Regulatory-Based Encouragement of management practices, **Tier 3**, Effluent Limitations.
DFG	FGC §§ 1 et seq. • § 5650 • §§ 12000-12002	• Enforcement • Reporting	Statewide	• Enforcement: citations by DFG wardens • Reporting: DFG staff report chronic (sublethal, long-term) water pollution conditions to RWQCBs, and cooperate in obtaining corrections or abatements to the condition.
FHA and AASHTO	ISTEA		Statewide	• Provides guidance on transportation development • Develops construction and maintenance standards
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq		SPS	DPR operates and maintains units of the SPS in urban areas.
DHS	HSC §116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies to evaluate of water quality.

R0018922

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Urban Management Measure 3.5D — Construction Site Chemical Control [Roads, Highways and Bridges]	
Part (1):	Limit application, generation, and migration of toxic substances;
Part (2):	Ensure the proper storage and disposal of toxic materials;
Part (3):	Apply nutrients at rates necessary to establish and maintain vegetation without causing significant nutrient runoff to surface water.

The agencies and authorities for the four components of this MM are the same as the agencies/authorities identified for MMs 3.5A 3.5B, and 3.5C, with the additional agencies/authorities listed below.

Agency	Authority	Programs	Implementing Area	Notes
Cal/Trans		Cal/Trans IPMP	Statewide on Cal/Trans roads	
DTSC	• HSC §§ 58000 et seq. • HSC §§ 25100 et seq.	• Permits to Operate • Hazardous Waste Facilities Permits • Site Mitigation Program and other hazardous waste cleanup programs	• Statewide	DTSC is lead State agency for hazardous waste management. • DTSC issues permits to operate to any person who stores, treats or disposes of or otherwise manages "hazardous waste." • DTSC manages the cleanup of hazardous waste sites, and regulates the transport, treatment, storage, and disposal of hazardous waste.
CDPR	FAC § 12811-12829 3 CCR § 6170-6193	Registration of Pesticides		

The following BACKUP AUTHORITIES pertain to Urban Management Measure 3.5D (Construction Site Chemical Control)
The backup authorities for this MM are the same as the backup authorities identified for MMs 3.5A, 3.5B, and 3.5C.

R0018923

Urban Management Measure 3.5E — Operation and Maintenance [Roads, Highways and Bridges]
Incorporate pollution prevention procedures into the operation and maintenance of roads, highways, and bridges to reduce pollutant loadings to surface waters.

Urban Management Measure 3.5F — Road, Highway and Bridge Runoff Systems
Develop and implement runoff management systems for existing roads, highways, and bridges to reduce runoff pollutant concentrations and volumes entering surface waters. 1. Identify priority and watershed pollutant reduction opportunities (e.g., improvements to existing urban runoff control structures;) and 2. Establish schedules for implementing appropriate controls.

Agency	Authority	Programs	Implementing Area	Notes
• Cal/Trans • SWRCB • USEPA	CWA § 402	SWMP	Statewide on Cal/Trans roads	Storm Water Quality Handbook: Chapter C6, Maintenance Manual, Volume I
Cities/Counties	• CWA § 402 • PZL (Gov. Code §§ 65000 et seq.) • SMA (Gov. Code §§ 66410 et seq.) • CCA § 30500	• SWPPPs • General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Enforcement	• Local areas with pop. >100,000 (Phase I) and bet. 50,000 - 100,000 (Phase II) • Local Governments statewide • LCP policies/ ordinances apply in coastal zone	• General Construction Activities Storm Water NPDES Permit • Cities/counties can adopt ordinances/rules and make land-use decisions consistent with State law. Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; and general police powers to protect public health, safety and welfare and declare, prohibit, and abate nuisances.

The following BACKUP AUTHORITIES pertain to Urban Management Measure 3.5E and 3.5F
The backup authorities for this MM are the same as the backup authorities identified for MMs 3.5A, 3.5B, and 3.5C.

R0018924

Urban Management Measure 3.6A — Pollution Prevention/Education: General Sources
Implement educational programs to provide greater understanding of watersheds, and to raise awareness and increase the use of applicable urban management measures and practices where needed to control and prevent adverse impacts to surface and ground water. Public education, outreach, and training programs should involve applicable user groups and the community. Implementation of urban pollution prevention and education programs includes the following activities, where applicable: 1. Households • Improper storage, use, and disposal of household hazardous chemicals, including automobile fluids, pesticides, paints, solvents, etc.; • Lawn and garden activities, including the application and disposal of lawn and garden care products, and improper disposal of leaves and yard trimmings; • Improper operation and maintenance of onsite disposal systems; • Improper disposal of pet excrement. 2. Landscaping • Turf management on golf courses, parks and recreational areas. 3. Commercial • Commercial activities, including parking lots, restaurants, vehicle service facilities, and other entities. 4. Other General Sources • Discharge of pollutants into storm drains, including floatables, waste oil, and litter; • Roads, highways, and bridges. • [Refer to the Urban Management Measures 3.1 – 3.5 listed in this document.]

Agency	Authorities (•) and Programs (♦)	Implementing Area	Notes
Local Governments (Cities and Counties)	Many programs, including the following: ♦ SFB/Southern CA NPDES stormwater programs (education/outreach efforts to reduce urban pollution from litter and improper disposal into storm drains). ♦ MBNMS WQPP watershed module for the Adopt-a-Beach coastal clean-up activities in central CA. ♦ Santa Clara Valley NPS Control Program/San Jose Office of Env. Management automobile service station management practice handbook. ♦ Sunnyvale's curbside used oil collection/outreach program. ♦ San Francisco's permanent HHW collection facility (includes education, waste disposal, facility inspection).	• Varies Statewide	Many local governments maintain planning, community liaison, or public education/information staff to organize special projects (e.g.., management practice handbooks, curbside collection, storm drain stenciling).

R0018925

CCC	• CCA (PRC §§ 30000 et seq.) ♦ Conservation Education Program (§ 30012) ♦ Coastal Cleanup Day ♦ Adopt-A-Beach program ♦ Save Our Seas curriculum.	• Coastal zone	CCC programs promote conservation awareness, recycling, and litter abatement efforts through community involvement and environmental education efforts/materials.
CIWMB	• CIWMA (PRC §§ 40400-49620) • CCR Title 14, Div. 7 and Title 27, Div. 2 ♦ Diversion, Planning, and Local Assistance ♦ HHW Grants ♦ Used Oil Grants ♦ Used Oil Certification ♦ Waste Reduction Program	Statewide at local level	• Model planning documents, work-books, and catalogs to help prevent, reduce, recycle, compost, dispose of wastes (including used oil/ HHWs). • Used oil grants • Grants to implement HHW waste/source reduction or reuse/recycling programs. • Incentives to collection centers for do-it-yourselfers to bring used oil for proper disposal or re-refining.
CDPR	• FAC §§ 11401 et seq. • CCR Title 3, §§ 6000 et seq. • Surface Water Protection (FAC §14005 ♦ Pesticide Labeling (FAC § 11501 and 3 CCR §§ 6235-6243) ♦ Availability of label storage and disposal requirements (3 CCR §§ 6602, 6670-6686) ♦ Pesticide Licensing/Training (FAC § 12851-12859) ♦ Integrated Pest Management (IPM) ♦ Urban Pesticide Committee	• Statewide	• Licensing/training for professional gardeners/landscapers/others who apply pesticides on golf courses, parks, recreational areas, etc. • Grants to educate urban gardeners on IPM/reduced pest control. • Outreach and education plan to prevent pesticide residues from reaching storm drains
• DTSC • Cal/EPA • USEPA • CA Community Colleges	• HSC §§ 58000 et seq. • H&SC §§ 25100 et seq. ♦ Hazardous Waste Generator/Small Business Outreach Workshops ♦ California Compliance School	• Statewide	• Hazardous waste management workshops for businesses • Classes/workbook and hands-on training for individuals who manage/work with hazardous wastes
DWR	• CACRFCA • WCLA • DFPP ♦ Urban Streams Restoration Program ♦ Water Education Program ♦ Model Water Efficient Landscape Ordinance	• Statewide • SFB Delta	• Assistance and grants to citizens and local agencies to address urban stream erosion and flooding problems • Helps water districts plan, organize, and implement water education/conservation programs • Cities/counties must adhere to DWR Model Water Efficient Landscape Ordinance or equivalent ordinance

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Other Efforts that pertain to Urban Management Measure 3.6A (Pollution Prevention/Education: General Sources)			
Agency	Authorities (•) and Programs (♦)	Implementing Area	Notes
City of Monterey City of Santa Cruz CCC, Central Coast RWQCB MBNMS AMBAG SWRCB BASMAA	• CWA § 402: NPDES storm water program • CZARA (16 USC § 1455b) • BASMAA ♦ MURP [developed pursuant to a CWA § 319 grant]	• Cities of Monterey and Santa Cruz • other small municipalities Statewide. • BASMAA—SF Area	Model URMP developed by Cities of Monterey and Santa Cruz. Includes a model framework to develop similar URMPs in other small cities, and a "How to Guide" with coordinating mechanisms for local agencies, recommended improvements to local CEQA Guidelines, and a model public education program. BASMAA's *Start at the Source* manual, Pesticide manual, Other outreach.
State/local/federal agency participation in CA's NMSs NERRs NEPs	• MPRSA (16 USC § 1431 et seq.) • CZMA § 315 • CWA § 320 (33 USC § 1330) ♦ ♦ MBNMS WQPP ♦ SMBRP ♦ SFEP	NMSs: • Monterey Bay • Channel Islands • Cordell Bank/ Gulf of the Farallones NERRs: • Elkhorn Slough • Tijuana River NEPs: • SMB, SFB and Morro Bay	The MBNMS WQPP includes numerous education efforts/actions. It is a collaborative effort of federal, State, and local agencies, and public and private groups to address NPS pollution in the region's watersheds. An MOA has been signed by: NOAA; USEPA, Region 9; Cal/EPA; SWRCB; RWQCB 2 (SFB); RWQCB 3 (Central Coast); CCC; and AMBAG.
DPR	Div. I, Chapter 1.25, Div. V, PRC §5000 et seq	SPS	DPR has an extensive educational program that includes talks, displays, curriculum development and special programs.
DHS	• HSC §116275 et seq. • Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
CDPR	• FAC §11501F • H_2O Home to Ocean Workbook	Statewide in urban areas	This workbook is a comprehensive guide for wastewater treatment plants on how to launch a public education campaign or enhance an existing outreach program for water quality.

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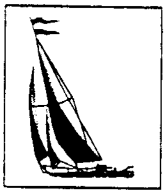
Marinas & Recreational Boating Management Measures



The SWRCB, CCC, and other State agencies have identified 17 MMs to address marina and recreational boating sources of nonpoint pollution. Because marinas are located at the water's edge, pollutants generated from marinas and boats are less likely to be buffered or filtered by natural processes. When boating and related activities (e.g., marinas and boat maintenance areas) are poorly planned or managed, they may threaten the health of aquatic systems and pose other environmental hazards. The USEPA (1993) identifies several sources of pollution associated with marinas and boating activities:

- Poorly flushed waterways;
- Pollutants discharged from boats (recreational boats, commercial boats, and "live-aboards");
- Pollutants carried in stormwater runoff;
- Physical alteration of wetlands and of shellfish/ other benthic communities during construction of marinas, ramps, and related facilities;
- Pollutants generated from boat maintenance activities on land and in the water.

California's marina and recreational boating MMs:

4.1 Assessment, Siting and Design
- A. Water Quality Assessment
- B. Marina Flushing
- C. Habitat Assessment
- D. Shoreline Stabilization
- E. Storm Water Runoff
- F. Fueling Station Design
- G. Sewage Facilities
- H. Waste Management Facilities

4.2 Operation and Maintenance
- A. Solid Waste Control
- B. Fish Waste Control
- C. Liquid Material Control
- D. Petroleum Control
- E. Boat Cleaning and Maintenance
- F. Maintenance of Sewage Facilities
- G. Boat Operation

4.3 Education/Outreach
- A. Public Education

California's management measures are intended to be applied to control impacts to water quality and habitat from marina siting and construction (new <u>and</u> expanding marinas), and marina and boat operation and maintenance. The measures are designed to reduce NPS pollution by requiring the best possible siting for marinas and maintenance areas, providing for the best available design and construction practices and appropriate operation and maintenance practices, and encouraging the development and use of effective pollution control and education efforts. The management measures cover the following operations and facilities (USEPA, 1993):

- Any facility that contains 10 or more slips, piers where 10 or more boats may tie up, or any facility where a boat for hire is docked;
- Any residential or planned community marina with 10 or more slips;
- Any mooring field where 10 or more boats are moored;
- Public or commercial boat ramps;
- Boat maintenance or repair yards that are adjacent to the water, and any Federal, State, or local facility that involves recreational boat maintenance or repair on or adjacent to the water.

The assessment, siting, and design MMs for marinas and recreational boating is summarized as follows:

4.1.A. **Water Quality Assessment** — Consider impacts to water quality in siting and designing new and expanding marinas.
4.1.B. **Marina Flushing** — Site and design marinas to provide for maximum flushing and circulation of surface waters, which can reduce the potential for water stagnation, maintain biological productivity, and reduce the potential for toxic accumulation in bottom sediment.
4.1.C. **Habitat Assessment** — Site and design marinas to protect against adverse impacts on fish and shellfish, aquatic vegetation, and important local-, State-, or federal-designated habitat areas.
4.1.D. **Shoreline Stabilization** — Stabilize shorelines where shoreline erosion is a pollution problem.
4.1.E. **Storm Water Runoff** — Implement runoff control strategies to remove at least 80% of suspended solids from storm water runoff coming from boat maintenance areas (some boat yards may conform to this provision through NPDES permits).
4.1.F. **Fueling Station Design** — Locate and design fueling stations to contain accidental fuel spills in a limited area; provide fuel containment equipment and spill contingency plans to ensure quick spill response.
4.1.G. **Sewage Facilities** — Install pumpout, pump station, and restroom facilities at new and expanding marinas where needed to prevent sewage discharges directly to State waters.
4.1.H. **Waste Management Facilities** — Install facilities at new and expanding marinas where needed for the proper recycling or disposal of solid wastes (e.g., oil filters, lead acid batteries, used absorbent pads, spent zinc anodes, and fish waste as applicable) and liquid materials (e.g., fuel, oil, solvents, antifreeze, and paints).

The operation and maintenance MMs for marinas and recreational boating are summarized as follows:

4.2.A. **Solid Waste Control** — Properly dispose of solid wastes produced by the operation, cleaning, maintenance, and repair of boats to limit entry of these wastes to surface waters.
4.2.B. **Fish Waste Control** — Promote sound fish waste management, where fish waste is a NPS problem, through a combination of fish cleaning restrictions, education, and proper disposal.
4.2.C. **Liquid Material Control** — Provide and maintain the appropriate storage, transfer, containment, and disposal facilities for liquid materials commonly used in boat maintenance, and encourage recycling of these materials.
4.2.D. **Petroleum Control** — Reduce the amount of fuel and oil that leaks from fuel tanks and tank air vents during the refueling and operation of boats.
4.2.E. **Boat Cleaning and Maintenance** — Minimize the use of potentially harmful hull cleaners and bottom paints, and prohibit discharges of these substances to State waters.
4.2.F. **Maintenance of Sewage Facilities** — Maintain pumpout facilities in operational condition, and encourage their use so as to prevent and control untreated sewage discharges to surface waters.

4.2.G. **Boat Operation** — Prevent turbidity and physical destruction of shallow-water habitat resulting from boat wakes and propwash.

The education/outreach MM for marinas and recreational boating is summarized as follows:

4.3A **Public Education** — Institute public education, outreach, and training programs to prevent and control improper disposal of pollutants into State waters.

4.0 MARINAS AND RECREATIONAL BOATING

IMPLEMENTATION AUTHORITIES

Marina and Recreational Boating Management Measures

4.1. **Assessment, Siting and Design**
- A. Water Quality Assessment
- B. Marina Flushing
- C. Habitat Assessment
- D. Shoreline Stabilization
- E. Storm Water Runoff
- F. Fueling Station Design
- G. Sewage Facilities
- H. Waste Management Facilities

4.2. **Operation and Maintenance**
- A. Solid Waste Control
- B. Fish Waste Control
- C. Liquid Material Control
- D. Petroleum Control
- E. Boat Cleaning and Maintenance
- F. Maintenance of Sewage Facilities
- G. Boat Operation

4.3. **Education/Outreach**
- A. Public Education/Outreach

Marinas and Recreational Boating Management Measure 4.1A — Water Quality Assessment

Part (1): Assess water quality as a part of the siting and design of new and expanding marinas to establish baseline water quality conditions or trends.
Part (2): Assess water quality at existing marinas to establish baseline water quality conditions.

Marinas and Recreational Boating Management Measure 4.1B — Marina Flushing

Site and design new and expanding marinas such that tides and/or currents will aid in flushing of the site or renew its water regularly.

Marinas and Recreational Boating Management Measure 4.1C — Habitat Assessment

Site and design new and expanding marinas to protect against adverse effects on shellfish resources, wetlands, submerged aquatic vegetation, or other important riparian and aquatic habitat areas as designated by local, State, or federal governments.

Marinas and Recreational Boating Management Measure 4.1D — Shoreline Stabilization

Where streambank or shoreline erosion is a nonpoint source pollution problem, streambanks/shorelines should be stabilized (when determining whether streambank/shoreline erosion is a NPS problem, assess natural erosion rates and the dynamic equilibrium of the streambank/shoreline). The use of vegetative stabilization methods is preferred over the use of structural stabilization methods, if appropriate considering the climate, severity of erosion, offshore bathymetry, and/or the potential adverse impact on other streambanks or shorelines and offshore areas.

Agency	Authority	Programs	Implementing Area	Notes
Various State and Local	• California Environmental Quality Act (CEQA) (PRC §§ 21000 et seq.) • CEQA Guidelines (Title 14 CCR §§ 15000 et seq.)	Environmental review of "projects" using Initial Study (Environmental Checklists), EIR, or Negative Declaration	Statewide	• Environmental Checklists help to identify potential NPS impacts. • EIR or Negative Declaration may identify mitigation measures to address potential adverse impacts.
Cities/Counties (CA contains 58 counties and approximately 468 incorporated cities.)	• PZL (Gov. Code §§ 65000 et seq.) • Subdivision Map Act (SbMA) (Gov. Code §§ 66410 et seq.) • CCA § 30500	• General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Leases on granted tide and submerged lands • Enforcement	• Statewide • LCP policies/ ordinances apply in coastal zone • Tide- /submerged lands granted in trust to cities and counties	• Cities/counties adopt policies/ ordinances; make land-use decisions consistent with State law. • Local governments may lease granted lands for marinas and may condition leases (e.g., to address assessment, siting, and design). • Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; general police powers to protect public health, safety and welfare and declare, prohibit, and abate nuisances.

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CCC	• CCA (PRC §§ 30000 et seq.) • CCC Administrative Regulations (Title 14 CCR §§ 13000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Coastal development permits • LCP certification/ amendments • Federal consistency: review of federal actions affecting land or water uses or natural resources of the coastal zone • Enforcement	Coastal zone (includes tidelands, submerged lands, public trust lands).	• CCC certifies LCPs prepared by coastal cities/counties. • Federal projects, permits and licenses must be found consistent with the CCMP before they are implemented. • Enforcement tools include: issue cease and desist/ restoration orders; file complaint for civil penalties.
SFBCDC	• MacAteer-Petris Act (MPA) (Gov. Code §§ 66600 et seq.), including San Francisco Bay (SFB) Plan • SMPA (PRC §§ 29000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Designation of priority uses adjacent to SFB • Permitting: development permits and marsh development permits • Federal consistency • Enforcement	SFB (shoreline areas within 100 ft. of SFB; tidal areas and specified tributaries; Suisun Marsh)	• Enforcement and federal consistency authorities are similar to those of CCC.
DFG	FGC §§ 1 et seq. ♦ § 1600-1607	• Streambed alteration permits for grading, filling, dredging activities in State waters or stream beds	Statewide: State waters or stream beds	• FGC focuses on problems including control of erosion and sedimentation (e.g., from grading, construction sites, golf courses, road cuts, etc.).
SLC	• PRC §§ 6000 et seq. (includes lease authority)	• SLC leases (PRC §6501.1 • Marina Leasing Program •	• Ungranted State sovereign lands •	• May condition leases for lands owned by the State which are under the jurisdiction of the SLC for such purposes as the SLC deems advisable, including, but not limited to, commercial, industrial, and recreational purposes. •

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The following BACKUP AUTHORITIES pertain to Marina Management Measures 4.1A, 4.1B, 4.1C, and 4.1D				
Agency	Authority	Programs	Implementing Area	Notes
SWRCB/ RWQCB	PCWQCA (Water Code [WC] §§13000 et seq.)	• Water Quality Control Plans (WQCPs) • WDRs • NPSMP • Watershed Management Initiative (WMI)	Statewide	• Enforcement tools: cleanup and abatement/cease and desist orders; admin. civil liability • RWQCB has primary responsibility for individual permits, inspection and enforcement: may prohibit discharges or place limits on discharge volume, area, timing, characteristics. • NPSMP's 3-tier approach to manage NPS pollution: **Tier 1**, Voluntary Implementation of management practices, **Tier 2**, Regulatory-Based Encouragement of management practices, **Tier 3**, Effluent Limitations.
DFG	FGC §§ 1 et seq. ♦ § 5650 ♦ §§ 12000-12002	• Enforcement • Reporting	Statewide	• Enforcement: citations by wardens • Reporting: DFG staff report chronic (sublethal, long-term) water pollution conditions to RWQCBs, and cooperate in obtaining corrections or abatements to the condition.
DHS	HSC §§ 100275, 115880, 116075, 112150 et seq.	Public beach and recreational water sanitation; shellfish beds	Coastal waters	Microbiological standards for beaches and recreational waters; microbiological standards for shellfish beds

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Other efforts that pertain to Marina MMs 4.1A, 4.1B, 4.1C, and 4.1D				
Agency	Authority	Programs	Implementing Area	Notes
DBW	• Harbors and Navigation Code (HNC) §§1 et seq. • Federal Clean Vessel Act of 1990 (FCVA)	• Harbors and Watercraft Revolving Fund (HWRF) • Clean Vessel Act Program (CVAP) • Other Financial, Technical Assistance, and Educational Programs	• SPS, State Water Project (SWP) reservoirs and on other State lands. • Assists local governments Statewide.	• DBW plans, designs, finances, and constructs State boating facilities, and coordinates with local governments to develop local boating facilities. Financing includes boating facility construction loans, boat launching facility grants, marina construction loans, capital outlay projects. • DBW assists in the construction of shoreline protection projects. • Authorized uses of HWRF loans (related to NPS MM implementation) include: parking, restrooms, vessel pumpout facilities, oil recycling facilities, landscaping, receptacles for separating, reusing, or recycling solid waste materials; etc. • Under HNC § 76.4(a)(3), projects eligible for HWRF loans must show evidence of compliance with CEQA.
State/local/federal agency participa-tion in MBNMS Water Quality Protection Program (WQPP)	• Marine Protection, Research and Sanctuaries Act (MPRSA) (16 USC § 1431 et seq.)	MBNMS WQPP Action Plan for Marinas	MBNMS	The MBNMS WQPP is a collaborative effort of federal, State and local agencies and public and private groups to address NPS pollution in the region's watersheds. A Memorandum of Agreement (MOA) has been signed by: NOAA; USEPA, Region 9; Cal/EPA; SWRCB; San Francisco Bay Region (RRWQCB 2); Central Coast Region (RWQCB 3); CCC; and Association of Monterey Bay Area Governments (AMBAG).

R0018934

Marinas and Recreational Boating Management Measure 4.1E — Storm Water Runoff
Implement effective runoff control strategies which include the use of pollution prevention activities and the proper design of marinas and boat maintenance areas (including parking areas). Reduce the average annual loadings of total suspended solids (TSS) in runoff from these areas to meet water quality objectives.

The agencies and authorities for this MM are the same as the agencies/authorities identified for MMs 4.1A, 4.1B, and 4.1C, with the additional agency/authorities listed below.

Agency	Authority	Programs	Implementing Area	Notes
SWRCB/ RWQCBs	• CWA (33 USC § 1251 et seq.) • PCWQCA (WC §§ 13000 et seq.)	Storm Water Discharge Program (SWDP) (CWA §402) • General Industrial and Construction Activities Storm Water Permits • Municipal Storm Water Permit (MSWP) Total Maximum Daily Load (TMDL) Program [pursuant to CWA § 303(d)]	SWDP applies to: • cities >100,000 pop. (Phase I) • cities of 50,000 - 100,000 pop. (Phase II) TMDL programs apply in CWA § 303(d)-listed watersheds.	• NPDES Permits (Phase I): [major industrial facilities; large/medium municipalities separate storm sewer systems; construction sites that disturb 5 or more acres]. • NPDES Permits (Phase II): [smaller municipalities; construction sites that disturb 1 to 5 acres]. • TMDL goals include: identify sources of pollution in watersheds; allocate pollution control responsibilities where water quality goals are not met.

The following BACKUP AUTHORITIES pertain to Marina Management Measure 4.1E
Backup authorities for this MM are the same as the backup authorities identified for MMs 4.1A, 4.1B, 4.1C, and 4.1D.

Other efforts that pertain to Marina Management Measure 4.1E
Other efforts related to this MM are the same as those identified for MMs 4.1A, 4.1B, 4.1C, and 4.1D.

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OSPR	• Oil Spill Prevention and Response Act of 1990 (OSPRA) (Cal. Gov. Code §§ 8670.28 et seq.); • PRC Div. 7.8; • Title 14 CCR §§ 815.01 et seq.; • Federal Oil Polluter Act of 1990 (OPA)	• Contingency Planning • Enforcement and Inspection	Statewide	• OSPR is lead State agency for oil spill prevention and response (responsibility shared with 22 agencies represented on State Interagency Oil Spill Committee [SIOSC]) • OSPR requires spill contingency plans for all marine facilities with potential discharge into the marine waters of the State. • OSPR enforces laws designed to prevent spills, responds to spills, and investigates spills. • OSPR/DFG wardens conduct spill investigations, gather and prepare evidence, and enforce the criminal statutes contained in the OSPRA (e.g., civil/criminal penalties for OSPRA violations).
CCC/SFBCDC	• OSPRA (Cal. Gov. Code §§ 8670.28 et seq.)	• CCC/SFBCDC Joint Oil Spill Program (JOSP)	• CCC: coastal zone • SFBCDC: SFB	• These are additional authorities/ responsibilities to those described for other MMs above.
SLC	• PRC §§6000 et seq. (includes lease authority) •	• SLC leases (PRC §6501.1) • Marina Leasing Program •	• Ungranted State sovereign lands •	• May review fueling station design during the commercial lease approval process on lands under the jurisdiction of the SLC. •

The following BACKUP AUTHORITIES pertain to Marina Management Measure 4.1F
The backup authorities for this MM are the same as the backup authorities identified for MMs 4.1A, 4.1B, 4.1C, and 4.1D.

R0018937

Marinas and Recreational Boating Management Measure 4.1G — Sewage Facilities
Install pumpout, dump station, and restroom facilities where needed at new and expanding and existing marinas to reduce the release of sewage to surface waters. Design these facilities to allow ease of access and post signage to promote use by the boating public.

The agencies and authorities for this MM are the same as the agencies/authorities identified for MMs 4.1A, 4.1B, 4.1C, and 4.1D, with the additional agency/authorities and other efforts listed below.

Agency	Authority	Programs	Implementing Area	Notes
DBW	• HNC §§ 1 et seq. • FCVA	• (HWRF • CVAP • Other Financial, Technical Assistance, and Educational Programs	• SPS, SWP reservoirs and on other State lands. • Assists local governments Statewide.	• DBW plans, designs, finances, and constructs State boating facilities, and coordinates with local governments to develop local boating facilities. Financing includes boating facility construction loans, boat launching facility grants, marina construction loans, capital outlay projects. • Under the CVAP, DBW helps fund the construction, renovation, operation, and maintenance of pumpout/dump stations to service pleasure craft. • Authorized uses of HWRF loans related to implementing this MM are restrooms and vessel pumpout facilities. • Under HNC § 76.4(a)(3), projects eligible for HWRF loans must show evidence of compliance with CEQA.
DBW with RWQCBs, SWRCB, USFWS, and all peace officers, State and local public health officers, and boating law enforcement officers as specified	• HNC §§ 1 et seq. • FCVA		• Statewide	• Every vessel terminal (marina) shall, as required by the RWQCBs, be equipped with vessel pumpout facilities for the transfer and disposal of sewage. In imposing this requirement, the RWQCB shall take into account the number and type of vessels that use or are berthed at the vessel terminal. In addition, the RWQCB may require any vessel pumpout facility to be equipped with a meter for the purpose of measuring use of the facility. All new pumpout facilities shall be equipped with a meter (HNC § 776). This section applies to dockage adjacent to and serving private

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				residences unless the RWQCB determines that vessel pumpout facilities are conveniently available to vessels so docked. • Any violation of HNC § 776 is a misdemeanor. Under HNC § 779, every peace officer of the State and of any city, county, or other public agency, all State and local public health officers, and all boating law enforcement officers shall enforce this chapter of the HNC and any adopted regulations • Every vessel pumpout facility shall have a notice posted on the facility identifying the city, county, local public health officer, or boating law enforcement officer responsible for enforcement [HNC § 777(b)]. • The SWRCB shall adopt standards for the location, construction, operation, and maintenance of vessel pumpout facilities (HNC § 778). • DBW guidelines pursuant to HNC § 775 et seq. are incorporated into the USFWS (1994) California Statewide Vessel Disposal Plan (CSVDP).
State/local/federal agency participa-tion in MBNMS	• MPRSA (16 USC § 1431 et seq.)	MBNMS WQPP Action Plan for Marinas	MBNMS	The MBNMS WQPP is a collaborative effort of federal, State and local agencies and public and private groups to address NPS pollution in the region's watersheds. An MOA has been signed by: NOAA; USEPA, Region 9; Cal/EPA; SWRCB; RWQCB 2 (SFB); RWQCB 3 (Central Coast); CCC; and AMBAG.

R0018939

Marinas and Recreational Boating Management Measure 4.1H — Waste Management Facilities
Install facilities where needed for the proper recycling or disposal of solid wastes (such as oil filters, lead acid batteries, used absorbent pads, spent zinc anodes, and fish waste as applicable) and liquid materials (such as fuel, oil, solvents, antifreeze, and paints) generated by users of marinas and boat maintenance areas. Design these facilities to allow ease of access, post signage to promote use by the boating public, and encourage recycling to the fullest extent possible.

The agencies and authorities for this MM are the same as the agencies/authorities identified for MMs 4.1A, 4.1B, 4.1C, and 4.1D, with the additional agency/authorities listed below.

Agency	Authority	Programs	Implementing Area	Notes
DTSC	• HSC, Div. 20 §§ 25100 et seq. • HSC, Div. 38 §§ 58000 et seq.	• Hazardous Waste Facilities Permits	Statewide	Regulates hazardous material transport, treatment, storage, and disposal; issues permits to operate to any person who stores, treats, or disposes of hazardous waste. Programs also encourage recycling of certain hazardous materials (e.g., used oil, spent batteries, etc.).

R0018940

The backup agencies/authorities for this MM are the same as those identified for MMs 4.1A, 4.1B, 4.1C, and 4.1D. Other efforts include:				
Agency	Authority	Programs	Implementing Area	Notes
CIWMB	• PRC §§ 40400-49620, including California Integrated Waste Management Act (CIWMA) • CCR (CCR) Title 14, Div. 7 and Title 27, Div. 2	• Diversion, Planning, and Local Assistance • Household Hazardous Waste (HHW) Grants • Used Oil Grants • Used Oil Certification	Statewide	• Assists local governments in complying with CIWMA (to divert 50% of waste from landfills by the year 2000). • Provides model planning documents, workbooks, etc. on waste prevention, reduction, reuse, recycling, and safe disposal of used oil and HHWs. • Awards used oil grants and grants to implement programs that emphasize HHW waste/source reduction and HHW reuse/recycling. • Provides incentives to centers that provide a convenient location for "do-it-yourselfers" to bring used oil for proper disposal or re-refining.
State/local/federal agency participa-tion in MBNMS	• MPRSA (16 USC § 1431 et seq.)	MBNMS WQPP Action Plan for Marinas	MBNMS	The MBNMS WQPP is a collaborative effort of federal, State and local agencies and public and private groups to address NPS pollution in the region's watersheds. An MOA has been signed by: NOAA; USEPA, Region 9; Cal/EPA; SWRCB; RWQCB 2 (SFB); RWQCB 3 (Central Coast); CCC; and AMBAG.

R0018941

Marinas and Recreational Boating Management Measure 4.2A — Solid Waste Control

Properly dispose of solid wastes produced by the operation, cleaning, maintenance, and repair of boats and operation of marinas—and encourage recycling of recyclable materials to the fullest extent possible—to limit entry of solid wastes to surface waters.

Marinas and Recreational Boating Management Measure 4.2B — Fish Waste

Promote sound fish waste management through a combination of fish-cleaning restrictions, public education, and proper disposal of fish waste.

Agency	Authority	Programs	Implementing Area	Notes
Various State and Local	• CEQA (PRC §§ 21000 et seq.) • CEQA Guidelines (Title 14 CCR §§ 15000 et seq.)	Environmental review of "projects" using Initial Study (Environmental Checklists), EIR, or Negative Declaration	Statewide	• Environmental Checklists help to identify potential NPS impacts. • EIR or Negative Declaration may identify mitigation measures to address potential adverse impacts.
Cities/Counties (CA contains 58 counties and approximately 468 incorporated cities.)	• PZL (Gov. Code §§ 65000 et seq.) • SbMA (Gov. Code §§ 66410 et seq.) • CCA § 30500	• General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Leases on granted tide and submerged lands • Enforcement	• Statewide • LCP policies/ ordinances apply in coastal zone • Tide-submerged lands granted in trust to cities and counties	• Cities/counties adopt policies/ ordinances; make land-use decisions consistent with State law. • Local governments may lease granted lands for marinas and may condition leases. • Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; general police powers to protect public health, safety and welfare and declare, prohibit, and abate nuisances.
SWRCB/ RWQCBs	• CWA (33 USC § 1251 et seq.) • PCWQCA (WC §§ 13000 et seq.)	• SWDP (CWA §402) General Municipal Storm Water Permits (GMSWPs) • TMDL Program [pursuant to CWA § 303(d)]	Storm Water Program applies to: • cities >100,000 pop. (Phase I) • cities of 50,000 - 100,000 pop. (Phase II) TMDL programs apply in CWA § 303(d)-listed watersheds.	NPDES Permits (Phase I): • large/medium municipalities separate storm sewer systems NPDES Permits (Phase II): • smaller municipalities TMDL goals include: identify pollution sources in watersheds; allocate pollution control responsibilities where water quality goals are not met.

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CCC	• CCA (PRC §§ 30000 et seq.) • CCC Administrative Regulations (Title 14 CCR §§ 13000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Coastal development permits • LCP certification/ amendments • Federal consistency: review of federal actions affecting land or water uses or natural resources of the coastal zone • Enforcement	Coastal zone (includes tidelands, submerged lands, public trust lands).	• CCC certifies LCPs prepared by coastal cities/counties. • Federal projects, permits and licenses must be found consistent with the CCMP before they are implemented. • Enforcement tools include: issue cease and desist/ restoration orders; file complaint for civil penalties.
SFBCDC	• MPA (Gov. Code §§ 66600 et seq.), including SFB Plan • SMPA (PRC §§ 29000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Designation of priority uses adjacent to SFB • Permitting: development permits and marsh development permits • Federal consistency • Enforcement	SFB (shoreline areas within 100 ft. of SFB; tidal areas and specified tributaries; Suisun Marsh)	• Enforcement and federal consistency authorities are similar to those of CCC.
SLC	• PRC §§ 6000 et seq. (includes lease authority)	• SLC leases (PRC §6501.1) • Marina Leasing Program	• Ungranted State soveriegn lands	• May require that lessees provide appropriate waste disposal and/or recycling containers at new or expanding marinas as part of the commercial lease approval process on lands under its jurisdiction. • May require lease covenants prohibiting sale of prepared food in polystyrene foam containers or packaging within the lease area as part of the lease approval process.
DPR	Div. 1, Chapter 1.25, Div. V, PRC §5000 et seq.	•	SPS	DPR operates and maintains units of the SPS that have boating-related activities.
DTSC (relates to Solid Waste MM, not Fish Waste MM)	• HSC, Div. 20 §§ 25100 et seq. • HSC, Div. 38 §§ 58000 et seq.	• Hazardous Waste Facilities Permits	Statewide	Regulates hazardous material transport, treatment, storage, and disposal; issues permits to operate to any person who stores, treats, or disposes of hazardous waste. Programs also encourage recycling of certain hazardous materials (e.g., used oil, spent batteries, etc.).

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The following BACKUP AUTHORITIES pertain to Marina Management Measures 4..2A and 4.2B				
Agency	**Authority**	**Programs**	**Implementing Area**	**Notes**
SWRCB/ RWQCB	PCWQCA (WC §§ 13000 et seq.)	• WQCP (Basin Plans) • WDRs • NPSMP • WMI	Statewide	• Enforcement tools: cleanup and abatement/cease and desist orders; admin. civil liability • RWQCB has primary responsibility for individual permits, inspection and enforcement: may prohibit discharges or place limits on discharge volume, area, timing, characteristics. • NPSMP's 3-tier approach to manage NPS pollution: **Tier 1**, Voluntary Implementation of management practices, **Tier 2**, Regulatory-Based Encouragement of management practices, **Tier 3**, Effluent Limitations.
DFG	FGC §§ 1 et seq. ♦ § 5650 ♦ §§ 12000-12002	• Enforcement • Reporting	Statewide	• Enforcement: citations by wardens • Reporting: DFG staff report chronic (sublethal, long-term) water pollution conditions to RWQCBs, and cooperate in obtaining corrections or abatements to the condition.
DHS	HSC §§ 100275, 115880, 116075, 112150 et seq.	Public beach and recreational water sanitation; shellfish beds	Coastal waters	Microbiological standards for beaches and recreational waters; microbiological standards for shellfish beds

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Other efforts that pertain to Marina Management Measure 4.2A and 4.2B				
Agency	Authority	Programs	Implementing Area	Notes
DBW	• HNC §§ 1 et seq. • FCVA	• (HWRF • CVAP • Other Financial, Technical Assistance, and Educational Programs	• SPS, SWP reservoirs and on other State lands. • Assists local governments Statewide.	• Authorized uses of HWRF loans related to implementing this MM are installation of receptacles for separating, reusing, or recycling solid waste materials.
CIWMB (relates to Solid Waste MM, not Fish Waste MM)	• PRC §§ 40400-49620, including CIWMA • CCR Title 14, Div. 7 and Title 27, Div. 2	• Diversion, Planning, and Local Assistance • HHW Grants	• Statewide	• Assists local governments in complying with CIWMA (to divert 50% of waste from landfills by the year 2000). • Provides model planning documents, workbooks, etc. on waste prevention, reduction, reuse, recycling, and safe disposal of HHWs. • Awards grants to implement programs that emphasize HHW waste source reduction or HHW reuse/recycling.
State/local/federal agency participation in MBNMS	• MPRSA (16 USC § 1431 et seq.)	MBNMS WQPP Action Plan for Marinas	MBNMS	The MBNMS WQPP is a collaborative effort of federal, State and local agencies and public and private groups to address NPS pollution in the region's watersheds. An MOA has been signed by: NOAA; USEPA, Region 9; Cal/EPA; SWRCB; RWQCB 2 (SFB); RWQCB 3 (Central Coast); CCC; and AMBAG.

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Marinas and Recreational Boating Management Measure 4.2C — Liquid Material Control
Provide and maintain appropriate storage, transfer, containment, and disposal facilities for liquid material—such as fuel, oil, solvents, antifreeze, and paints—and encourage recycling of these materials to the fullest extent possible.

Marinas and Recreational Boating Management Measure 4.2D — Petroleum Control
Reduce the amount of fuel and oil from boat bilges and fuel tank air vents entering marina and surface waters.

Agency	Authority	Programs	Implementing Area	Notes
Various State and Local	• CEQA (PRC §§ 21000 et seq.) • CEQA Guidelines (Title 14 CCR §§ 15000 et seq.)	Environmental review of "projects" using Initial Study (Environmental Checklists), EIR, or Negative Declaration	Statewide	• Environmental Checklists help to identify potential NPS impacts. • EIR or Negative Declaration may identify mitigation measures to address potential adverse impacts.
Cities/Counties (CA contains 58 counties and approximately 468 incorporated cities.)	• PZL (Gov. Code §§ 65000 et seq.) • SbMA (Gov. Code §§ 66410 et seq.) • CCA § 30500	• General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Leases on granted tide and submerged lands • Enforcement	• Statewide • LCP policies/ ordinances apply in coastal zone • Tide- /submerged lands granted in trust to cities and counties	• Cities/counties adopt policies/ ordinances; make land-use decisions consistent with State law. • Local governments may lease granted lands for marinas and may condition leases (e.g., to address assessment, siting, and design). • Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; general police powers to protect public health, safety and welfare and declare, prohibit, and abate nuisances.
SWRCB/ RWQCBs	• CWA (33 USC § 1251 et seq.) • PCWQCA (WC §§ 13000 et seq.)	• SWDP (CWA § 402) GMSWPs • TMDL Program [pursuant to CWA § 303(d)]	SWDP applies to: • cities >100,000 pop. (Phase I) • cities of 50,000 - 100,000 pop. (Phase II) TMDL programs apply in CWA § 303(d)-listed watersheds.	NPDES Permits (Phase I): • large/medium municipalities separate storm sewer systems NPDES Permits (Phase II): • smaller municipalities TMDL goals include: identify pollution sources in watersheds; allocate pollution control responsibilities where water quality goals are not met.

CCC	• CCA (PRC §§ 30000 et seq.) • CCC Administrative Regulations (Title 14 CCR §§ 13000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.) • OSPRA (Gov. Code §§ 8670.28 et seq.)	• Coastal development permits • LCP certification/ amendments • Federal consistency: review of federal actions affecting land or water uses or natural resources of the coastal zone • CCC/SFBCDC JOSP • Enforcement	Coastal zone (includes tidelands, submerged lands, public trust lands).	• CCC certifies LCPs prepared by coastal cities/counties. • Federal projects, permits and licenses must be found consistent with the CCMP before they are implemented. • Enforcement tools include: issue cease and desist/ restoration orders; file complaint for civil penalties.
SFBCDC	• MPA (Gov. Code §§ 66600 et seq.), including SFB Plan • SMPA (PRC §§ 29000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.) • OSPRA (Gov. Code §§ 8670.28 et seq.)	• Designation of priority uses adjacent to SFB • Permitting: development permits and marsh development permits • Federal consistency • CCC/SFBCDC JOSP • Enforcement	SFB (shoreline areas within 100 ft. of SFB; tidal areas and specified tributaries; Suisun Marsh)	• Enforcement and federal consistency authorities are similar to those of CCC.
DBW	• HNC §§ 1 et seq.	•		• It is a misdemeanor for any person to discharge oil (including fuel oil, oil sludge, and oil refuse) by any methods, means, or manner, into or upon the navigable waters of the State from any vessel (HNC § 133). • Any person that intentionally or negligently causes or permits any oil to be deposited in State waters is liable for civil penalties and cleanup costs (HNC § 151). • It is unlawful to transfer petroleum, chemicals, other hazardous substances between shore and a vessel unless the flow is continuously monitored as specified [HNC § 135(a)]. This section does not apply to: (a) fuel transfers to any self-propelled vessel < 65 feet in length, if the fueling facility is equipped with dispensing nozzles of the automatic shut-off type that do not have catch-locks and meet all federal standards;

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				(b) onshore tanks if appropriate containment or diversionary structures, or both, or other equipment that is adequate to prevent the overflowed substance from reaching State waters.
OSPR	• OSPRA (Gov. Code §§ 8670.28 et seq.); • PRC Div. 7.8; • Title 14 CCR §§ 815.01 et seq.; • OPA.	• Contingency Planning • Enforcement and Inspection	Statewide	• OSPR is lead State agency for oil spill prevention and response (responsibility shared with 22 agencies represented on SIOSC) • OSPR requires spill contingency plans for all marine facilities with potential discharge into the marine waters of the State. • OSPR enforces laws designed to prevent spills, responds to spills, and investigates spills. • OSPR/DFG wardens conduct spill investigations, gather and prepare evidence, and enforce the criminal statutes contained in the OSPRA (e.g., civil/criminal penalties for OSPRA violations).
DPR	•	•	SPS	DPR operates and maintains units of the SPS that have boating-related activities.
DTSC	• HSC, Div. 20 §§ 25100 et seq. • HSC, Div. 38 §§ 58000 et seq.	• Hazardous Waste Facilities Permits	• Statewide	Regulates hazardous material transport, treatment, storage, and disposal; issues permits to operate to any person who stores, treats, or disposes of hazardous waste. Programs also encourage recycling of certain hazardous materials (e.g., used oil, spent batteries, etc.).
SLC	• PRC §§ 6000 et seq. (includes lease authority)	• SLC leases (PRC §6501.1) • Marina Leasing Program	• Ungranted State sovereing lands	General lease provisions require lessees to be fully responsible for any hazardous wastes generated in the lease area and to comply with all applicable provisions of federal, State, and local law, regulation or ordinance dealing with such wastes or materials.

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The following BACKUP AUTHORITIES pertain to Marina Management Measures 4..2C and 4.2D				
Agency	**Authority**	**Programs**	**Implementing Area**	**Notes**
SWRCB/ RWQCB	PCWQCA (WC §§ 13000 et seq.)	• WQCP (Basin Plans) • WDRs • NPSMP • WMI	Statewide	• Enforcement tools: cleanup and abatement/cease and desist orders; admin. civil liability • RWQCB has primary responsibility for individual permits, inspection and enforcement: may prohibit discharges or place limits on discharge volume, area, timing, characteristics. • NPSMP's 3-tier approach to manage NPS pollution: **Tier 1**, Voluntary Implementation of management practices, **Tier 2**, Regulatory-Based Encouragement of management practices, **Tier 3**, Effluent Limitations.
DFG	FGC §§ 1 et seq. ◆ § 5650 ◆ §§ 12000-12002	• Enforcement • Reporting	Statewide	• Enforcement: citations by wardens • Reporting: DFG staff report chronic (sublethal, long-term) water pollution conditions to RWQCBs and cooperate in obtaining corrections or abatements to the condition.
DHS	HSC §§ 100275, 115880, 116075, 112150 et seq.	Public beach and recreational water sanitation; shellfish beds	Coastal waters	Microbiological standards for beaches and recreational waters; microbiological standards for shellfish beds

Other efforts that pertain to Marina Management Measure 4.2Cand 4.2D				
Agency	**Authority**	**Programs**	**Implementing Area**	**Notes**
DBW	• HNC §§ 1 et seq. • FCVA	• HWRF • CVAP • Other Financial, Technical Assistance, and Educational Programs	• SPS, SWP reservoirs and on other State lands. • Assists local governments Statewide.	• Authorized uses of HWRF loans related to implementing this MM are for oil recycling facilities.
DFG-OSPR	• OSPRA (Cal. Gov. Code §§ 8670.28 et seq.)	• Education-Outreach Program	Statewide	Education-Outreach Program is intended to assist operators of Small Craft Refueling Docks (SCRDs) (waterside operations serving primarily small craft of less than 20 meters in length and less than

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				5 tons net weight) in spill prevention and response efforts. Certified docks must make efforts to prevent spills, and must immediately report spills that occur to the U.S. Coast Guard (USCG) and Cal/OES. Information is provided through: (1) brochures/flyers/other written materials/ slide shows/telephone contact; (2) self-determined inspections by Oil Spill Prevention Specialists (OSPS) (who can identify strengths and weaknesses in a refueling dock's system and, when appropriate, show a dock operator ways to improve his/her ability to prevent and respond to spills); and (3) training.
CIWMB	• PRC §§ 40400-49620, including CIWMA • CCR Title 14, Div. 7 & Title 27, Div. 2	• Diversion, Planning, and Local Assistance • HHW Grants • Used Oil Grants • Used Oil Certification	• Statewide	• Assists local governments in complying with CIWMA (to divert 50% of waste from landfills by the year 2000). • Provides model planning documents, workbooks, etc. on waste prevention, reduction, reuse, recycling, and safe disposal of used oil and HHWs. • Awards used oil grants and grants to implement programs that emphasize HHW waste/source reduction and HHW reuse/recycling. • Provides incentives to centers that provide a convenient location for "do-it-yourselfers" to bring used oil for proper disposal or re-refining.
State/local/federal agency participation in MBNMS	• MPRSA (16 USC § 1431 et seq.)	• MBNMS WQPP Action Plan for Marinas	• MBNMS	The MBNMS WQPP is a collaborative effort of federal, State and local agencies and public and private groups to address NPS pollution in the region's watersheds. An MOA has been signed by: NOAA; USEPA, Region 9; Cal/EPA; SWRCB; RWQCB 2 (SFB); RWQCB 3 (Central Coast); CCC; and AMBAG.

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Marinas and Recreational Boating Management Measure 4.2E — Boat Cleaning and Maintenance				
For boats that are in the water, perform (1) topside cleaning and maintenance operations to minimize, to the extent practicable, the release to surface waters of (a) harmful products such as cleaners and solvents and (b) paint; and (2) underwater hull cleaning and maintenance operations to minimize, to the extent practicable, the release of paint and anodes.				
Agency	**Authority**	**Programs**	**Implementing Area**	**Notes**
Various State and Local	• CEQA (PRC §§ 21000 et seq.) • CEQA Guidelines (Title 14 CCR §§ 15000 et seq.)	Environmental review of "projects" using Initial Study (Environmental Checklists), EIR, or Negative Declaration	Statewide	• Environmental Checklists help to identify potential NPS impacts. • EIR or Negative Declaration may identify mitigation measures to address potential adverse impacts.
Cities/Counties (CA contains 58 counties and approximately 468 incorporated cities.)	• PZL (Gov. Code §§ 65000 et seq.) • SbMA (Gov. Code §§ 66410 et seq.) • CCA § 30500	• General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Leases on granted tide and submerged lands • Enforcement	• Statewide • LCP policies/ ordinances apply in coastal zone • Tide- /submerged lands granted in trust to cities and counties	• Cities/counties adopt policies/ ordinances; make land-use decisions consistent with State law. • Local governments may lease granted lands for marinas and may condition leases. • Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; general police powers to protect public health, safety and welfare and declare, prohibit, and abate nuisances.
SWRCB/ RWQCBs	• CWA (33 USC § 1251 et seq.) • PCWQCA (WC §§ 13000 et seq.)	• SWDP (CWA § 402) GMSWPs • TMDL Program [pursuant to CWA § 303(d)]	SWDP applies to: • cities >100,000 pop. (Phase I) • cities of 50,000 - 100,000 pop. (Phase II) TMDL programs apply in CWA § 303(d)-listed watersheds.	NPDES Permits (Phase I): • large/medium municipalities separate storm sewer systems NPDES Permits (Phase II): • smaller municipalities TMDL goals include: identify pollution sources in watersheds; allocate pollution control responsibilities where water quality goals are not met.
CCC	• CCA (PRC §§ 30000 et seq.) • CCC Administrative Regulations (Title 14 CCR §§ 13000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Coastal development permits • LCP certification/ amendments • Federal consistency: review of federal actions affecting land or water uses or natural resources of the coastal zone • Enforcement	Coastal zone (includes tidelands, submerged lands, public trust lands).	• CCC certifies LCPs prepared by coastal cities/counties. • Federal projects, permits and licenses must be found consistent with the CCMP before they are implemented. • Enforcement tools include: issue cease and desist/ restoration orders; file complaint for civil penalties.

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SFBCDC	• MPA (Gov. Code §§ 66600 et seq.), including SFB Plan • SMPA (PRC §§ 29000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Designation of priority uses adjacent to SFB • Permitting: development permits and marsh development permits • Federal consistency • Enforcement	SFB (shoreline areas within 100 ft. of SFB; tidal areas and specified tributaries; Suisun Marsh)	• Enforcement and federal consistency authorities are similar to those of CCC.
DPR	•		SPS	DPR operates and maintains units of the SPS that have boating-related activities.
DTSC	• HSC, Div. 20 §§ 25100 et seq. • HSC, Div. 38 §§ 58000 et seq.	• Hazardous Waste Facilities Permits	Statewide	Regulates hazardous material transport, treatment, storage, and disposal; issues permits to operate to any person who stores, treats, or disposes of hazardous waste. Programs also encourage recycling of certain hazardous materials (e.g., used oil, spent batteries, etc.).
SLC	• PRC §§ 6000 et seq. (includes lease authority)	• SLC leases (PRC §65101.1) • Marina Leasing Program •	• Ungranted State sovereign lands	• General lease provisions require lessees to be fully responsible for any hazardous wastes generated in the lease area and to comply with all applicable provisions of federal, State, and local law, regulation or ordinance dealing with such wastes or materials.

The following BACKUP AUTHORITIES pertain to Marina Management Measures 4..2E				
Agency	Authority	Programs	Implementing Area	Notes
SWRCB/ RWQCB	PCWQCA (WC §§ 13000 et seq.)	• WQCPs (Basin Plans) • WDRs • NPSMP • WMI	Statewide	• Enforcement tools: cleanup and abatement/cease and desist orders; admin. civil liability • RWQCB has primary responsibility for individual permits, inspection and enforcement: may prohibit discharges or place limits on discharge volume, area, timing, characteristics. • NPSMP's 3-tier approach to manage NPS pollution: **Tier 1**, Voluntary Implementation of management practices, **Tier 2**, Regulatory-Based Encouragement of management practices, **Tier 3**, Effluent Limitations.

DFG	FGC §§ 1 et seq. ♦ § 5650 ♦ §§ 12000-12002	• Enforcement • Reporting	Statewide	• Enforcement: citations by wardens • Reporting: DFG staff report chronic (sublethal, long-term) water pollution conditions to RWQCBs, and cooperate in obtaining corrections or abatements to the condition.
DHS	HSC §§ 100275, 115880, 116075, 112150 et seq.	Public beach and recreational water sanitation; shellfish beds	Coastal waters	Microbiological standards for beaches and recreational waters; microbiological standards for shellfish beds

Other efforts that pertain to Marina Management Measure 4.2E

Agency	Authority	Programs	Implementing Area	Notes
DBW	• HNC §§ 1 et seq. • FCVA	• HWRF • CVAP • Other Financial, Technical Assistance, and Educational Programs	• SPS, SWP reservoirs and on other State lands. • Assists local governments Statewide.	• Authorized uses of HWRF loans related to implementing this MM are receptacles for separating, reusing, or recycling solid waste materials, etc.
State/local/federal agency participa-tion in MBNMS	• MPRSA (16 USC § 1431 et seq.)	MBNMS WQPP Action Plan for Marinas	MBNMS	The MBNMS WQPP is a collaborative effort of federal, State and local agencies and public and private groups to address NPS pollution in the region's watersheds. An MOA has been signed by: NOAA; USEPA, Region 9; Cal/EPA; SWRCB; RWQCB 2 (SFB); RWQCB 3 (Central Coast); CCC; and AMBAG.

Marinas and Recreational Boating Management Measure 4.2F — Maintenance of Sewage Facilities
Ensure that sewage pumpout facilities are maintained in operational condition and encourage their use.

Agency	Authority	Programs	Implementing Area	Notes
Various State and Local	• CEQA (PRC §§ 21000 et seq.) • CEQA Guidelines (Title 14 CCR §§ 15000 et seq.)	Environmental review of "projects" using Initial Study (Environmental Checklists), EIR, or Negative Declaration	Statewide	• Environmental Checklists help to identify potential NPS impacts. • EIR or Negative Declaration may identify mitigation measures to address potential adverse impacts.
Cities/Counties (CA contains 58 counties and approximately 468 incorporated cities.)	• PZL (Gov. Code §§ 65000 et seq.) • SbMA (Gov. Code §§ 66410 et seq.) • CCA § 30500	• General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Leases on granted tide and submerged lands • Enforcement	• Statewide • LCP policies/ ordinances apply in coastal zone • Tide-submerged lands granted in trust to cities and counties	• Cities/counties adopt policies/ ordinances; make land-use decisions consistent with State law. • Local governments may lease granted lands for marinas and may condition leases. • Local Health Depts. have authority to inspect sewage disposal facilities. • Local Harbor Districts often maintain pumpout facilities and keep boat owners and harbor users appraised of the availability of the facility. • Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; general police powers to protect public health, safety and welfare and declare, prohibit, and abate nuisances.
SWRCB/ RWQCBs	• CWA (33 USC § 1251 et seq.) • PCWQCA (WC §§ 13000 et seq.)	• SWDP (CWA § 402) GMSWPs • TMDL Program [pursuant to CWA § 303(d)]	Storm Water Program applies to: • cities >100,000 pop. (Phase I) • cities of 50,000 - 100,000 pop. (Phase II) TMDL programs apply in CWA § 303(d)-listed watersheds.	NPDES Permits (Phase I): • large/medium municipalities separate storm sewer systems NPDES Permits (Phase II): • smaller municipalities TMDL goals include: identify pollution sources in watersheds; allocate pollution control responsibilities where water quality goals are not met.

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CCC	• CCA (PRC §§ 30000 et seq.) • CCC Administrative Regulations (Title 14 CCR §§ 13000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Coastal development permits • LCP certification/ amendments • Federal consistency: review of federal actions affecting land or water uses or natural resources of the coastal zone • Enforcement	Coastal zone (includes tidelands, submerged lands, public trust lands).	• CCC certifies LCPs prepared by coastal cities/counties. • Federal projects, permits and licenses must be found consistent with the CCMP before they are implemented. • Enforcement tools include: issue cease and desist/ restoration orders; file complaint for civil penalties.
SFBCDC	• MPA (Gov. Code §§ 66600 et seq.), including SFB Plan • SMPA (PRC §§ 29000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Designation of priority uses adjacent to SFB • Permitting: development permits and marsh development permits • Federal consistency • Enforcement	SFB (shoreline areas within 100 ft. of SFB; tidal areas and specified tributaries; Suisun Marsh)	• Enforcement and federal consistency authorities are similar to those of CCC.
DBW with RWQCBs, SWRCB, USFWS, and all peace officers, State and local public health officers, and boating law enforcement officers as specified	• HNC §§ 1 et seq. • FCVA • HSC §§ 11750-117525		• Statewide	• Vessel pumpout facilities for the transfer and disposal of sewage from marine sanitation devices shall be operated and maintained in a manner that will prevent the discharge of any sewage to the waters of the State and shall be maintained in good working order and regularly cleaned [HNC § 777(a)] • Every vessel pumpout facility shall have a notice posted on the facility identifying the city, county, local public health officer, or boating law enforcement officer responsible for enforcement [HNC § 777(b)]. • The SWRCB shall adopt standards for the location, construction, operation, and maintenance of vessel pumpout facilities (HNC § 778). • Every peace officer of the State and of any city, county, or other public agency, all State and local public health officers, and all boating law enforcement officers shall enforce this chapter of the HNC and any adopted regulations (HNC § 779). Nothing in

				this chapter of the HNC precludes the regulation of houseboats as defined in State law. • DBW guidelines pursuant to HNC § 775 et seq. are incorporated into the CSVDP. • No person shall place, deposit, or dump any human excreta in or upon the navigable waters of the State, that are within any marina, yacht harbor, fresh water lake, or fresh water impoundment, form any vessel tied to any dock, slip, or wharf that has toilet facilities available for the use of persons on the vessel (HSC § 117520)
DPR	Div. 1, Chapter 1.25, Div. V, PRC §5000 et seq.	•	SPS	DPR operates and maintains units of the SPS that have boating-related activities.
SLC	• PRC §§ 6000 et seq. (includes lease authority)	• SLC leases (PRC §6501.1) • Marina Leasing Program •	• Ungranted State soveriegn lands	• General lease provisions require lessees to be fully responsible for any hazardous wastes generated in the lease area and to comply with all applicable provisions of federal, State, and local law, regulation or ordinance dealing with such wastes or materials.

The following BACKUP AUTHORITIES pertain to Marina Management Measures 4..2F				
Agency	**Authority**	**Programs**	**Implementing Area**	**Notes**
SWRCB/ RWQCB	PCWQCA (WC §§ 13000 et seq.)	• WQCP • WDRs • NPSMP • WMI	Statewide	• Enforcement tools: cleanup and abatement/cease and desist orders; admin. civil liability • RWQCB has primary responsibility for individual permits, inspection and enforcement: may prohibit discharges or place limits on discharge volume, area, timing, characteristics. • NPSMP's three-tier approach to manage NPS pollution: **Tier 1**, Voluntary Implementation of management practices, **Tier 2**, Regulatory-Based Encouragement of management practices, **Tier 3**, Effluent Limitations.
DFG	FGC §§ 1 et seq. ♦ § 5650 ♦ §§ 12000-12002	• Enforcement • Reporting	Statewide	• Enforcement: citations by wardens • Reporting: DFG staff report chronic (sublethal, long-term) water pollution conditions to RWQCBs and cooperate in obtaining corrections or abatements to the condition.
DHS	HSC §§ 100275, 115880, 116075, 112150 et seq.	Public beach and recreational water sanitation; shellfish beds	Coastal waters	Microbiological standards for beaches and recreational waters; microbiological standards for shellfish beds

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Other efforts that pertain to Marina Management Measure 4.2F				
Agency	**Authority**	**Programs**	**Implementing Area**	**Notes**
DBW	• HNC §§ 1 et seq. • FCVA	• HWRF • CVAP • Other Financial, Technical Assistance, and Educational Programs	• SPS, SWP reservoirs and on other State lands. • Assists local governments Statewide.	• Under the CVAP, DBW helps fund the construction, renovation, operation, and maintenance of pumpout/dump stations to service pleasure craft. • Authorized uses of HWRF loans related to implementing this MM are: restrooms, vessel pumpout facilities. • DBW provides educational materials regarding vessel pumpout locations and use, and pamphlets that review State/federal marine pollution laws. The pamphlet *Shipshape Sanitation, MSDs and Pumpouts* explains laws and regulations for MSDs and vessel sewage discharge and the importance of proper disposal.
State/local/federal agency participa-tion in MBNMS	• MPRSA (16 USC § 1431 et seq.)	MBNMS WQPP Action Plan for Marinas	MBNMS	The MBNMS WQPP is a collaborative effort of federal, State and local agencies and public and private groups to address NPS pollution in the region's watersheds. An MOA has been signed by: NOAA; USEPA, Region 9; Cal/EPA; SWRCB; RWQCB 2 (SFB); RWQCB 3 (Central Coast); CCC; and AMBAG.

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Marinas and Recreational Boating Management Measure 4.2G — Boat Operation
Restrict boating activities where necessary to decrease turbidity and physical destruction of shallow-water habitat.

Agency	Authority	Programs	Implementing Area	Notes
Cities/Counties (CA contains 58 counties and approximately 468 incorporated cities.)	• PZL (Gov. Code §§ 65000 et seq.) • SbMA (Gov. Code §§ 66410 et seq.) • CCA § 30500	• General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Leases on granted tide and submerged lands • Enforcement	• Statewide • LCP policies/ ordinances apply in coastal zone • Tide-submerged lands granted in trust to cities and counties	• Cities/counties can adopt policies/ ordinances, and can condition leases for marinas on granted lands, to address boat operations at marinas. • Enforcement tools include: inspections; fines; infractions; misdemeanors; general police powers to protect public health, safety and welfare and declare, prohibit, and abate nuisances.
DPR	•	•	SPS	DPR operates and maintains units of the SPS that have boating-related activities.
The following BACKUP AUTHORITIES pertain to Marina Management Measures 4.2G				
DBW	• HNC §§ 1 et seq.		Statewide	DBW promotes boating safety and education as part of its mission to ensure that boating is as safe as possible. The agency sponsors boating law enforcement to ensure that California boating laws are enforced uniformly throughout the State, and provides supplemental State funding to local governments for marine patrols.

Marinas and Recreational Boating Management Measure 4.3A — Public Education/Outreach
Implement educational programs to provide greater understanding of watersheds, and to raise awareness and increase the use of applicable marina and boating management measures and practices where needed to control and prevent adverse impacts to ground and surface water. Public education, outreach, and training programs should involve applicable user groups and the community (e.g., boaters, boating groups, marina owners and operators, boat maintenance facility operators, waterfront agencies, service providers, live-aboards, environmental community and other related groups). [Refer to the Marinas and Recreational Boating Management Measures 4.1 – 4.2 listed in this document.]

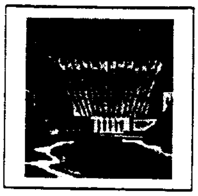
Efforts that pertain to Management Measure 4.3A — Education/Outreach: Public Education

Agency	Authorities (•) and Programs (♦)	Implementing Area	Notes
Local Governments (Cities and Counties)	Many programs, including the following: ♦ SFB/Southern CA NPDES stormwater programs (education/outreach efforts to reduce pollution from litter and improper disposal into storm drains). ♦ HHW collection facilities (includes education, waste disposal, facility inspection).	Varies Statewide	• Many local governments maintain planning, community liaison or public education/information staff to organize special projects (e.g., management practice handbooks). • Many local harbor departments/harbor patrols maintain harbor facilities, coordinate federal dredging activities, administer tidelands lease sites, and provide boater assistance and emergency response, including water safety, education, and school and community outreach programs.
CCC	• CCA (PRC §§ 30000 et seq.) ♦ Conservation Education Program (PRC§ 30012) ♦ Boater Education Program ♦ *Boating and Clean Green Campaign (BCGC)* ♦ Coastal Cleanup Day ♦ Adopt-A-Beach program ♦ Save Our Seas curriculum	• Coastal zone/ Statewide (e.g., throughout the San Francisco Bay/Delta, Los Angeles County, Orange County, San Diego County, and other areas).	• CCC programs promote conservation awareness, recycling, and litter abatement efforts through community involvement and environmental education efforts/materials. • *BCGC* is a Statewide campaign intended to: (1) facilitate installation of new services at marinas to help boaters prevent emissions of oil and other pollutants into State waters; and (2) educate boaters to use these services and other practices that reduce the pollution associated with boating. *BCGC* staff have: (1) researched practices and awareness of boaters related to managing used oil and preventing oil/fuel discharges; (2) presented boater used oil management and spill prevention strategies to local government and marina operators; (3) developed "boater kits" containing bilge pads, environmental/safety information for boaters, etc.; and (4) helped hand out boater kits from the SF Baykeeper's "green" boat (a natural gas-powered boat maintained/retrofitted using environmentally sound products/equipment).

CIWMB	• CIWMA (PRC §§ 40400-49620), including CIWMA • CCR Title 14, Div. 7 and Title 27, Div. 2 ♦ Diversion, Planning, and Local Assistance ♦ HHW Grants and Used Oil Grants ♦ Used Oil Certification ♦ Waste Reduction Program	Statewide at local level	• Helps local governments in CIWMA compliance (to divert 50% of waste from landfills by year 2000). • Provides model planning documents, workbooks, etc. on waste prevention, reduction, reuse, recycling, and safe disposal of used oil and HHWs. • Awards used oil grants and grants to implement programs that emphasize HHW waste/source reduction and HHW reuse/recycling. • Provides incentives to centers that provide a convenient location for "do-it-yourselfers" to bring used oil for proper disposal or re-refining.
DBW	• HNC §§ 1 et seq. • FCVA ♦ HWRF ♦ Clean Vessel Act Pumpout Grant Program ♦ Aquatic Safety Educational Program (AquaSMART) for K-12 students in CA public schools. ♦ Other Financial, Technical Assistance, and Educational Programs	• SPS, SWP reservoirs and on other State lands. • Assists local governments Statewide.	• DBW plans, designs, finances, and constructs State boating facilities and coordinates with local governments to develop local boating facilities. Financing includes boating facility construction loans, boat launching facility grants, marina construction loans, and capital outlay projects. • DBW provides educational materials regarding vessel pumpout locations and use and pamphlets that review State/federal marine pollution laws [e.g., the pamphlet *Shipshape Sanitation, MSDs and Pumpouts* explains laws and regulations for Marine Sanitation Devices and vessel sewage discharge, and the importance of proper disposal].
DFG-OSPR	• OSPRA (Cal. Gov. Code §§ 8670.28 et seq.); ♦ Education-Outreach Program	Statewide	Education-Outreach Program is intended to assist operators of SCRDs (waterside operations serving primarily small craft of less than 20 meters in length and less than 5 tons net weight) in spill prevention/response efforts. Certified docks must make efforts to prevent spills, and must report spills that occur to the USCG and Cal/OES. Information is provided through: (1) brochures/flyers/other materials/slide shows/ telephone contact; (2) self-determined inspections by OSPS (who can identify strengths and weaknesses in a refueling dock's system, and when appropriate show a dock operator ways to improve his/her ability to prevent and respond to spills); and (3) training.

DTSC **Cal/EPA** **USEPA** **CA Community Colleges**	• HSC §§ 58000 et seq. • HSC §§ 25100 et seq. ♦ Hazardous Waste Generator/Small Business Outreach Workshops ♦ California Compliance School	Statewide	• Hazardous waste management workshops for businesses • Classes/workbook and hands-on training for individuals who manage/work with hazardous wastes
State/local/federal agency participation in CA's • **NMSs** • **NERRs** • **NEPs**	• MPRSA (16 USC § 1431 et seq.) • CZMA § 315 • CWA § 320 (33 USC § 1330) ♦ MBNMS WQPP ♦ Santa Monica Bay Restoration Project (SMBRP) ♦ San Francisco Estuary Project (SFEP)	NMSs: • Monterey Bay • Channel Islands • Cordell Bank/ Gulf of the Farallones NERRs: • Elkhorn Slough • Tijuana River NEPs: • Santa Monica Bay (SMB), SFBand Morro Bay	• See MBNMS WQPP Action Plan for Marinas • The MBNMS WQPP is a collaborative effort of federal, state, and local agencies and public and private groups to address NPS pollution in the region's watersheds. An MOA has been signed by: NOAA; USEPA, Region 9; Cal/EPA; SWRCB; RWQCB 2 (SFB); RWQCB 3 (Central Coast); CCC; and AMBAG. • The National Estuary Program (NEP) provides impetus, funding, and technical assistance for the management of nationally significant estuaries.
California Clean Boating Network (CCBN)			The CCBN (comprised of public members and CCC, SLC, DFG, DBW, NOAA, USCG, and other agency staffs) conducts public outreach, including the development and distribution to marinas and other users of the marine environment of a binder that includes exemplary education products that address pollutants associated with marina and boater activity.
DPR	Div. 1, Chapter 1.25, Div. V, PRC §5000 et seq.	SPS	DPR has an extensive educational program that includes talks, displays, curriculum development and special programs.

Hydromodification Management Measures



The SWRCB, CCC, and other State agencies have identified eight management measures (MMs) to address hydromodification sources of nonpoint pollution affecting State waters. Hydromodification includes modification of stream and river channels, dams and water impoundments, and streambank/shoreline erosion.

Channel modification activities are undertaken in rivers or streams to straighten, enlarge, deepen or relocate the channel. These activities can affect water temperature, change the natural supply of fresh water to a water body, and alter rates and paths of sediment erosion, transport, and deposition. Hardening the banks of waterways with shoreline protection or armor also accelerates the movement of surface water and pollutants from the upper reaches of watersheds into coastal waters. Channelization can also reduce the suitability of instream and streamside habitat for fish and wildlife by depriving wetlands and estuarine shorelines of enriching sediments, affecting the ability of natural systems to filter pollutants, and interrupting the life stages of aquatic organisms (USEPA, 1993).

California's MMs to address sources of nonpoint pollution related to hydromodification activities:

5.1 Channelization/Channel Modification
- A. Physical & Chemical Characteristics of Surface Waters
- B. Instream & Riparian Habitat Restoration

5.2 Dams
- A. Erosion & Sediment Control
- B. Chemical & Pollutant Control
- C. Protection of Surface Water Quality & Instream and Riparian Habitat

5.3 Streambank & Shoreline Erosion
- A. Eroding Streambanks & Shorelines

5.4 Education/Outreach
- A. Educational Programs

Dams can adversely impact hydrology and the quality of surface waters and riparian habitat in the waterways where the dams are located. A variety of impacts can result from the siting, construction, and operation of these facilities. For example, improper siting of dams can inundate both upstream and downstream areas of a waterway. Dams reduce downstream flows, thus depriving wetlands and riparian areas of water. During dam construction, removal of vegetation and disturbance of underlying sediments can increase turbidity and cause excessive sedimentation in the waterway.
The erosion of shorelines and streambanks is a natural process that can have either beneficial or adverse impacts on riparian habitat. Excessively high sediment loads resulting from erosion can smother submerged aquatic vegetation, cover shellfish beds and tidal flats, fill in riffle pools, and contribute to increased levels of turbidity and nutrients.

Management Measures:

Channelization/Channel Modification. California's management measures for channelization and channel modification promote the evaluation of channelization and channel modification projects. Channels should be evaluated as a part of the watershed planning and design processes, including watershed changes from new development in urban areas, agricultural drainage, or forest clearing. The purpose of the evaluation is to determine whether resulting NPS changes to surface water quality or instream and riparian habitat can be expected and whether these changes will be good or bad. Existing channelization and channel modification projects can be evaluated

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to determine the NPS impacts and benefits associated with the projects. Modifications to existing projects, including operation and maintenance or management, can also be evaluated to determine the possibility of improving some or all of the impacts without changing the existing benefits or creating additional problems. In both new and existing channelization and channel modification projects, evaluation of benefits and/or problems will be site-specific.

Dams. The second category of management measures address NPS pollution associated with dams. Dams are defined as constructed impoundments that are either (1) 25 feet or more in height *and* greater than 15 acre-feet in capacity, or (2) 6 feet or more in height *and* greater than 50 acre-feet in capacity. MMs 5.2A and 5.2B address two problems associated with dam construction: (1) increases in sediment delivery downstream resulting from construction and operation activities and (2) spillage of chemicals and other pollutants to the waterway during construction and operation. MM 5.2C addresses the impacts of reservoir releases on the quality of surface waters and instream and riparian habitat in downstream.

Streambank and Shoreline Erosion. The third category of hydromodification measures addresses the stabilization of eroding streambanks and shorelines in areas where streambank and shoreline erosion creates a polluted runoff problem. Bioengineering methods such as marsh creation and vegetative bank stabilization are preferred. Streambank and shoreline features that have the potential to reduce polluted runoff shall be protected from impacts, including erosion and sedimentation resulting from uses of uplands or adjacent surface waters. This MM does not imply that all shoreline and streambank erosion must be controlled; the measure applies to eroding shorelines and streambanks that constitute an NPS problem in surface waters.

Education/Outreach. MM 5.4A focuses on the development and implementation of pollution prevention and education programs for agency staffs and the public, as well as the promotion of assistance tools that emphasize restoration and low-impact development. Education, technical assistance, incentives, and other means can be used to promote projects that reduce NPS pollutants, which retain or re-establish natural hydrologic functions (e.g., channel restoration projects and low-impact development projects), and/or which prevent and restore adverse effects of hydromodification activities.

5. HYDROMODIFICATION

IMPLEMENTATION AUTHORITIES

5.1 **Channelization and Channel Modification**

A. Physical and Chemical Characteristics of Surface Waters

B. Instream and Riparian Habitat Restoration

5.2 **Dams**

A. Erosion and Sediment Control

B. Chemical and Pollutant Control

C. Protection of Surface Water Quality and Instream and Riparian Habitat

5.3 **Streambank and Shoreline Erosion**

A. Eroding Streambanks and Shorelines

5.4 **Education/Outreach**

A. Educational Programs

Hydromodification Management Measure 5.1A — Physical and Chemical Characteristics of Surface Waters

1. Evaluate the potential effects of proposed channelization and channel modification on the physical and chemical characteristics of surface waters;
2. Plan and design channelization and channel modification to reduce undesirable impacts;
3. Develop an operation and maintenance program for existing modified channels that includes identification and implementation of opportunities to improve physical and chemical characteristics of surface waters in those channels.

Hydromodification Management Measure 5.1B — Instream and Riparian Habitat Restoration

1. Evaluate the potential effects of proposed channelization and channel modification on instream and riparian habitat;
2. Plan and design channelization and channel modification to reduce undesirable impacts;
3. Develop an operation and maintenance program with specific timetables for existing modified channels that includes identification of opportunities to restore instream and riparian habitat in those channels.

Hydromodification Management Measure 5.3A — Eroding Streambanks and Shorelines

1. Where streambank or shoreline erosion is a NPS problem, streambanks and shorelines should be stabilized. The use of vegetative stabilization methods is strongly preferred over the use of structural stabilization methods, if appropriate considering the climate, severity of wave and wind erosion, offshore bathymetry, and the potential adverse impact on other streambanks, shorelines and offshore areas.
2. Protect streambank and shoreline features with the potential to reduce NPS pollution.
3. Protect streambanks and shorelines from erosion due to uses of either the shorelands or adjacent surface waters.

Agency	Authority	Programs	Implementing Area	Notes
RWQCB	CEQA (PRC §§21000 to 21177)	Environmental Review	Statewide	Comments on impacts of hydromodification
SWRCB/RWQCB	CWA §401	WQCrP	Statewide	• Regulate impacts of hydromodification projects. • Develop relevant CEQA guidance • Establish interagency agreements • Develop technical assistance/guidance • Address activities which impact the physical characteristics of waters, e.g., gravel mining, floodplain encroachment.

Various State and Local	• CEQA (PRC §§ 21000 et seq.) • CEQA Guidelines (Title 14 CCR §§ 15000 et seq.)	Environmental review of "projects" using Initial Study (Environmental Checklists), EIR, or Negative Declaration	Statewide	• Environmental Checklists help to identify potential NPS impacts. • EIR or Negative Declaration may identify mitigation measures to address potential adverse impacts.
Cities/Counties (CA contains 58 counties and approximately 468 incorporated cities.)	• PZL (Gov. Code §§ 65000 et seq.) • SbMA (Gov. Code §§ 66410 et seq.) • CCA § 30500	• General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Enforcement	• Statewide • LCP policies/ ordinances apply in coastal zone	• Cities/counties adopt policies/ ordinances; make land-use decisions consistent with State law. • Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; and general police powers to protect public health, safety and welfare and declare, prohibit, abate nuisances.
CCC	• CCA (PRC §§ 30000 et seq.) • CCC Administrative Regulations (Title 14 CCR §§ 13000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Coastal development permits • LCP certification/ amendments • Federal consistency: review of federal actions affecting land or water uses or natural resources of the coastal zone • Enforcement	Coastal zone (includes tidelands, submerged lands, public trust lands).	• CCC certifies LCPs prepared by coastal cities/counties. • Federal projects, permits and licenses must be found consistent with the CCMP before they are implemented. • Enforcement tools include: issue cease and desist/ restoration orders; file complaint for civil penalties.
SFBCDC	• MPA (Gov. Code §§ 66600 et seq.), including SFB Plan • SMPA (PRC §§ 29000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Designation of priority uses adjacent to Bay • Permitting: development permits and marsh development permits • Federal consistency authority • Enforcement	SFB (shoreline areas within 100 ft. of Bay; tidal areas and specified tributaries; Suisun Marsh)	• SFBCDC has regulatory authority over channelization/channel modification projects involving dredge and fill activities within its jurisdiction. • Enforcement/federal consistency authorities similar to CCC.

DFG	FGC §§ 1 et seq. • FGC §§ 1600-1607	• Streambed alteration permits for grading, filling, dredging activities in State waters or stream beds • MOU between DFG, DWR Cal/RA, and State Reclamation Board (SRB) to implement habitat protection provisions	Statewide: State waters or stream beds	• FGC focuses on problems including control of erosion and sedimentation (e.g., from grading, construction sites, golf courses, road cuts, etc.).
SLC	• PRC §§ 6000 et seq. (includes lease authority)	• SLC leases (PRC §6303) Maintenance dredging • SLC leases (PRC §6890) San and gravel extraction leasing	• Granted Lands with minderals reserved and ungranted State sovereign lands	• Dreding lease activity is contingent upon applicant's compliance with permits, recommendations, or limitations issued by federal, State, and local governments including compliance with CEQA. • Commercial extraction of hard minerals, excluding oil, gas, and geothermal, is contingent upon applicant's compliance with permits, recommendation, or limitations issued by federal, State, and local governments including compliance with CEQA,
SCC	PRC Chapter 6, Div 21	CREP	Coastal zone and coastal watersheds, statewide	Through its watershed and wetland enhancement plans, the SCC stabilizes streambanks and shorelines, using vegetative methods, and protects streambanks and shorelines from erosion by acquiring properties to prevent future alteration of native vegetative cover.

The following BACKUP AUTHORITIES/PROGRAMS pertain to MMs 5.1A, 5.1B, and 5.3A				
SWRCB/RWQCBs	• PCWQCA (WC §§ 13000 et seq.) • CWA (33 USC § 1251 et seq.)	• NPSMP pursuant to CWA § 319 and other NPS planning efforts (CWA § 208, CZARA) • TMDL Program pursuant to CWA § 303(d) • Storm Water Management Plan (SWMP) and SWDP/NPDES Permits pursuant to WC § 13377 and CWA § 402 • WDRs (WC § 13263) • Water Quality Standards pursuant to WC § 13170 and CWA § 303(c)(1) • Basin Plan • WMI • Water Quality Certification (WQCr) under CWA §401	• Statewide • Stormwater Discharge Program applies to municipalities > 100,000 population	• Enforcement tools: cleanup and abatement/cease and desist orders; admin. civil liability • Under CWA § 401, SWRCB can regulate through certification any proposed federally-permitted activity which may impact water quality. • RWQCBs have primary responsibility for individual permitting, inspection and enforcement: may impose discharge prohibitions, and other limits on characteristics, volume, area, or timing of discharge.
DPR	Div. 1, **Chapter** 1.25, Div. V, **PRC §5000 et** seq.		SPS	DPR operates and maintains units of the SPS that has hydromodification activities.
DHS	HSC **§§** 116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.

Other Efforts that pertain to MMs 5.1A, 5.1B, and 5.3A				
DWR		• Urban Streams Restoration Project (USRP) • MOU between DWR, DFG Cal/RA, and SRB to implement habitat protection provisions	Statewide	DWR works with citizens and local government agencies to address water-related problems of urban streams (including modified channels) such as bank erosion and sedimentation, and offers grants for projects that solve urban creek problems and restore natural environmental values.
SCC	• PRC §§ 31000 et seq.	• Acquire interest in land (PRC §§ 32204.1, 31105) • Conduct resource enhancement projects (PRC § 31251)	Coastal zone and coastal watershed areas outside coastal zone (PRC § 31251.2)	SCC addresses channelization/ channel modification MMs through its resource enhancement program.

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Hydromodification Management Measure 5.2A — Dams: Erosion and Sediment Control

1. Reduce erosion and, to the extent practicable, retain sediment onsite during and after construction, and
2. Prior to land disturbance, prepare and implement an approved erosion and sediment control plan or similar administrative document that contains erosion and sediment control provisions.

Hydromodification Management Measure 5.2B — Dams: Chemical and Pollutant Control

1. Limit application, generation, and migration of toxic substances;
2. Ensure the proper storage and disposal of toxic materials; and
3. Apply nutrients at rates necessary to establish and maintain vegetation without causing significant nutrient runoff to surface waters.

Hydromodification Management Measure 5.2C — Dams: Protection of Surface Water Quality and Instream and Riparian Habitat

Develop and implement a program to manage the operation of dams in coastal areas that includes an assessment of:

1. Surface water quality and instream and riparian habitat and potential for improvement and
2. Significant nonpoint source pollution problems that result from excessive surface water withdrawals.

Agency	Authority	Programs	Implementing Area	Notes
SWRCB/RWQCB	CWA § 401	WQCP	Statewide	
SWRCB/RWQCB	PCWQCA	WDRs	Statewide	
SWRCB/RWQCB	PRC §§ 20000 et seq.	CEQA	Statewide	
SWRCB/RWQCB	WC §§ 1-12000	Water Right Permit	Statewide	
DFG	FGC §§ 1601-1603	Permit to work in a stream	Statewide	

The following are BACKUP AUTHORITIES that pertain to MMs 5.2A, 5.2B, and 5.2C.

Agency	Authority	Programs	Implementing Area	Notes
DWR, SRB, DFG, CA Cal/RA	SB 34	Delta Flood Protection Plan of 1998 (DFPP)	Statewide	
Wildlife Conservation Board (WCB)	FGC §§ 1300 et seq.	Wildlife Conservation Law of 1947 (WCL)	Statewide	
DHS	HSC § 116275 et seq.	Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.

Hydromodification Management Measure 5.4A. Educational Programs

Implement educational programs to provide greater understanding of watersheds, to raise awareness and increase the use of applicable hydromodification management measures and practices where needed to control and prevent adverse impacts to surface and ground water, and to promote projects which retain or re-establish natural hydrologic functions (e.g., channel restoration projects). Public education, outreach, and training programs should involve applicable user groups and the community.

[Refer to the Hydromodification Management Measures 5.1 – 5.3 listed in this document.]

Agency	Authority	Programs	Implementing Area	Notes
Local Governments (Cities and Counties)			Varies Statewide	Some local governments maintain planning, community liaison, and public education/ information staff to organize special projects (e.g.., BMP handbooks)
SWRCB/RWQCBs	• PCWQCA [WC §§ 13000 et seq.]	• Education	Statewide	PCWQCA establishes comprehensive programs for the protection of water quality and beneficial uses of water
CCC	• CCA (PRC §§ 30000 et seq.), particularly §§ 30012 and 30006.5	• Education • Technical Assistance	Coastal zone	The CCC has prepared several Procedural Guidance Manuals and reports that address activities related to hydromodification, instream and riparian habitat areas, and eroding shoreline/streambanks
DFG	• FGC §§ 1600 et seq.	• Education and Technical/ Financial Assistance	Statewide	
DWR		• USRP • Water Education Program • Model Water Efficient Landscape Ordinance (MWELO)	Statewide	• DWR works with citizens and local government agencies to address water-related problems of urban streams (including modified channels) such as bank erosion and sedimentation, and offers grants for projects that solve urban creek problems and restore natural environmental values. • DWR provides technical assistance to local water districts in planning, organizing and implementing water education and conservation programs for schools and the general public.

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SCC	• PRC §§ 31000 et seq.	• Education and Technical/ Financial Assistance	Coastal zone and coastal watershed areas outside coastal zone (PRC § 31251.2)	• SCC protects wetlands by funding wetland, stream and riparian restoration projects.
SLC	• PRC §§ 6000 et seq.	• Education	State tidelands and submerged lands	•
State/local/federal agency participation in CA's NMSs, NERRs, and NEPs	• MPRSA (16 USC § 1431 et seq.) • CZMA § 315 • CWA § 320 (33 USC § 1330)	• MBNMS WQPPP • SMBRP • SFEP	• NMSs: • Monterey Bay • Channel Islands • Cordell Bank/ Gulf of the Farallones • NERRs: • Elkhorn Slough • Tijuana River • NEPs: • SMB, SFB and Morro Bay	• The MBNMS WQPP is a collaborative effort of federal, State and local agencies and public and private groups to address NPS pollution in the region's watersheds. An MOA has been signed by: NOAA; USEPA, Region 9; Cal/EPA; SWRCB; RWQCB 2 (SFB); RWQCB 3 (Central Coast); CCC; and AMBAG. • Overall goal of management activities on NMSs and NERRs is to preserve, restore, and enhance functions and values attributable to riparian areas and wetlands [including receiving waters detoxification, flood water retention, research, recreation, and provision of habitat]. • NEP provides impetus, funding, and technical assistance for the management of nationally significant estuaries.
The following are BACKUP AUTHORITIES that pertain to MM 5.4A.				
DHS	• HSC § 116275 et seq.	• Drinking water source assessment and protection; drinking water sampling and analysis; regulation of public drinking water systems	• Watersheds associated with drinking water sources	• Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.

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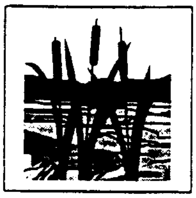
Wetlands, Riparian Areas, & Vegetated Treatment Systems Management Measures



The SWRCB, CCC, and other State agencies have identified four management measures (MMs) to promote the protection and restoration of wetlands and riparian areas and the use of vegetated treatment systems as means to control nonpoint sources of pollution. Wetlands and riparian areas reduce polluted runoff by filtering out runoff-related contaminants such as sediment, nitrogen and phosphorus; thus maintaining the water quality benefits of these areas is important. These areas also help to attenuate flows from higher-than-average storm events. This protects downstream areas from adverse impacts such as channel scour, erosion and temperature and chemical fluctuations. Changes in hydrology, substrate, geochemistry, or species composition can impair the ability of wetland or riparian areas to filter out excess sediment and nutrients, and so can result in deteriorated water quality. The following activities can cause such impairment: drainage of wetlands for cropland, overgrazing, hydromodification, highway construction, deposition of dredged material, and excavation for ports and marinas.

California's MMs to protect and restore wetlands and riparian areas and use vegetated treatment systems as means to control pollution from nonpoint sources:

6A. Protection of Wetlands & Riparian Areas

6B. Restoration of Wetlands & Riparian Areas

6C. Vegetated Treatment Systems

6D. Education/Outreach

Management Measures:

Wetlands/Riparian Areas Protection. Implementation of MM 6A is intended to protect the existing water quality improvement functions of wetlands and riparian areas as a component of NPS programs.

Wetlands/Riparian Areas Restoration. Restoration of wetlands and riparian areas (MM 6B) refers to the recovery of a range of functions that existed previously by reestablishing hydrology, vegetation, and structure characteristics. Damaged or destroyed wetland and riparian areas should be restored where restoration of such systems will significantly abate polluted runoff.

Vegetated Treatment Systems. MM 6C promotes the installation of vegetated treatment systems (e.g., artificial or constructed wetlands) in areas where these systems will serve a polluted runoff-abatement function. Vegetated filter strips and engineered wetlands remove sediment and other pollutants from runoff and wastewater, and prevent pollutants from entering adjacent waterbodies. Removal typically occurs through filtration, deposition, infiltration, absorption, adsorption, decomposition and volatilization.

Education/Outreach. MM 6D promotes the establishment of programs to develop and disseminate scientific information on wetlands and riparian areas and to develop greater public and agency staff understanding of natural hydrologic systems—including their functions and values, how they are lost, and the choices associated with their protection and restoration.

6.0 WETLANDS, RIPARIAN AREAS, AND VEGETATED TREATMENT SYSTEMS

IMPLEMENTATION AUTHORITIES

Management Measures

6A. Protection of Wetlands and Riparian Areas

6B. Restoration of Wetlands and Riparian Areas

6C. Vegetated Treatment Systems

6D. Education/Outreach

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Management Measure 6A — Protection of Wetlands and Riparian Areas
Protect from adverse effects wetlands and riparian areas that serve to reduce NPS pollution; maintain this function while protecting the other existing functions of these wetlands and riparian areas as measured by characteristics such as vegetative species composition, diversity, and cover, hydrology and quality of surface water and ground water, geochemistry of the substrate, and fauna species composition, diversity, and abundance.

Management Measure 6B — Restoration of Wetlands and Riparian Areas
Promote the restoration of the pre-existing functions in damaged and destroyed wetlands and riparian systems in areas where the systems will serve to reduce NPS pollution.

Management Measure 6C — Vegetated Treatment Systems
Promote the use of engineered vegetated treatment systems such as constructed wetlands or vegetated filter strips where these systems will serve to reduce NPS pollution.

Agency	Authority	Programs	Implementing Area	Notes
Various State and Local	• CEQA (PRC §§ 21000 et seq.) • CEQA Guidelines (Title 14 CCR §§ 15000 et seq.)	Environmental review of "projects" using Initial Study (Environmental Checklists), EIR, or Negative Declaration	Statewide	• Environmental Checklists help to identify potential NPS impacts. • EIR or Negative Declaration may identify mitigation measures to protect/ restore wetlands or use vegetated treatment systems.
Cities/Counties (CA contains 58 counties and approximately 468 incorporated cities.)	• PZL (Gov. Code §§ 65000 et seq.) • SbMA (Gov. Code §§ 66410 et seq.) • CCA § 30500	• General Plans/GP updates • LCPs/LCP amendments • Zoning ordinances • Subdivision ordinances • Permits pursuant to above • Enforcement	• Statewide • LCP policies/ ordinances apply in coastal zone	• Cities/counties adopt policies/ ordinances; make land-use decisions consistent with State law. • Enforcement tools include: inspections; fines; infractions; misdemeanors; stop work orders; and general police powers to protect public health, safety and welfare and declare, prohibit, and abate nuisances.
SWRCB/RWQCB	• CWA (33 USC § 1251 et seq.) • PCWQCA (WC §§ 13000 et seq.)	• CWA § 401 Certification Program	Statewide at local level	• Regulate impacts to wetland/riparian areas • Develop CEQA guidance • Establish interagency agreements • Develop technical assistance/guidance • Alternatives to flood management approaches
RWQCB	CEQA (PRC §§21000 to 21177)	Environmental Review	Statewide	Comments on watershed scale and project-specific impacts to riparian/wetland areas

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CCC	• CCA (PRC §§ 30000 et seq.) • CCC's Administrative Regulations (Title 14 CCR §§ 13000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Coastal development permits • LCP certification/ amendments • Federal consistency: review of federal actions affecting land or water uses or natural resources of the coastal zone • Enforcement	Coastal zone (includes tidelands, submerged lands, public trust lands).	• CCC certifies LCPs prepared by coastal cities/counties. • Federal projects, permits and licenses must be found consistent with the CCMP before they are implemented. • Enforcement tools include: file complaint for civil penalties; issue cease and desist orders; and issue restoration orders.
SFBCDC	• MPA (Gov. Code §§ 66600 et seq.), including SFB Plan • SMPA (PRC §§ 29000 et seq.) • CCMP pursuant to CZMA (16 USC §§ 1451 et seq.)	• Designation of priority uses adjacent to Bay • Permitting: development permits and marsh development permits • Federal consistency • Enforcement	SFB (shoreline areas within 100 ft. of SFB; tidal areas and specified tributaries; Suisun Marsh)	• Federal projects, permits and licenses must be found consistent with the CCMP, before they are implemented. • Enforcement/federal consistency authorities similar to CCC.
DFG	• FGC § 1 et seq. ♦ FGC §§ 1600-1603 ♦ California Endangered Species Act (CESA) • California Wetlands Conservation Policy, 1993 (CWCP)	• Streambed alteration permits for grading, filling, dredging activities in State waters or stream beds • MOU between DFG, DWR, Cal/RA, and SRB to implement habitat protection provisions	Statewide: State waters or stream beds (including wetlands)	• In streambed alteration agreements, DFG suggests fish and wildlife protection measures; measures accepted by project proponent become part of an enforceable agreement. • FGC focus includes control of erosion and sedimentation. • CWCP calls for no net wetlands loss and a long-term net gain in the quantity/quality/permanence of wetland acreage and values.
WCB	•	• Wetland purchase and riparian purchase/restoration programs (e.g., Riparian Habitat Conservation Program [RHCP], CVJV)	• Statewide • Central Valley	Acquires, restores, and enhances wetlands and riparian areas

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SLC	• PRC §§ 6000 et seq. (includes lease authority) • Kapiloff Land Bank Act (PRC §§8600 et seq.)	• SLC leases (PRC §6501.1) • Kapiloff Land Bank Fund	• Ungranted State sovereign lands • Statewide	• SLC may lease sovereign lands for wetlands habitat preservation and/or restoration. • As trustee of the Kapiloff Land Bank Fund, SLC acquires lands for wetlands restoration and preservation. These lands then take on the characteristics of sovereign tide and submerged lands. • Granted lands are monitored to ensure compliance with the Public Trust. • Enforcement tools include: insurance, indemnity, bonding, remediation, inspections, fines, stop work orders, termination of lease, etc
SCC	CPRC Chapter 6, Div 21	CREP	Coastal zone and coastal watersheds, statewide	• The SCC implements many projects to protect wetlands and riparian areas through acquisition of fee or less-than-fee interests in land. • SCC implements many projects that restore wetlands and riparian areas through the development of enhancement plans and undertaking efforts to alter hydrology, replant vegetation, and restore fisheries habitat. • SCC has helped on a few occasions to actually construct wetlands that serve as vegetated treatment systems to reduce NPS pollution.

The following BACKUP AUTHORITIES pertain to Urban Management Measures 6A, 6B, and 6C				
Agency	Authority	Programs	Implementing Area	Notes
SWRCB/RWQCBs	PCWQCA (WC §§ 13000 et seq.)	• WQCP (Basin Plans) • WDRs • NPSMP • WMI	Statewide	• Enforcement tools: Cleanup and Abatement Orders; Cease and Desist Orders; Administrative Civil Liability • RWQCBs have primary responsibility for individual permitting, inspection and enforcement.
DFG	FGC § 1 et seq.	• Enforcement • Reporting	Statewide	• Enforcement: DFG wardens enforce water pollution control sections of FGC (e.g., §§ 5650) • Reporting: DFG staff report chronic (sublethal, long-term) water pollution conditions to RWQCBs and cooperate in obtaining corrections or abatements to the condition.
DPR	Div. 1, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR operates and maintains units of the SPS in and around wetlands.
DHS	HSC § 116275 et seq.	Drinking water source assessment and protection, drinking water sampling and analysis regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.

Other Efforts that pertain to Management Measure 6A, 6B, and 6C				
Agency	**Authority**	**Programs**	**Implementing Area**	**Notes**
DWR	• California Urban Creeks Restoration and Flood Control Act of 1984 (CUCRFCA) • DFPP	• Technical Assistance • MOU between DWR, DFG, Cal/RA, and SRB to implement habitat protection provisions	• Statewide • SFB Delta	• DWR works with citizens and local agencies to address bank erosion and flooding problems of urban streams.
CARCDs and NRCS		• Technical Assistance • Financial (assistance with grants to farmers)	• Statewide	RCDs/NRCS assist farmers in making wetland determinations of agricultural lands.
State/local/federal agency participation in CA's • **NMSs** • **NERRs** • **NEPs**	• MPRSA (16 USC § 1431 et seq.) • CZMA § 315 • CWA § 320 (33 USC § 1330)	• MBNMS WQPP • SMBRP • SFB	NMSs: • Monterey Bay • Channel Islands • Cordell Bank/ Gulf of the Farallones NERRs: • Elkhorn Slough • Tijuana River NEPs: • SMB, SFB and Morro Bay	The MBNMS WQPP is a collaborative effort of federal, State and local agencies and public and private groups to address NPS pollution in the region's watersheds. An MOA has been signed by: NOAA; USEPA, Region 9; Cal/EPA; SWRCB; RWQCB 2 (SFB); RWQCB 3 (Central Coast); CCC; and AMBAG.
Wetlands Research Project (WRP) (partnership of State and federal agencies with wetland responsibilities)		• Southern CA Wetlands Inventory (Carpenteria Salt Marsh, Mugu Lagoon, Malibu Lagoon, Ballona Wetlands, Bolsa Chica Wetlands, Upper Newport Bay, N. San Diego County Lagoons, Tijuana Estuary)	So. California	WRP designed as a vehicle "to accelerate the pace, the extent and the effectiveness of coastal wetland restoration in the Southern California Bight. Includes Planning and Public Education programs

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Management Measure 6D — Education/Outreach
Implement educational programs to provide greater understanding of watersheds, to raise awareness and increase the use of applicable management measures and practices for wetlands and riparian areas, and to promote projects which retain or re-establish natural hydrologic functions. Public education, outreach, and training programs should involve applicable user groups and the community. [Refer to the Wetlands, Riparian Areas, and Vegetated Treatment Systems Management Measures 6A – 6C listed in this document.]

Agency	Authority	Programs	Implementing Area	Notes
SWRCB/ RWQCBs	• PCWQCA [WC §§ 13000 et seq.]	• Basin Plans • Education	• Statewide	
CCC	• CCA (PRC §§ 30000 et seq.), particularly §§ 30012 and 30006.5	• Education • Guidance Manuals (Polluted Runoff, Wetlands, Wetlands Mitigation Banking, LCP Periodic Reviews)	• coastal zone	
SFBCDC	• MPA (Gov. Code §§ 66600 et seq.), including SFB Plan • SMPA (PRC §§ 29000 et seq.)	• Education	SFB (shoreline areas within 100 ft. of SFB; tidal areas and specified tributaries; Suisun Marsh)	
DFG	• FGC §§ 1600 et seq.	• Education and Technical/ Financial Assistance • MOU between DFG, DWR Cal/RA, and SRB to implement habitat protection provisions	• Statewide	MOU among DRF, DWR, Cal/RA, and SRB to implement habitat protection provisions.
DHS	HSC § 116275 et seq.	Drinking water source assessment and protection, drinking water sampling and analysis; regulation of public drinking water systems	Watersheds associated with drinking water sources	Assessment of potential contaminating activities in watershed; self-determined protection programs by drinking water systems and communities; collection of data on contaminants in drinking water supplies for the evaluation of water quality.
DPR	Div. 1, Chapter 1.25, Div. V, PRC §5000 et seq.		SPS	DPR has an extensive educational program that includes displays, talks, curriculum development and special programs.

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DWR	• CUCRFCA	• Urban Streams Restoration Program • Technical Assistance • MOU between DWR, DFG, Cal/RA, and SRB to implement habitat protection provisions	• Statewide	DWR works with citizens and local agencies to address bank erosion and flooding problems of urban streams.
SCC	PRC Chapter 6, Div 21	CREP; Coastal Access Program; Education and Technical/Financial Assistance	Coastal zone and coastal watersheds, statewide	SCC can provide interpretive signs as part of its coastal resource or access projects to educate the public about a multitude of coastal issues, including NPS pollution, wetland and other habitat values, functions and processes.
SLC	• PRC §§ 6000 et seq.	• Education	Ungranted tide- and submerged lands owned by State (PRC § 6301)	
CARCDs and NRCS	•	• Technical Assistance • Financial (assistance with grants to farmers)	• Statewide	RCDs/NRCS assist farmers in making wetland determinations of agricultural lands.
State/local/federal agency participa-tion in CA's • **NMSs** • **NERRs** • **NEPs**	• MPRSA (16 USC § 1431 et seq.) • CZMA § 315 • CWA § 320 (33 USC § 1330)	• MBNMSWQPP • SMBRP • SFEP	NMSs: • Monterey Bay • Channel Islands • Cordell Bank/ Gulf of the Farallones NERRs: • Elkhorn Slough • Tijuana River NEPs: • SMB, SFB and Morro Bay	Includes numerous education efforts/actions.

LIST OF ACRONYMS

AASHTO - American Association of State Highway and Transportation Officials
AB – Assembly Bill
ABAG - Association of Bay Area Governments
ACOE – Army Corp of Engineers
AMBAG - Association of Monterey Bay Area Governments
ARS – Agricultural Research Service
ASBS – Areas of Special Biological Significance
BASMAA – Bay Area Stormwater Management Agencies Association
BAWPG – Bay Area Wetlands Planning Group
BC – Building Code
BCGC – Boating and Clean Green Campaign
BIOS – Biologically Integrated Orchard Systems
BOF – Board of Forestry
CAA – Clean Air Act
CAC – County Agricultural Commissioner
Cal/EPA – California Environmental Protection Agency
Cal/OES – California Office of Emergency Services
Cal/RA – California Resources Agency
Cal/Trans – California Department of Transportation
Cal/Trans IPMP – California Department of Transportation Integrated Pest Management Program
CAMMPR – California Management Measures for Polluted Runoff
CARB – California Air Resources Board
CARCD – California Association of Resource Conservation Districts
CCA – California Coastal Act
CCBN – California Clean Boating Network
CCC – California Coastal Commission
CCC's CPR Plan – CCC's Controlling Polluted Runoff Plan
CCR – California Code of Regulations
CCMP – California Coastal Management Program
CDF – California Department of Forestry and Fire Protection
CDP – Coastal Development Permit
CDPR – Department of Pesticide Regulation
CEEIN – California Environmental Education Interagency Network
CEQA – California Environmental Quality Act
CERCLA – Comprehensive Environmental Response and Compensation Liability Act
CESA – California Endangered Species Act
CFB – California Farm Bureau
CFR – Code of Federal Regulations
CIMIS – California Irrigation Management Information System
CIWMA – California Integrated Waste Management Act
CIWMB – California Integrated Waste Management Board
CMS – Conservation Management System
CNPCP – Coastal Nonpoint Source Pollution Control Program
CrCA – Critical Coastal Area
CREP – Coastal Resource Enhancement Program
CRMP – Coordinated Resource Management and Planning Program
CRWQMP – California Rangeland Water Quality Management Plan
CSVDP – California Statewide Vessel Disposal Plan, USFWS (1994)
CUCRFCA – California Urban Creeks Restoration and Flood Control Act of 1984
CURES – Coalition for Urban/Rural Environmental Stewardship
CVAP – Clean Vessel Act Program
CWA - Clean Water Act
CWC – California Water Code
CWCP – California Wetlands Conservation Policy (1993)
CZARA Coastal Zone Act Reauthorization Amendments of 1990
CZM – Coastal Zone Management
CZMA – Coastal Zone Management Act
CZSTA – Coastal Zone Special Treatment Areas
DBW – Department of Boating and Waterways
DFA – Department of Food and Agriculture
DFG – Department of Fish and Game
DFPP – Delta Flood Protection Plan of 1988
DHS – Department of Health Services
DOC – Department of Conservation
DPR - Department of Parks and Recreation
DTSC – Department of Toxic Substance Control
DWR – Department of Water Resources
EIR – Environmental Impact Report

EQIP – Environmental Quality Incentives Program
ESA – Endangered Species Act
FAC – Food and Agriculture Code
FACT – Functioning Assessment Criteria Test
FCVA – Federal Clean Vessel Act of 1992
FGC – Fish and Game Code
FHA – Federal Housing Administration
FHWA – Federal Highway Administration
FIFRA – Federal Insecticide, Fungicide, Rodenticide Act
FOTG – Field Office Technical Guide
FPA –Forest Practice Act (Z'Berg-Nejedly)
FPR – Forest Practice Rules
FSA – Farm Services Agency
g-Guidance – Guidance Specifying Management Measures for Sources of Nonpoint Pollution on Coastal Waters (CZARA §6217[g])
GMSWP – General Municipal Storm Water Permit
GP – General Plan
HC – Housing Code
HHW – Household Hazardous Waste
HNC – Harbors and Navigation Code
HSC – Health and Safety Code
HTB – Heal the Bay
HWRF – Harbors and Watercraft Revolving Fund
IAC – Interagency Committee
ICE – Information Center for the Environment
IPM – Integrated Pest Management
ISTEA – Intermodal Surface Transportation Efficiency Act
ISW Plan – Inland Surface Waters Plan
JOSP – Joint Oil Spill Program
LCP – Local Coastal Program
LEA – Local Enforcement Agency
LTMP – Long Term Monitoring Program
MAA – Management Agency Agreement
MBNMS - Monterey Bay National Marine Sanctuary
MM – Management Measure
MOA - Memorandum of Agreement
MOU – Memorandum of Understanding
MP – Management practice
MPA – MacAteer-Petris Act
MPRSA – Marine Protection, Research and Sanctuaries Act
MSD – Marine Sanitation Devices
MSWP – Municipal Storm Water Permit
MTHP – Modified Timber Harvest Plan
MURP – Model Urban Runoff Program
MWELO – Model Water Efficient Landscape Ordinance
NEP - National Estuary Program
NEPA – National Environmental Policy Act
NERR - National Estuary Research Reserve
NMS - National Marine Sanctuary
NOAA – National Oceanic and Atmospheric Administration
NPDES – National Pollutant Discharge Elimination System
NPS – Nonpoint Source
NPSMP – Nonpoint Source Management Plan
NRCS – National Resources Conservation Service
NTMP – Nonindustrial Timber Management Plan
OCWD – Orange County Water District
ODW – Office of Drinking Water
OPA – Federal Oil Pollution Act of 1990
OSDS – Onsite Disposal System
OSPR – DFG/Office of Oil Spill Prevention and Response
OSPRA – Oil Spill Prevention and Response Act of 1990
OSPS – Oil Spill Prevention Specialists
PCWQCA – Porter Cologne Water Quality Control Act
PIPP – Public Information Public Participation Committee of the SWQTF
PRC – Public Resources Code
PTHP – Program Timber Harvesting Plan
PZL – Planning and Zoning Law
R&HA – Rivers and Harbors Act
RCD – Resource Conservation District
RCRA – Resource Conservation and Recovery Act
ReCAP – CCC's Regional Cumulative Assessment Program
RHCP – Riparian Habitat Conservation Program
RMS – Resource Management Systems
RWQCB – Regional Water Quality Control Board
RWQCB 1 – North Coast Region
RWQCB 2 – San Francisco Bay Region
RWQCB 3 – Central Coast Region
RWQCB 4 – Los Angeles Region
RWQCB 5S – Central Valley Region, Sacramento Office
RWQCB 5F – Central Valley Region, Fresno Office
RWQCB 5R – Central Valley Region, Redding Office

RWQCB 6SLT – Lahontan Region, South Lake Tahoe Office
RWQCB 6V – Lahontan Region, Victorville Office
RWQCB 7 – Colorado River Basin Region
RWQCB 8 – Santa Ana Region
RWQCB 9 – San Diego Region
SANDAG - San Diego Area Governments
SbMA – Subdivision Map Act
SCAG - Southern California Association of Governments
SCC – State Coastal Conservancy
SCCWRP – Southern California Coastal Water Research Project
SCRD – Small Craft Refueling Dock
SFB – San Francisco Bay
SFBCDC - San Francisco Bay Conservation and Development Commission
SFEP – San Francisco Estuary Project
SIOSC – State Interagency Oil Spill Committee
SLC – State Lands Commission
SMA – Streamside Management Areas
SMARA – Surface Mining and Reclamation Act
SMB – Santa Monica Bay
SMBRP – Santa Monica Bay Restoration Project
SMPA – Suisun Marsh Preservation Act
SPS – State Park System; State Parks
SRB – State Reclamation Board
SRF – State Revolving Fund
SRWP – Sacramento River Watershed Project
SWDP – Storm Water Discharge Program
SWMP – Storm Water Management Plan
SWP – State Water Project
SWPPP – Storm Water Pollution Prevention Program
SWQTF – Stormwater Quality Task Force
SWRCB – State Water Resources Control Board
SYP – Sustained Yield Plan
TAC – Technical Advisory Committee
THP – Timber Harvesting Plan
TMDL – Total Maximum Daily Load
TRPA – Tahoe Regional Planning Agency
TSS – Total Suspended Solids
UC – University of California
UCCE University of California Cooperative Extension
UPC – Uniform Plumbing Code
URMP – Urban Runoff Management Program
USBR – U. S. Bureau of Reclamation
USC – United States Code
USCG – U.S. Coast Guard
USCOE – U.S. Corps of Engineers
USDA – U. S. Department of Agriculture
USDI – U. S. Department of Interior
USEPA – U. S. Environmental Protection Agency
USFWS - U.S. Fish and Wildlife Service
USGS – U. S. Geological Survey
USRP – Urban Streams Restoration Project
WC – Water Code
WCB – Wildlife Conservation Board
WCL – Wildlife Conservation Law of 1947
WCLA – Water Conservation Landscaping Act of 1990
WDR – Waste Discharge Requirement
WLPZ – Watercourse and Lake Protection Zone
WMI – Watershed Management Initiative
WQA – Water Quality Assessment
WQCP – Water Quality Control Plans
WQCrP – Water Quality Certification Program
WQMP – Water Quality Management Plan
WQPP - Water Quality Protection Program
WRP – Wetlands Research Project

Designing and Implementing an Effective Storm Water Management Program

Storm Water NPDES Phase II Regulations

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Preface

The American Public Works Association (APWA) received funding from the United States Environmental Protection Agency (EPA) to develop a training program for local governments who will be affected by the Phase II rules developed as part of the National Pollutant Discharge Elimination System (NPDES) storm water program. The training program consisted of:

- This workbook; and
- A series of workshops conducted in the fall of 1998 and the spring of 1999.
- A live workshop, combined with satellite videoconfcrencing, presented in 21 cities on February 15, 2000.

Project Participants

APWA Environmental Programs and Government Relations staff from Washington, D.C. took the lead on this project, supported by Education Program staff from APWA's Kansas City offices.

To assist with the project, an advisory group was formed with local governmental representatives from each of the ten EPA regions around the country. These individuals, who are experts in implementing storm water management programs in their communities, committed to help design and implement an effective training program.

R. W. Beck, Inc., a national utility and engineering consulting firm, was hired to work with APWA and its advisors to create the workbook and the workshop curriculum.

Training Program Audience

The primary audience for the workbook and workshops is:

- Public Works officials from communities under 100,000 in population;
- Elected officials from those communities; and
- Agencies/Counties who may be involved in storm water program development.

Learning Objectives

The workbook and workshops are designed to help answer the following questions:

- Why is storm water management important?
- What are the requirements of the proposed regulations?
- What can you do to manage storm water more effectively? (What strategies are working? How can you determine which strategies are most applicable in your community?)
- How can you convince people that storm water management is important? (How can you educate the public, encourage community involvement, and build consensus with decision-makers and other affected parties?)
- Who should administer and oversee your storm water management program? (What institutional and organizational options are working in Phase I and Phase II communities?)
- How can you get needed funding for your storm water management program?
- Does it make sense to cooperate with your neighbors to develop a watershed approach to storm water management?

Each of the seven chapters of this workbook correspond with one of these learning objectives.

Project Approach

To develop this workbook and the workshop curriculum, R. W. Beck, Inc. conducted extensive research into storm water management practices for smaller communities. The research included the following activities:

- Literature search to find articles, manuals, workbooks, and electronic resources related to storm water management;
- Telephone interviews with communities/entities responsible for effective or innovative storm water management programs;
- Four site visits to develop more detailed documentation about storm water management programs in the selected communities/regions; and
- Discussions with industry experts, APWA staff, and the storm

Appendix A, included on the enclosed CD-ROM, includes brief fact sheets summarizing each of the telephone interviews.

Appendices C through E provide summaries of the site visits conducted as part of this project.

Appendix J contains a list of selected electronic resources that address storm water management and water quality issues. Selected Best Management Practices manuals are listed in Appendix K. Appendix L includes selected references and documents used to develop this workbook.

Feedback Exchange

To learn more about upcoming APWA workshops, find out how you can get involved in APWA's storm water advisory group, or provide feedback to APWA about this workbook, please contact:

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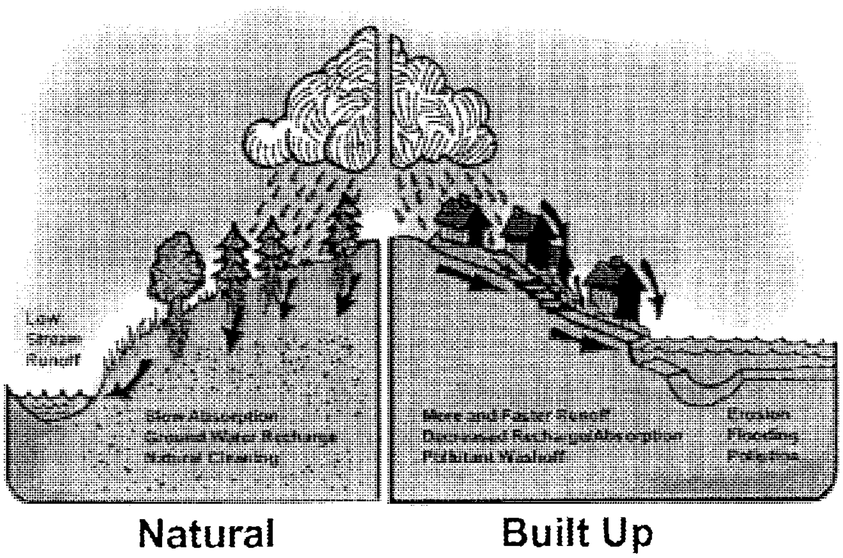
Chapter 1
Why Worry About Storm Water?



"Into every life a little rain must fall," so goes the old saying.

What the adage forgets to mention is what happens when the rainfall becomes storm water runoff.

Storm water runoff is a natural process. In the natural course of events, precipitation that falls over undeveloped land:

- Transpires or evaporates,
- Soaks into the ground to nourish plants, trees and other vegetation and to recharge aquifers, or
- Flows through natural conveyances (such as grassy channels, gullies, and ravines) to wetlands, streams, lakes, and other waterways.

As development occurs, impervious surfaces - such as streets, parking lots, and buildings - replace natural ground cover, preventing infiltration of rainfall. The result is an increase in surface runoff. The runoff carries whatever pollutants are in its path to our water bodies. In addition, when a storm event occurs, and rainfall is unusually heavy, surface water and runoff are carried quickly through conveyances, with no chance for infiltration. Heavy concentrations of pollutants may result, along with flooding of streets and waterways.

To address concerns associated with this runoff, communities and regulators have been examining storm water management strategies for decades, with particular strides toward best management practices in recent years.

This chapter describes the need for storm water management planning and policy and addresses:

- A definition of storm water;
- Reasons to be concerned about storm water management;
- Impacts of storm water quantity and quality;
- Benefits of storm water management; and
- The relationship between storm water management and other environmental programs.

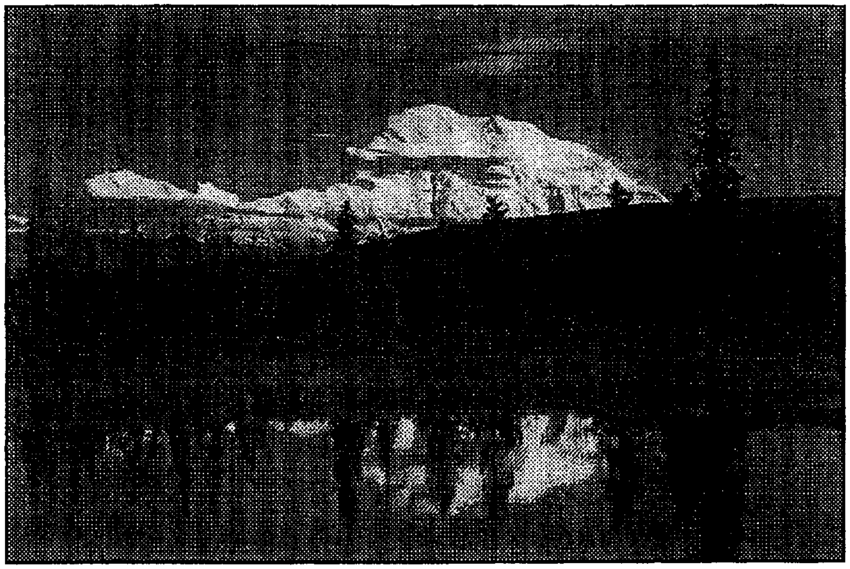
What is Storm Water?

Storm water is surface flow water from precipitation that accumulates in and flows through natural and/or man-made storage and conveyance systems during and immediately following a storm event. As storm water travels through a conveyance system, it carries pollutants to lakes, rivers, wetlands, coastal waters, and ground waters, impairing water quality. The sources of these pollutants are typically diffuse, therefore sources of pollutants carried by runoff have not historically been regulated.

Why Worry About Storm Water?

Although pollution conveyed by storm water has historically been overlooked due to the complications associated with identifying the sources of pollution, it is one of the most significant sources of pollution to our nation's waters today. Poor management of storm water can lead to impaired water bodies, degraded animal habitats, polluted drinking water, increased flooding, and hydrologic changes to streams, lakes, wetlands and rivers (such as erosion of streambeds or deposits of soil and silt in waterways, which can further alter their natural state).

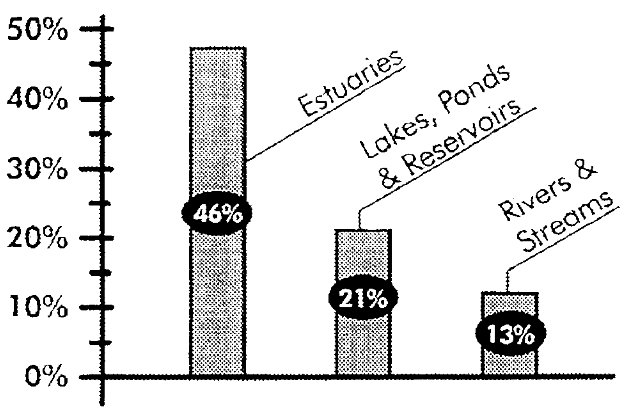
Conversely, communities that have developed aggressive storm water management programs, especially in conjunction with other environmental activities, have revitalized their surface waters, improved local quality of life, and created places where businesses and residents want to locate.



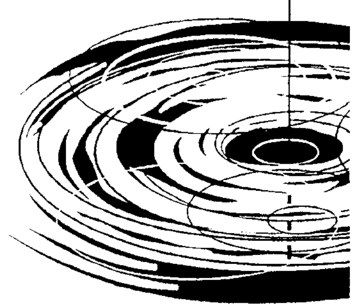
The National Picture

Several comprehensive studies have indicated that diffuse sources of pollution conveyed by storm water runoff are major contributors of water pollution in the United States. The Association of State and Interstate Water Pollution Control Administrators and the United States Environmental Protection Agency (EPA) conducted a study and published a report in 1985 entitled *America's Clean Water - The States' Nonpoint Source Assessment.* This report indicated that 38 states reported urban runoff as a major cause of impairment to their waters. Twenty-one states reported construction site runoff as a major cause of impairment. In addition, *The National Water*

Percent of Assessed U.S. Water Bodies Impaired by Urban Runoff/Storm Sewers



Source: EPA, 1998. *The National Water Quality Inventory, 1996 Report to Congress*, EPA 841-R-97-008



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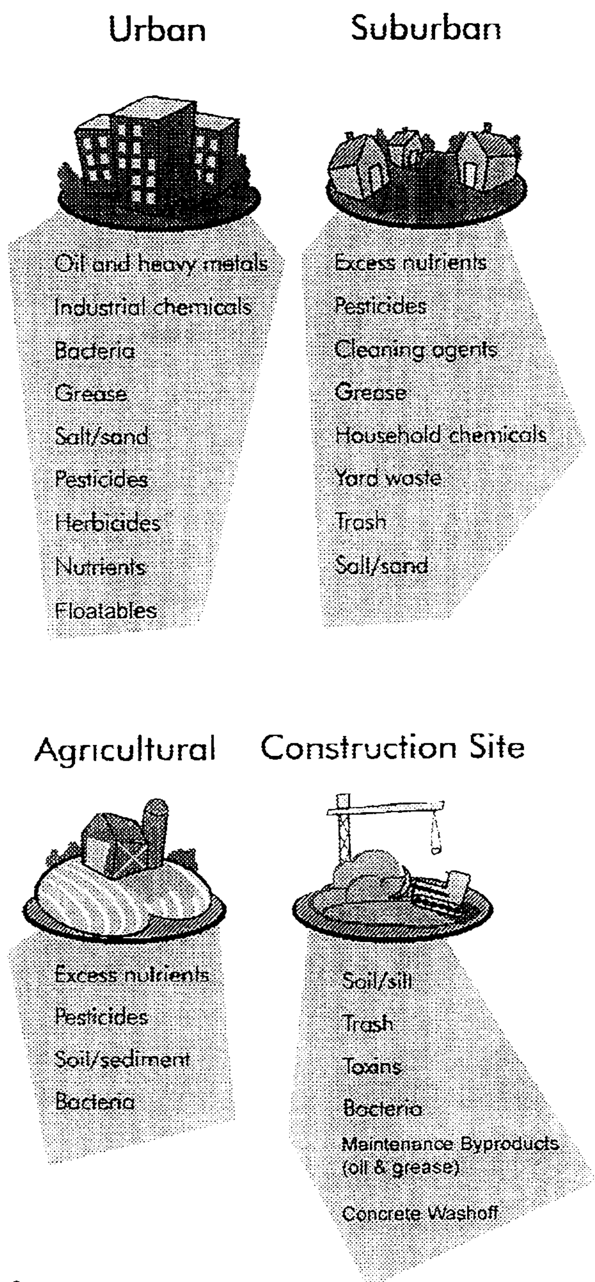
Quality Inventory, 1996 Report to Congress reported that the leading cause of water quality impairment, on a nationwide basis, was diffuse (nonpoint) sources, carried by stormwater runoff.

Typical Pollutants Associated with Different Types of Runoff



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Storm Water Quality

The quality of storm water is important to your community because storm water conveys to rivers, streams, estuaries, bays and reservoirs. Storm water can also seep into aquifers, which are often used to supply drinking water. Pollutants in storm water, therefore, can impair drinking water, recreational waters, and animal habitats (such as waterfowl habitats, fish spawning areas, and shellfish beds). These resources are inherently valuable, but they also provide many communities with sources of economic viability.

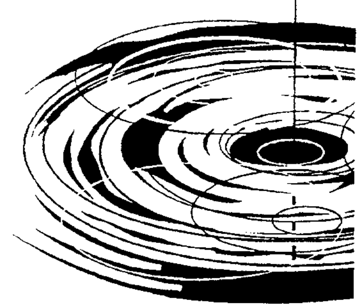
Different types of non point source runoff present distinct challenges to surface and ground water. Pollutants carried by storm water in all types of environments, however, have the potential to impair aquifers, rivers, streams, lakes, and wetlands.

Storm Water Quantity

As land is developed, the amount of impervious area increases. Storm water does not have as much soft, porous ground to sink into, therefore more runoff is introduced to your storm water conveyance system. This increase in storm water can result in the following negative impacts to your community:

- An increase in pollutants introduced to waterways;
- An increase in flooding due to overloaded storm water conveyance systems and higher surface body (lakes, ponds, rivers and resevoirs) water levels;
- A decrease in the amount of water recharged to aquifers; and
- An increase in salinity of ground water (in coastal areas) due to the lack of groundwater recharge and an imbalance in hydrostatic pressure.

Increased storm water quantity, therefore, can result not only in flooding, but also in additional pollution to water bodies due to erosion and lack of pollutant settling time, as well as a reduction in the amount and/or quality of water recharged to the aquifer.



Common Factors that Affect Storm Water Quantity or Quality

Illicit discharges to storm sewer system	• Illicit sanitary discharges result in high bacteria counts in waters • Illicit industrial/commercial discharges result in high pollutant loadings
Heavy rainfall	• Flooding due to overloaded storm sewer system • Increased pollutant loadings due to overloaded storm sewer system • Increased pollutant loadings due to increased storm water runoff
Old/poorly maintained storm sewer system	• Increased pollutants flushed into receiving water because of poor maintenance practices • Flooding due to inadequate system • Turbidity from excessive erosion
Heavy use of fertilizer in watershed	• Increased algae bloom leads to reduction in oxygen in water (eutrophication), which kills fish, leads to beach closings
Heavy use of pesticides in watershed	• Increased chemical loadings • Increased toxicity
High level of development/ urbanization	• Increased frequency and /or severity of flooding due to overloaded storm sewer system • Increased pollutant loadings due to urban activities (e.g. automobile fluids, industrial chemicals) • Increased pollutant loadings due to runoff reaching streams more quickly (lack of setting time and natural filtration) • Increased pollutant loadings due to increased erosion • Increased presence of fertilizers, herbicides, floatables, etc. • Increased presence of floatable trash (cigarette butts, styrafoam containers, etc.)
Cross connection from sanitary sewer system	• Increased pollutants loadings to receiving water

Flood Control in Griffin, Georgia

The City of Griffin, Georgia implemented a storm water management program in 1996. The impetus for their program was 150-year old, deteriorating infrastructure that was worn out, frequently clogged, and no longer serving the needs of the City's 23,000 residents. Storm events in Griffin often resulted in pipes overflowing into streets and ditches being carved through yards by the runoff. In some areas, yards, garages, and homes were flooded on a regular basis.

The City formed a storm water utility to fund the storm water management program. Griffin worked hard to make citizens and businesses aware of the need for the storm water utility through radio, television, and public forums addressing storm water issues. They also met with the local Chamber of Commerce and sent letters to the top 150 industries and the top 25 chief financial officers.

Some of the activities Griffin undertook include:

- Implemented an Adopt-A-Stream program
- Implemented an Adopt-A-Storm Drain program
- Improved drainage and conveyance systems
- Required use of extended detention ponds
- Improved storm drain maintenance
- Improved street cleaning operations
- Sought grants for public education, bioengineering research, and flood mitigation

The City of Griffin has alleviated its flood problem, improving the quality of life, health and safety of residents, and increasing local housing values by implementating a pro-active storm water management program.

What Benefits Can You Expect from Improved Storm Water Management?

Storm water management is a vital component of preserving our nation's waters and wetlands. Your community's drinking water, recreational facilities, economic resources, animal habitats, shellfish beds, fish spawning areas, river and stream beds, and roadways are being placed at risk if you do not design and implement an adequate storm water management plan.

Benefits of Storm Water Management

- Decreased flooding ➡ increased safety and reduced property damage
- Improved surface water quality ➡ potential increase in recreation/tourism

Source Control Measures — Reduce or eliminate the possibility of storm water coming into contact with a pollutant. Examples include:

- Storing chemicals properly
- Using conservation tillage
- Keeping clean rainfall away from wastes
- Timing chemical applications or logging activities based on weather forecasts or seasonal weather patterns
- Protecting natural hydrology by maintaining pervious surfaces in developing areas
- Improving street sweeping and catch basin cleaning measures
- Minimizing salt/sand application for de-icing, or using alternative materials such as clay and gravel
- Active erosion control practices for all construction sites
- Intelligent land use and management of developments

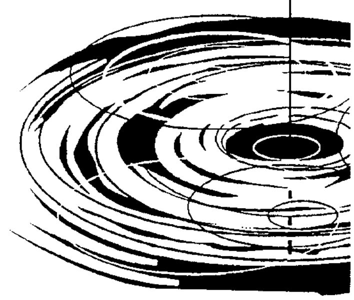
Delivery Reduction Measures — Intercept pollutants leaving the source before they are introduced to a waterway. Examples include:

- Using infiltration basins
- Using grassy swales
- Restoring wetlands
- Planting trees to absorb excess storm water
- Using grit and oil separators
- Water quality detention ponds

Storm Water Management - It's Part of Smart Environmental Programming

While "storm water management" may not immediately leap to mind as a top priority for most citizens or elected officials, clean water is an issue that almost everyone can agree on. Lack of or a poor storm water management program is a disservice to the community. You need to understand and promote the link between storm water management and other important community issues such as:

- Abundant clean drinking water
- Availability of healthy lakes, bays, and streams for fishing, swimming, recreation, and tourism
- Flood control
- Clean roadways
- Adequate animal habitats
- Existence of trees and other vegetation
- Pollution control
- Erosion control



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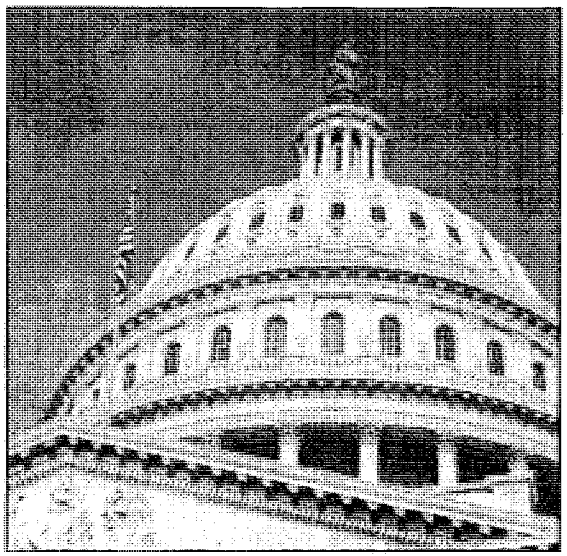
- Smart growth, sustainability, and livability concerns
- Comprehensive master planning

Your community may already have programs underway that address these issues or may be faced with other requirements such as TMDLs that will require you to address some of these issues.

When we try to pick out anything by itself, we find it hitched to everything else in the universe. - John Muir

Chapter 2
What Are We Required To Do About Storm Water?



Developing an effective storm water management program makes sense. In addition to the practical benefits derived from storm water management programs, federal regulations govern how you manage storm water in your community.

This chapter addresses:

- An overview of federal policy and regulations for storm water management;
- The objectives of Phase II regulations;
- A discussion of EPA's role in administering the Phase II Rule, as well as the roles of state, local, and tribal governments and permitting authorities;
- A description of NPDES storm water Phase II requirements;
- A discussion of who is covered by the Phase II regulations; and
- A description of what's involved in the Phase II permitting process.

Federal Storm Water Management Policy

The federal government has finalized regulations for storm water management in smaller communities - known as the National Pollutant Discharge Elimination System (NPDES) Phase II Rule. This rule is designed to comply with the requirements of the Clean Water Act and to further protect our nation's streams, rivers and beaches from polluted storm water runoff. Phase II regulations follow the 1990 NPDES Phase I Rule, which addressed priority sources of pollutant runoff, including storm water pollution from medium and large municipal separate storm sewer systems, industrial sources, and construction sites disturbing at least five acres.

Phase II requirements grew out of a long-standing concern on the part of federal legislators for protecting surface water. To better understand these regulations, you must look at the evolution of the NPDES program.

The Clean Water Act

The Clean Water Act (CWA) is the primary federal legislation that protects surface waters, such as lakes, rivers, and coastal areas. The CWA stems from the federal Water Pollution Control Act (WPCA), which was originally enacted in 1948. This legislation employed ambient water quality standards in specifying the acceptable levels of pollution in a state's waters. This approach - stressing tolerable pollution rather than preventable causes of water pollution - proved to be an ineffective means of preventing pollution. Other problems with the WPCA included awkwardly shared federal and state responsibility for promulgating the standards and cumbersome enforcement procedures.

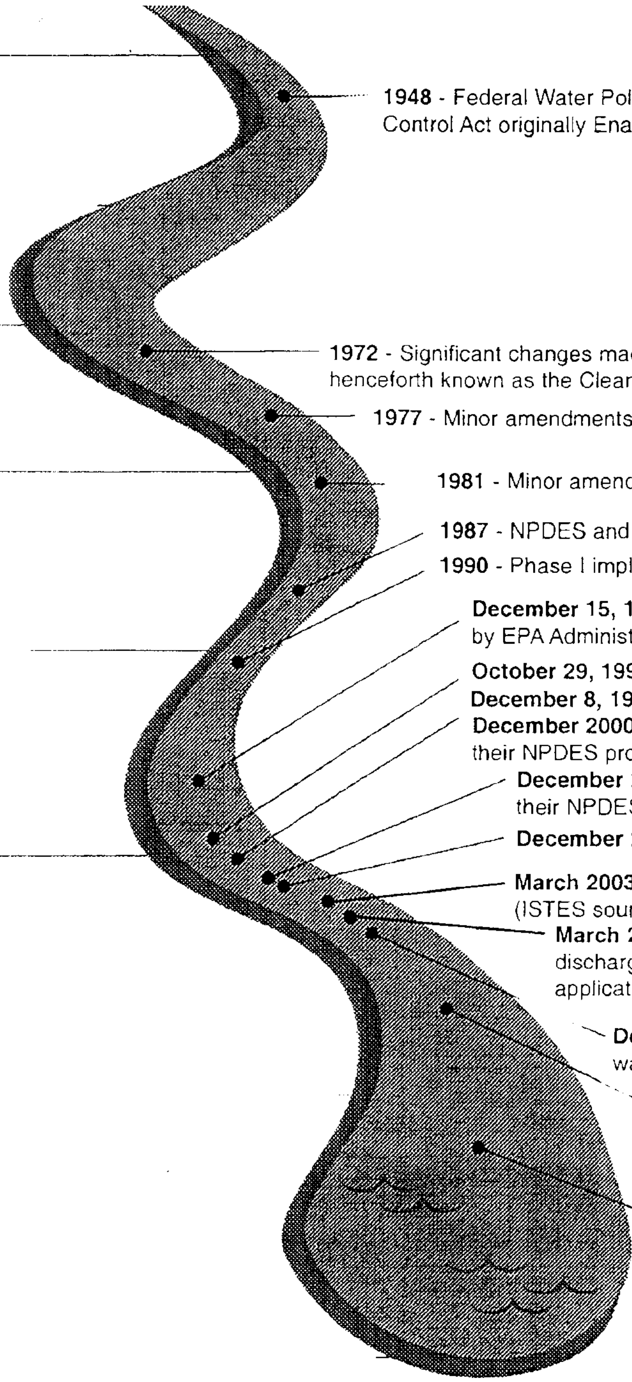
The CWA was developed in 1972 to strengthen and expand the WPCA. The CWA took a different approach to addressing water pollution. The amendments focused on establishing effluent limitations on point sources, or "any discernible, confined and discrete conveyance... from which pollutants are or may be discharged" (P.L. 92-500). Increased accountability for protecting water quality was placed on dischargers of pollutants. The amendments also required states and tribes to survey their waters and determine an appropriate use for each, then set specific water quality criteria for various pollutants to protect those uses. Another addition to the 1972 CWA was the provision of certain funding mechanisms to help communities meet their clean water goals.

The 1972 CWA also introduced the National Pollutant Discharge Elimination System (NPDES).

NPDES (Section 402)

The NPDES program was established as the fundamental regulatory mechanism of the CWA. The NPDES program requires anyone discharging a pollutant from a point source into the waters

Federal Storm Water Management Policy Timeline



1940

1950

1948 - Federal Water Pollution Control Act originally Enacted

1960

1970

1972 - Significant changes made to FWPCA henceforth known as the Clean Water Act

1977 - Minor amendments made to the CWA

1980

1981 - Minor amendments made to the CWA

1987 - NPDES and nonpoint source programs established

1990 - Phase I implementation

1990

December 15, 1997 - Proposed Phase II rule signed by EPA Administrator

October 29, 1999 - Final Phase II rule signed by EPA

December 8, 1999 - Final Phase II rule published in Federal Register

December 2000 - NPDES-authorized states must modify their NPDES program if no statutory change is required

December 2001 - NPDES-authorized states must modify their NPDES program if no statutory change is required

2000

December 2002 - Permitting authority designates small MS4s

March 2003 - Municipal industrial NPDES application due (ISTES sources)

March 2003 - regulated small MS4s and storm water discharges associated with other activity submit permit application (or 3 yrs and 90 days after final regulations issued)

December 2004 - Permitting authority with storm water watershed plans designates small MS4s

2010

2008 - Regulated small MS4s programs developed and implemented (or five years after permit issuance)

December 2012 - Reevaluation of the Phase II rule by EPA

2020

Every 5 Years - Submission of No Exposure Certification of the United States to obtain an NPDES permit. The initial focus was on industrial and municipal wastewater. Controlling these targeted point sources has substantially improved water quality.

However, several studies have shown that pollution from diffuse (nonpoint) sources - such as storm water runoff from urban and agricultural areas, construction sites, land disposal, and resource extraction (mining) - are now the leading cause of water quality impairment. Although storm water runoff originates from diffuse sources, it is often discharged through separate storm sewers or other conveyances, which are regulated under the CWA.

The 1987 amendments to the CWA, therefore, added Section 402(p), which required the EPA to develop a comprehensive phased program to regulate storm water discharges under the NPDES program. This task promised to be challenging because storm water originates from so many separate, undiscernable sources, and there were not yet proven control techniques to mitigate storm water pollution.

The Phase I rule was issued in November 1990. The rule addressed storm water discharges from medium and large municipal separate storm sewer systems(MS4s)(those serving communities with a population of at least 100,000), as well as storm water discharges associated with industrial activity.

The Phase II proposed rule was signed by the EPA Administrator on December 15, 1997. Final Phase II regulations, which effect smaller communities, were signed October 29, 1999.

NPDES permitting authorities must modify their existing NPDES permits by December 2000, if statutory changes are not required, or by December 2001 if statutory changes are required. Regulated small MS4s and storm water discharges associated with other activities need to submit their permit applications by March 2003 (or 3 years and 90 days after final regulations are issued). Regulated small MS4 programs should be developed and implemented by 2008, or five years after permit issuance.

Appendix G includes a copy of the Phase II Rule. Appendix H presents a brief summary of other federal regulations that affect storm water management.

What are the Objectives of Phase II Regulations?

The United States Environmental Protection Agency's (EPA's) objectives in developing the Phase II regulations include:

- Provide a comprehensive storm water program that designates and controls additional sources of storm water discharges to protect water quality, pursuant to CWA Section 402 (p)(6).

Major Differences Between Phase I and Phase II

	Phase I	Phase II
Who Is Covered	• Large MS4s (serving a population of 250,000 or more) • Medium MS4s (serving a population of 100,000 to 250,000) • Construction activities disturbing five or more acres • Industries (specified by SIC code)	• Small MS4s (serving a population of less than 100,000 and located in an urbanized area or designated by the permitting authority) • Construction activities disturbing between one and five acres • Industrial sources designated by the permitting authority • ISTEA sources (including municipally owned/operated industrial facilities)
Monitoring	• Mandatory ongoing monitoring required of medium and large MS4s	• NPDES permitting authorities establish small MS4 monitoring requirements
Application Requirements	• Very specific, detailed application requirements. • Application requirements don't lend themselves to general permits	• Streamlined application requirements • General permits encouraged; application requirements lend themselves to this approach
Program Requirements	• Specific activities required • Municipalities must address commercial and industrial dischargers in the community	• More broad – municipalities can develop own BMPs to address minimum control measures • Municipalities do not necessarily have to address industrial dischargers

- Address discharges of storm water activities not addressed by Phase I, including:
    - Construction activities disturbing less than five acres;
    - "Light" industrial activities not exposed to storm water;
    - "MS4s located in urbanized areas not covered under Phase I; and
    - Municipally owned industrial facilities that were addressed under Phase I but granted an extension under ISTEA (Intermodal Surface Transportation Efficiency Act).
- Facilitate and promote watershed planning as a framework for implementing water quality programs wherever possible.

EPA aims to achieve these objectives by balancing nationwide automatic designation and locally based designation. EPA will designate on a nationwide basis:

- Storm water discharges from small MS4s located in urbanized areas; and
- Construction activities that result in land disturbance equal to or greater than one acre.

EPA believes that this designation criteria addresses the main sources of storm water pollution causing significant degradation of surface waters. Permitting authorities may designate additional small MS4s, categories, or individual sources of storm water discharges that are problematic in specific communities.

What is EPA's Role in Implementing Phase II?

EPA's role in Phase II implementation includes provision of a flexible regulatory framework; development of tools to help the regulated community; provision of permits; and oversight of state programs.

Provide Flexible Regulatory Framework

EPA's approach is to provide a regulatory framework that ensures that permits issued to municipalities include the minimum control measures, while providing the NPDES permitting authorities with a significant amount of flexibility so that they can be sensitive to regional issues. Some of the ways in which Phase II allows for flexibility include:

- Permitting authorities establish designation criteria for small MS4s located outside of urbanized areas.

- Permitting authorities can designate other MS4s or construction, industrial, or commercial facilities that are not covered nationally, on a case-by-case or regional basis.

- Permitting authorities may provide waivers to MS4s and construction activities in certain situations, such as where:

    - Construction activities of between one and five acres:

        (1) The value of the rainfasll erosivity factor is less than five (5);

        (2) TMDL assessment or equivelant assessment addresses the pollutants of concern.

    - Regulated small MS4s serving jurisdictions with a population of less than 1,000:

        (1) Its discharges are not contributing substantially to pollutant loadings; and

        (2) If there is a discharge of any pollutant(s) a TMDL is already established to address the pollutant(s) of concern.

    - Regulated small MS4s with a population under 10,000 if:

        (1) All water receiving discharges from the system have been evaluated; and

        (2) A TMDL or equivalent analysis has been conducted and allocated for pollutants; and

        (3) It has been determined that current and future discharges do not have the potential to result in exceedences of water quality standards.

- General permits are encouraged and may be issued on a watershed basis.

- Qualifying local programs can be incorporated in NPDES permit requirements.

- Minimum control measures may be implemented by another governmental entity, such as a larger, neighboring community.

- A cooperative and/or a watershed-based approach is encouraged.

- TMDLs for single pollutant(s) os concern.

EPA expects encouraging the use of general permits for the majority of sources to be designated under Phase II to lessen the regulatory burden placed on the permitting authority. EPA is also working to streamline the application/Notice of Intent (NOI) process to reduce the burden on the regulated community.

Roles of the Federal Government, States, Permitting Authorities, and Municipalities/Tribes in Implementing Phase II NPDES Regulations

Federal Government	All States	NPDES Permitting Authorities	Municipalities/ Tribes
Develop overall framework of program: • Rule • Toolbox • Permit Encourage use of watershed approach Provide financial assistance: • No appropriated funds • Federal grant programs Implement program for non-NPDES authorized states, tribes, and territories Oversee state programs Comply with requirements as a discharger: • Federally-owned MS4s (i.e., hospitals/prisons) • Federal construction projects	Comply with requirements as a discharger: • State-operated MS4s • State construction sites Communicate with EPA	Comply with other regulatory requirements Designate sources: • Develop criteria • Apply criteria • Designate interconnected sources • Address public petition Provide waivers Issue permits Issue menu of appropriate BMPs in cases of general permits Support local programs: • Provide financial support (to extent possible) • Oversee programs • Ensure municipalities have adequate legal authority	All regulated MS4s must establish a storm water management program that meets the requirements of six minimum control measures: • Public education • Public involvement/ participation • Illicit discharge detection and elimination • Construction site controls • Post-construction controls • Pollution prevention/good housekeeping for municipal operations Comply with requirements as a discharger, including municipally owned/operated industrial sources

Develop Tool Box

EPA has made a commitment to work with the Storm Water Phase II Urban Wet Weather Flows Advisory Committee to develop a "tool box" to assist states, tribes, municipalities and other parties involved in the Phase II program. This tool box will facilitate efficient and cost-effective implementation of the regulation. EPA developed a preliminary working tool box in 1999. The tool box should be finalized by the time the general permit is issued and will be updated as new information becomes available. The tool box will include:

- Fact sheets;
- Guidance documents;
- Information clearinghouse;
- Training and outreach efforts;
- Technical research;
- Support for demonstration projects; and
- Regional workshops.

EPA worked with the Urban Water Resources Research Council of the American Society of Civil Engineers to develop a database on BMP effectiveness, which is available on CD-ROM and through the Internet. For more information on this database, refer to Appendix I.

Provide Permits

The EPA is the permitting authority for non-authorized states, tribes and territories. EPA, therefore, has the same responsibility as any other NPDES permitting authority - issuing permits, designating additional sources, and taking appropriate enforcement actions. EPA will tailor the program to the needs of the state, tribe, or territory.

Oversee State Programs

EPA also must oversee the programs for NPDES-approved states and tribes. EPA and the states and tribes will work together to implement, enforce, and improve the program. EPA also will work with states and tribes to help them modify their existing programs where inadequacies exist. In addition, EPA reviews the continuing planning process (CPP) periodically, to assess the accomplishments of the program. If EPA's evaluation of a state's program deems that the program is inadequate, EPA will work extensively with the state to help improve the program. If the state program is not brought into compliance, the NPDES authorization can be revoked.

What Does the Federal Government Require for Storm Water Management under Phase II?

For MS4s:

The EPA requires, under the Phase II regulation, that all owners/operators of small MS4s reduce the discharge of pollutants from a regulated system to the "maximum extent practicable" to protect water quality. At a minimum, jurisdictions regulated under Phase II must:

- Specify BMPs for six minimum control measures and implement them to the "maximum extent practicable;"
- Identify measurable goals for control measures;
- Show an implementation schedule of activities or frequency of activities; and
- Define the entity responsible for implementation.

For Construction and Other Activities:

Construction activities that disturb one to five acres must also be regulated under an NPDES Phase II permit. The NPDES permitting authority may also require that other facilities and industrial and construction activities, as well as small MS4s outside urbanized areas, be designated on a case-by-case or categorical basis.

Each of these requirements is discussed in more detail in the subsections that follow.

What is a BMP?

Best management practices (BMPs) for storm water management are schedules of activities, prohibitions of practices, maintenance procedures, the use of pollution control devices and other management practices used to prevent or reduce the amount of pollution introduced to receiving bodies of storm water runoff.

Non-structural BMPs include: ordinances and zoning requirements (such as erosion and sediment control ordinances); maintenance activities (such as storm drain cleaning and street sweeping); and education/outreach activities.

Structural BMPs include structures like: detention ponds; grassed swales; sand filters and filter strips; infiltration basins; and porous pavement, etc.

Generally non-structural BMPs are more cost-effective than structural BMPs. If structural BMPs are needed, they can be implemented in a more cost-effective manner if they are included in initial plans.

BMPs for Six Minimum Control Measures

Municipal storm water management programs must specify best management practices (BMPs) for the following six minimum control measures:

1) Public Education and Outreach on Storm Water Impacts

- A public education program must be implemented to distribute educational materials to the community.
- The community should be made aware about the impacts of storm water discharges to waterbodies and the steps needed to decrease storm water pollution.
- Municipalities are **encouraged** to work with their state and Phase I communities to develop an education/outreach program more efficiently.

2) Public Involvement/Participation

- The public **must** be involved in developing the municipality's storm water program by following state, tribal, and local public notice requirements.
- All economic and ethnic groups **should** be included.
- Examples of public involvement/ participation that **should** be considered include public hearings, citizen advisory boards, and working with citizen volunteers.

3) Illicit Discharge Detection and Elimination

- The owner or operator of a regulated small MS4 **must** demonstrate awareness of their system, using maps or other existing documents.
- They also **must** develop a storm sewer system map that shows all outfalls, and the location/name of all waters of the US that receive discharges.
- A Phase II community **must** effectively prohibit illicit discharges into the separate storm sewer system.
- Appropriate enforcement procedures **must** be implemented.
- A Phase II community **must** develop and implement a plan to detect and address illicit discharges (including illegal dumping) to the system.
- Public employees, businesses, and the general public **must** be informed of the hazards associated with illegal discharges and improper disposal of waste.
- Need to specifically address categories of non-storm water discharges in 40 CFR 122.34 (b)(3)(iii).

4) Construction Site Storm Water Runoff Control

- The owner or operator of a regulated small MS4 **must** develop, implement, and enforce a program to reduce pollutants in any storm water from construction sites of more than one acre.

- An ordinance or other regulatory mechanism **must** be used to control erosion and sediment to the maximum extent practicable and allowable under state, tribal or local law, as well as sanctions to ensure compliance.

- Must include procedures for site inspection and enforcement of control measures.

- Must have procedures for input from public.

- Must address water quality impacts through site plan review process.

- Must require construction site operators to control wastes generated at site.

- Existing erosion and sediment control ordinances **may** suffice, if approved by the NPDES permitting authority.

5) Post-Construction Storm Water Management in New Development and Redevelopment

- Owners or operators of regulated small MS4s **must** develop, implement, and enforce a program that addresses storm water runoff from new development and redevelopment projects that result in land disturbances of at least an acre and that discharge to their MS4.

- Appropriate structural and non-structural BMPs **must** be used.

- Controls **must** ensure that water quality impacts are minimized.

- Adequate long-term operation and maintenance of BMPs connected to a regulated MS4 **must** be addressed.

- The goal, at a minimum, **should** be to maintain pre-development runoff conditions.

- EPA **encourages** the use of preventive measures, including non-structural BMPs, which are usually thought to be more cost-effective.

6) Pollution Prevention/Good Housekeeping for Municipal Operations

- Owners or operators of small MS4s **must** develop and implement a cost-effective operation and maintenance as well as employee training programs with the goal of preventing or reducing pollutant runoff from municipal operations.

EPA Encourages:

- The use of maintenance activities and schedules and long-term inspection procedures
- The use of controls for reducing or eliminating the discharge of pollutants from roads, highways, parking lots, maintenance and storage yards, and waste transfer stations
- Implementation of procedures for the proper disposal of waste, such as dredge spoil, floatables, and other debris removed via operations and maintenance activities
- New flood management projects should incorporate water quality protection to the greatest extent possible
- Pollution prevention measures in municipal operations, such as golf course maintenance, fleet maintenance, open space maintenance, planning, building and oversight, and storm water maintenance

Measurable Goals for Control Measures

The requirement of identifying measurable goals for each control measure is unique to Phase II. Communities regulated under Phase I were not required to devise measurable goals. Examples of measurable goals include:

- Inspecting or repairing a certain number of drain inlets each year;
- Conducting street-sweeping operations a certain number of times each year;
- Surveying all municipal right-of-ways to identify illicit discharges;
- Conducting a certain number of training classes for municipal operations each year;
- Soliciting the help of a certain number of volunteers each year to perform water quality monitoring or education/outreach activities; or
- Reducing sediment loading.

Implementation Schedule of Activities or Frequency of Activities

Regulated communities must show an implementation schedule of activities or frequency of activities that will be done as part of the storm water management program. An example might include the following entries:

Sweep entire x miles of road in county	2 times per year
Vacuum storm drain inlets	2 times per year

Conduct classroom storm water education	4 times per year
Implement Household Hazardous Waste Program	by July 31, 1999

Common Storm Water Management Implementation Entities

Storm Water Utility

Storm Water or Surface Water Department or Division

Storm Water Management Commission

Special Storm Water District

Engineering Department

Public Works Department

Department of Public Health (water quality monitoring)

Fire Department (illicit discharge detection)

Planning Department (construction/post-construction)

State transportation agency

State environmental regulatory agency

Watershed Management Group

Joint Powers Authority (Adjacent municipalities)

A more in-depth discussion of institutional frameworks that could implement a storm water management program is provided in Chapter 5.

What is a Watershed Approach?

A watershed is a land area that drains into a particular stream, river, or bay. Watersheds can vary in size from a few acres (i.e., for a minor stream) to thousands of square miles.

A watershed approach to storm water management planning considers an entire ecosystem. Because ecosystems, and the pollutants that can impact them, do not know legal boundaries, such as town or county lines, it makes sense to address storm water pollution on a watershed basis.

Taking a watershed approach allows for communities in the watershed to share resources, beginning with watershed mapping efforts, to most effectively combat nonpoint source pollution. The EPA encourages a watershed approach, and several communities, such as Chesapeake Bay and Casco Bay, have found the watershed approach to be successful.

Who is Regulated Under Phase II?

Automatically Included	***Exceptions***
Owners/operators of small municipal separate storm sewer systems located in urbanized areas including military facilities, large hospitals, prisons or other such MS4s operators that exist in an urbanized area.	• Systems that serve less than 1,000 people where no significant impacts are known, and where TMDL assessment addresses the pollutants of concern if any are identified. • Any other system waived from the requirements by the NPDES permitting authority.
All construction site activities involving clearing, grading and excavating land equal to or greater than 1 acre (including projects that are comprised of several sites of less than one acre each).	Requirements could be waived by NPDES permitting authority based on: • Low predicted soil loss (erosivity factor of less than 5); or • TMDL addresses pollutant of concern.
Municipally owned/operated industrial sources required to be regulated under the existing NPDES storm water program but exempted from immediate compliance by ISTEA.	Industrial and other sources that provide a written certification of "no exposure of materials and activities to storm water."

Conditionally Included
Owners/operators of small municipal separate storm sewer systems meeting the criteria for designation (to be established by permitting authority)
Owners/operators of any municipal separate storm sewer system contributing substantially to the storm water pollutant loadings of a regulated, physically interconnected municipal separate storm sewer system
Construction site activities that disturb less than 1 acre of land that are designated by the permitting authority

Entity Responsible for Implementation

Regulated communities must also indicate who is responsible for the storm water management program. There may be one individual in one department who is responsible for the entire program, or the responsibility may be shared among several departments.

Many Phase II communities have a more limited resource base than communities regulated under Phase I. Phase II communities will also have a broad array of governing structures. Defining an implementation entity will therefore require much thought and perhaps some creativity.

The Phase II regulations are amenable to creative implementation strategies, as they encourage communities to take a watershed or cooperative approach. Communities may also be covered under a neighboring Phase I community, or allow another entity, such as a county, to implement certain minimum control measures or portions of minimum control measures. The regulated entity, however, is still responsible for complying with the requirements of the permit.

In defining an implementation entity, you should consider the following:

- What financial resources are already available to your community?
- What will the cost of implementing and operating the storm water management plan be?
- What other communities are located in the watershed?
- Who in the community has expertise in storm water management components of a storm water management program?
- What actions have already been taken that would qualify as BMPs under the Phase II regulations?
- Are there neighboring communities or other communities in the watershed that already have a storm water management program in place?
- Are there neighboring communities that will also be subject to proposed Phase II regulations with whom a community can share resources?

Who Is Covered by Proposed Phase II Regulations?

Those covered by the NPDES Phase II regulations include the federal government, tribes, states, local governments, individuals undertaking construction activities, and industry.

On a national basis, the following entities will be covered:

- Owners/operators of small MS4s located in urbanized areas; and

- Construction activities resulting in land disturbances equal to or greater than one acre.

The NPDES permitting authority could, however, provide waivers for construction activities serving less than 5 acres if certain conditions apply, such as:

- Determination of low soil loss associated with construction activity based on an erosivity factor less than five; and

- A TMDL assessment or equivelant analysis addresses the pollutants of concern on the construction site.

Waivers could also be provided for small MS4s if they:

- Regulated small MS4s serving jurisdictions with a population of less than 1,000:

  (1) Its discharges are not contributing substantially to pollutant loadings; and

  (2) If there is a discharge of any pollutant(s) of concern.

- Regulated small MS4s with a population under 10,000 if:

  (1) all water receiving discharges from the system have been evaluated; and

  (2) a TMDL or equivalent analysis has been conducted and allocated for pollutants; and

  (3) it has been determined that current and future discharges do not have the potential to result in exceedences of water quality standards.

In addition, the NPDES permitting authority could extend designation to municipalities, construction sites, or industrial/commercial sources outside of the nationwide designated classes on a case-by-case or categorical basis. Small MS4s located outside of an urbanized area, for example, could be included based on watershed and water quality considerations. At a minimum, the rule requires that the NPDES permitting authority consider for regulation a particular subset of small MS4s located outside of urbanized areas.

Other storm water discharges from unregulated industrial, commercial, and residential sources could also be designated if an NPDES permitting authority deems it necessary to protect water quality.

It is important to note that the Phase II regulations also apply to communities that will be included under the 2000 Census. These communities are expected to have the same deadline as those included under the 1990 Census - in other words, 3 years and 90 days from publication of the final rule.

What is an Urbanized Area?

An "urbanized area" comprises one or more places - the central place(s) (which include both incorporated and Census-designated places) and the adjacent densely settled surrounding area (or urban fringe) consisting of:

- Incorporated places,
- Census-designated places, and
- Unincorporated areas of the county or Census-designated places

that together have a population of at least 50,000.

The urban fringe is a contiguous area with an average population density of at least 1,000 persons per square mile at its perimeter.

There are 405 urbanized areas in the United States that cover 2 percent of total U.S. land area and approximately 63 percent of the nation's population.

For a graphic depicting the definition of urbanized area, see Appendix G.

What's Involved in the PHASE II Permitting Process?

There are two types of NPDES permits — general and individual. An individual permit is a permit specifically tailored for an individual facility based on the information contained in the application(s). The permitting authority develops a permit for that facility based on the information contained in the permit application, such as type of activity, nature of discharge, receiving water quality, etc. The permit is then issued to the facility for a specific time period (not to exceed five years).

A general permit is developed and issued by a permitting authority to cover multiple facilities within a specific category. General permits may offer a cost-effective option for agencies because of the large number of facilities that can be covered under a single permit. Permittees usually submit a Notice of Intent (NOI) to the permitting authority to be covered under a general permit.

Generally both types of NPDES permits (individual and general) are obtained by application to the EPA or to the appropriate state agency. The owner or operator of a regulated small MS4 would be

Which States, Tribes and Territories Are Not Authorized to Issue NPDES Permits?*

State/Territory	Who State/Territory Needs to Contact	
Alaska	EPA Region X	(206) 553-8399
Arizona	EPA Region IX	(415) 744-1906
Idaho	EPA Region X	(206) 553-8399
Maine	EPA Region I	(617) 565-3580
Massachusetts	EPA Region I	(617) 565-3580
New Hampshire	EPA Region I	(617) 565-3580
New Mexico	EPA Region VI	(214) 665-7175
Texas*	EPA Region VI	(214) 665-7175
District of Columbia	EPA Region III	(215) 597-0547
Puerto Rico	EPA Region II	(212) 637-3724
Pacific Territories	EPA Region IX	(415) 744-1906
Indian Territories	EPA Region Where Tribe is Located	

The remaining 42 states and the Virgin Islands have NPDES permitting authority. *Florida and Texas do not yet have NPDES authorization for storm water permits, but expect to receive such authorization in 2000.

required to identify and submit to the NPDES permitting authority the following information:

- The BMPs that will be implemented;
- The measurable goals for the minimum control measures;
- The month and year in which each BMP will be started and completed, or the frequency of action if it is ongoing; and
- The person(s) responsible for implementing or coordinating the storm water management program.

This information could be submitted in a Notice of Intent (NOI), if the community wishes to apply under a general permit, or on an individual application if the community or facility seeks an individual permit. If a community wants to propose other controls within its permit rather than the Six Minimum Control Measures, the rule provides an alternative application process.

EPA is not specifying NOI requirements for operators of construction sites of less than five acres applying for coverage under a general permit. While EPA recognizes tbe benefit of NOIs — which allow for better outreach and dissemination of information — federal regulators are sensitive to the burden being placed on the regulated community and on the NPDES regulators. Therefore, it is up to the NPDES permitting authority to determine whether it will require NOI submission for construction sites disturbing less than five acres.

The application form is reviewed by the permit writer who then prepares a draft permit. Once the draft is ready, it is sent to the applicant and published in order to notify the general public of the proposed permitting activity. The permit writer then accepts comments on the draft permit from all interested persons. Revisions are then made based on comments received, and the permis is issued final.

What Do Regulated Communities Have to Do On an Ongoing Basis?

Under the Phase II rule, regulated communities must conduct periodic evaluations and assessments of their storm water management practices, maintain records, and prepare required reports.

Evaluation and Assessment Requirements	***Record Keeping Requirements***	***Reporting Requirements***

• Evaluate program compliance
• Evaluate the appropriateness of identified BMPs
• Evaluate progress toward achieving measurable goals.
The NPDES permitting authority may determine monitoring requirements appropriate to your watershed. EPA encourages participation in a group monitoring project.
	• Keep records required by the NPDES permitting authority for at least three years.
	• Submit the records when requested by the permitting authority.
	• Make your records and stormwater management plan accessible to the public during regular working hours.
	    • A reasonable copying fee may be charged.
	    • Advance notice of up to two days for copying may be requested.
		• Submit annual reports to the permitting authority for the 1st permit term.
		• In subsequent terms, submit reports in years two and four, or more frequently as required
		• Reports should include:
		    • Status of permit condition compliance
		    • Appropriateness of identified BMPs
		    • Progress toward achieving measurable goals for each measure
		    • Results of data collected and analyzed during the reporting period
		    • A summary of the activities that will take place during the next reporting period
		    • Any changes in measurable goals

A Closer Look at the General Permit Process

Under Phase II, the NPDES permitting authority may issue a general permit for all nationally delegated entities. The process of issuing a general permit could include the following components:

- The NPDES permitting authority might announce its intent to develop a general permit for a particular category of discharger (i.e., based on population of community, etc).

- The NPDES permitting authority might solicit ideas from those who will be covered under the general permit as to what should be included in the permit.

- The NPDES permitting authority issues a draft general permit and requests comments on the draft permit to be made within 90 days. Generally notice of the permit is published in the newspaper that serves the localities that would be covered by the permit. Some states may require that the notice run for a certain length of time.

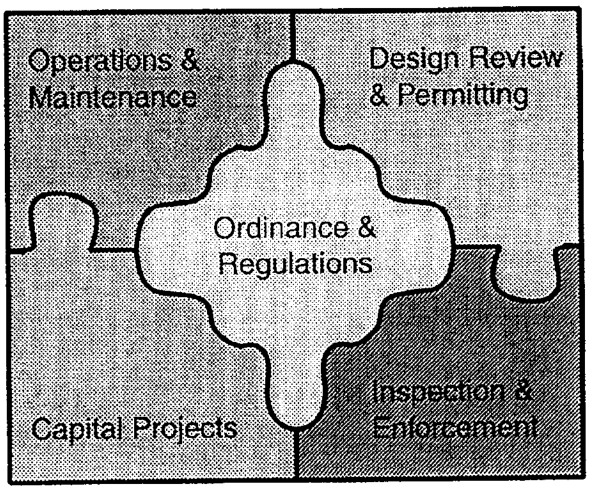
- The NPDES permitting authority analyzes the comments and writes a final permit. If the permit is issued by a non-EPA entity, it must be approved by EPA.

- Municipalities or others seeking coverage under the general permit submit a Notice of Intent (NOI) to the NPDES permitting authority. Current dischargers must apply for coverage within 3 years and 90 days of the date the final regulation goes into effect (if it goes into effect on March 1, 1999, the deadline would be June 1, 2002).

- The permitting authority reviews the NOI and follows up with permitee as required.

- The permitee is covered under the general permit in 48 hours. They will be notified by mail of their permit number. If, for some reason, the NOI is not adequate, they will hear from the NPDES permitting authority.

Chapter 3
What Does an Effective Storm Water Management Program Look Like?



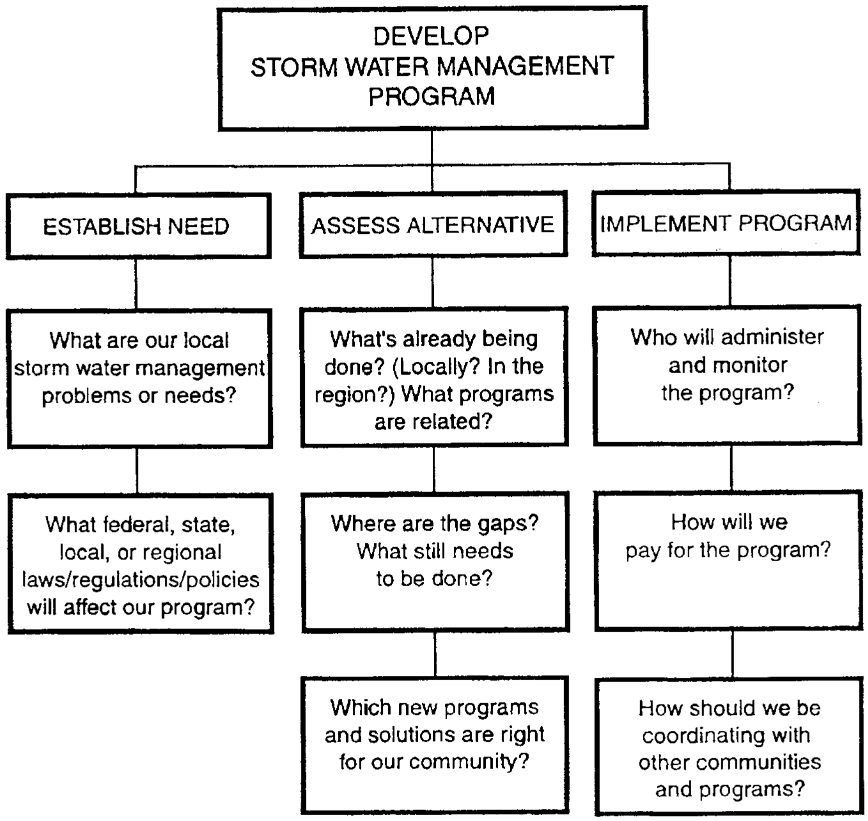
Effective storm water program planning requires several key steps: (1) identifying your local needs and requirements for compliance with the Phase II rule; (2) assessing alternatives; and (3) developing a plan to implement the selected alternatives. Chapters 1 and 2 of this workbook addressed the need for storm water management programs for smaller communities, from both a practical and regulatory context.

This chapter describes the alternative approaches to storm water management required by the Phase II rule and the process of evaluating the best solutions for your community. The chapter addresses typical components of a storm water management program, including:

- New or revised regulations/ordinances;
- Design review and permitting;
- Inspection and enforcement activities;
- System inventory/mapping;
- Operations and maintenance;

- Capital projects;
- Program planning;
- Public education;
- Project administration; and
- Linkages with other environmental programs.

First Things First



Before you begin planning a Phase II-compliant storm water management program, you should examine what's already being done in your community. At a minimum, ask yourself the following questions:

- What is the nature and status of your storm water system, including its capacity, how it operates, where the components of the system are located, what the maintenance routine is, and where the storm water discharges?

- What existing ordinances or regulations currently address storm water management directly or indirectly? Even if you do not have a storm water management ordinance, you may have other ordinances or regulations with features that affect storm water management, such as: land use and development, zoning, landscaping, wellhead protection, open space and conservation, economic development, growth management, etc.

- What related environmental programs may affect storm water management in the region?

- What storm water management programs are currently in place? How many of the six minimum control measures specified in the Phase II rule or identified by your local NPDES permitting authority are in place?

- Where are the gaps between current programs and policies and those that will be needed to effectively manage storm water and fulfill regulatory and permitting requirements?

Once you have answered these questions, you are ready to begin evaluating alternatives to fill those gaps. Each BMP should be evaluated using locally appropriate criteria, including:

- How much will it cost? Who will bear those costs? How acceptable are costs likely to be to affected stakeholders?

- What minimum control measures will this program element address?

- What is the likelihood of success (both technically and socio-politically) given local conditions?

- How easy or difficult will implementation be?

- Do we have the needed expertise, authority, and control?

- Is this alternative compatible with community values?

- Is there potential for cooperation with other agencies?

- What are the potential "unintended consequences" (environmental and otherwise)?

By answering these questions, you can better design a program that meets federal standards as well as the needs of your community. The sections that follow address additional questions that will help you understand the requirements of a Phase II storm water management program.

Will We Need New Ordinances or Regulations?

You will need to ensure that you have regulations or ordinances in place that satisfy the Phase II minimum control measures for:

- Construction site storm water runoff control;
- Post-construction storm water management in new development and redevelopment;
- Illicit discharge detection and elimination; and
- Illegal dumping
- Pollution prevention/ good housekeeping for municipal operations.

In addition to meeting new federal requirements for storm water management, developing and enforcing appropriate regulations can minimize your future cost of implementing and maintaining storm water facilities from newly developed areas.

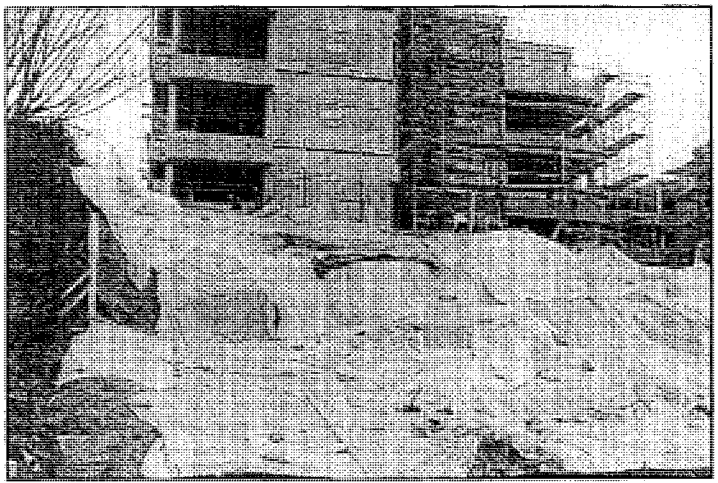
Regulations to satisfy minimum control measures usually consist of design standards for new development and redevelopment; operations and maintenance requirements for private facilities; and ordinances/regulations prohibiting illicit discharges.

Design Standard Regulations for New Development and Redevelopment

Design standards to control storm water runoff should:

- Define what types of construction activities must comply with the standards;
- Define thresholds and standards for different types of construction activities, such as:
  - Small sites for single family residential construction,
  - Larger residential, commercial, or industrial sites,
  - Very large or unique residential, commercial, or industrial sites,
  - Sites in close proximity to environmentally sensitive areas, and
  - Redevelopment projects;
- Mitigate for downstream impacts;
- Define exemptions; and
- Take into consideration the resources available for design review, inspection and enforcement.

If you don't already have them in place, you will need design standards for storm water runoff pollution controls to satisfy Phase II minimum control measures for pre- and post-construction. While treatment control BMPs may be applicable, most agencies with successful storm water management programs emphasize source controls. There is increasing recognition that treating storm water runoff with today's BMPs may be only partially effective.



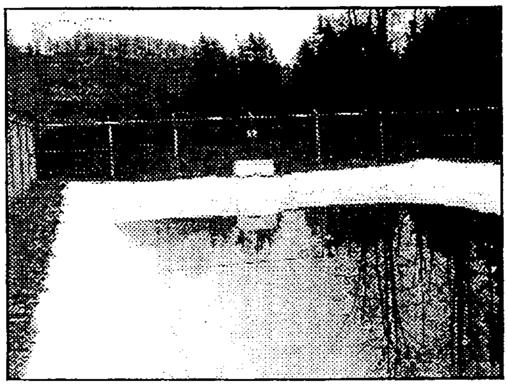
During construction, regulations will be needed for temporary BMPs to control erosion and sedimentation and reduce pollutants in runoff from sites with one or more acres of land disturbance. State, regional, or local requirements may set more stringent thresholds for temporary erosion and sediment controls. Regulations for temporary BMPs must also control other waste on the construction site that can adversely affect water quality.

From sites with one or more acres of land disturbance, regulations will also be needed to ensure that BMPs are used to control the quantity and quality of storm water runoff after construction. State, regional, or local requirements may set more stringent thresholds for these permanent BMPs.

Sample Temporary Erosion and Sediment Control BMPs

Source Controls	Treatment Controls
• Construction sequencing	• Stabilized construction entrances
• Limiting the amount of area disturbed at one time	• Silt fences and hay bales
• Time limits on activities during both wet and dry weather	• Diversions
• Timely stabilization of denuded areas	• Sediment traps and basins
• Proper storage of construction materials	• Temporary vegetation/mulching
• Proper disposal of construction waste	

Vegetated Water



Oil/Water Separator

Operation and Maintenance Regulations for Private Facilities Connected to Regulated MS4s.

To satisfy the Phase II minimum control measure for storm water management for new development and redevelopment, an operations and maintenance program is required for all storm water facilities discharging to a regulated MS4. To prevent and reduce pollutant runoff from your municipal system, operations and maintenance will be required for your publicly owned system, as well as any privately owned storm water facilities connected to the public system.

Typically local governments maintain the public system, but you must make a policy decision about who is responsible for maintaining the privately owned facilities connected to the public system. The issue of who maintains privately owned storm water facilities is further complicated where storm water from the publicly owned system enters a private system on private property. Some common policy options for maintaining private facilities are listed below.

- **Option 1** - The municipality is responsible only for maintaining the public system where it owns or has maintenance easements to the facilities. Private property owners are responsible for maintaining all private systems on private property.

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• **Option 2** - The municipality is responsible for maintaining both the public system (where it owns or has maintenance easements to the facilities) and the private facilities where storm water from the public system enters a private system on private property. Private property owners are responsible for maintaining those private systems that do not accept water from public systems.

• **Option 3** - The municipality is responsible for maintaining both the public and private systems. This arrangement can be implemented with formal or informal agreements with property owners for right-of-entry.

Whose Water Is It, Anyway?

With regard to storm water system maintenance, the overriding philosophy in King County, Washington is simple — storm water facilities located on private property that do not impact public conveyances or stem from public conveyances are the responsibility of the property owner.

In 1992, however, King County was asked to address some of these issues as a provision of a rate increase. Thus the Neighborhood Drainage Program was established. This program dedicates approximately $650,000 each year to repair storm drain problems on private property.

Projects are NOT considered for the Neighborhood Drainage Program if:

- The property is in an incorporated municipality;
- The project could fall under the responsibility of another program;
- The problem is simply a neighbor versus neighbor dispute; or
- The problem is due to violation of an enforceable code.

Potential projects are ranked by a point system. Consistent problems, and those that impact living quarters, receive higher points. The projected cost of fixing the problem is also considered, with the lowest cost projects typically receiving a higher priority.

On average, the County undertakes 6 to 8 capital improvement projects, 12 to 15 somewhat complex maintenance projects, and 30 more simple "quick fix" projects per year. One third to one half of the projects that are not accepted in the program receive some other sort of technical assistance.

The program is very popular among property owners, as well as elected officials, because it is highly visible and has resulted in the repair of many nuisances in the County.

More information on King County's storm water management program can be found on the World Wide Web at http://splash.metrokc.gov/wlr.

You will need regulations to support any policy decision made to require private property owners to maintain all or a portion of their systems for pollution prevention. These regulations usually include:

- A definition of what the private property owner is required to maintain;
- A requirement that prevents the obstruction or disposal of debris in the storm water system on private property;
- Requirements for proper disposal of waste from maintenance activities; and
- Inspection and enforcement provisions.

Regulations to Prevent Illicit Connections

The Phase II regulations require minimum control measures to prevent illicit discharges of non-storm water into your municipal storm sewer system (MS4). If you have not already done so, you will need to establish the authority to prevent illicit connections by implementing regulations that address:

- Definition of discharges prohibited to the MS4;
- Definition of discharges permissible to the MS4;
- Exemptions; and
- Authority to enforce.

What Type of Design Review and Permitting Requirements are Appropriate for Our Community?

Effective enforcement of minimum control measures number 4 (construction site storm water runoff control) and 5 (post-construction storm water management in new development and redevelopment) will require you to implement new or revise current design standards and a permitting process. You will need to review project design plans and calculations to verify that both pre-construction and post-construction storm water BMPs meet your requirements. Permits can then be either granted or denied depending upon whether all the community standards for the project were met.

One important tenet of successful storm water management programs is linkage to other land development programs at the local level. For example, approximately 88 percent of the urban communities surveyed by the Watershed Management Institute in 1997 require storm water management and erosion and sediment control plans to be approved before building permits can be issued.

In fact, Winter Park, Florida (a Phase II community located near the City of Orlando) coordinates zoning approval with the approval of runoff control plans.

Educating the development community as to what your standards are will also be a crucial element in the process.

The process that you use to perform reviews and issue permits for construction will depend on the following factors:

- The size of your community;
- Your institutional framework;
- Your staffing level; and
- The level of storm water runoff controls required.

In some communities it may be appropriate to perform design reviews and issue permits for all projects using the same procedure. In other communities, the review process may be different depending upon the size or type of project and the potential for adverse impacts.

Rules of Thumb for Establishing Design Review Procedures

- Meet with project engineer and/or architect early in the process
- Provide plan review checklists or other tools to ensure that the requirements are clear
- Make sure there are clear linkages with other approvals
- Allow for a pre-construction conferencing phase to help prevent problems from occurring later in the design review and permitting process.
- Create a relationship between the complexity of the permitting process and the potential for adverse impacts.
- Clearly convey design requirements to the development community.

Saving Time and Money through Pre-Application Meetings

When Stafford Township, New Jersey passed their aggressive storm water management ordinance in 1987 — which requires developers to give preference to underground infiltration systems to control storm water runoff - the Township had no experience in actually constructing or maintaining the underground infiltration type system. It was a learning experience for the Township's Engineer, the Environmental Commission, and the development community.

The Township has been willing to listen to developers and make adjustments to the original requirements where it is reasonable and practical to do so. "This does not mean," emphasizes the Township's Mayor, Carl Block, "that we just roll over when we get opposition from a developer. We are very clear. You either meet our standards, or you build elsewhere. But we are willing to make sensible compromises as long as our overall standards aren't affected."

According to Martha Kremer, the Director of Community Development and the Township's Zoning Officer, some of the biggest challenges that staff faced in trying to implement the storm water management ordinance were:

- Lack of understanding about the technology;
- Difficulties in communicating the plan's goals and requirements to small residential builders ; and
- Working through objections from larger retailers who have wanted to move into the Township.

"Most of the time, once we sat down with the engineer or project developer and explained what we wanted them to do, it was no problem," noted Kremer.

To ensure that such discussions took place early in the site development process, the Township implemented requirements for pre-application meetings in 1988. These meetings are intended to expedite the application process, reduce development costs, suggest and recommend appropriate and ordinance-compliant site design; and provide applicants with direction toward the other agency approvals that may have jurisdiction over their site.

The pre-application meetings require flexibility on the part of the Township's professional staff, as well as the applicant. The advantages include providing input from several local sources early in the design process, saving applicants the costs involved with repetitive engineered revisions, and allowing the Township to be well-informed as it considers the development application. In addition, Kremer notes that projects where pre-application meetings have been conducted experienced a shorter review process and a less costly project. "We spend more time in up-front planning, but we spend less time trying to fix the problems and monitoring bad situations."

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What Types of Inspection and Enforcement Tasks Are Required?

Phase II NPDES regulations will require you to enforce the requirements of minimum control measure number 3 (illicit discharge detection and elimination), number 4 (construction site storm water runoff control), and number 5 (post-construction storm water management in new development and redevelopment). To comply with these requirements, you will need adequate inspection and enforcement activities.

Inspections

Inspections are required to ensure that storm water BMPs are constructed and maintained in accordance with approved designs. Inspections are also required to detect and address illicit discharges to the system. At a minimum, you must conduct:

- Inspections during construction for erosion and sediment control;

- Inspections during and immediately after construction for proper installation of permanent storm water control BMPs;

- Ongoing maintenance inspections of completed storm water BMPs to ensure continued water quality protection; and

- A plan to detect and address illicit discharges (including illegal dumping) to the system.

Inspections of temporary erosion and sediment controls used during construction should be performed at regular frequencies and after significant storm events.

When inspection staff resources are insufficient to visit all construction sites on a regular basis, priorities should be established based on potential impacts to water quality at the site. Cooperative partnerships between you and the development community can increase the effectiveness of limited staff resources for inspection.

Keys to Building a Cooperative Inspection Policy

- Perform high profile inspections and provide reports that emphasize the importance of proper erosion and sediment controls to key project stakeholders
- Provide training to "certify" private inspectors. Require contractors or private facility owners to hire "certified" inspectors to inspect on a regular frequency, and to supply your agency with inspection reports
- Provide training and education to the development community on how to install erosion and sediment control BMPs
- Provide training to private facility owners about proper facility maintenance
- Implement inspection procedures that outline what the inspector should do and what should be done if requirements are not met

Inspections for proper installation of permanent storm water control BMPs must be performed at critical stages during construction. These inspections should occur prior to when structures are buried, when details can be observed and necessary corrections can be made. Implementing requirements for the developer to produce "as-constructed" record drawings will also encourage construction that conforms to approved plans.

Where maintenance is required by private property owners, ongoing maintenance inspections of completed storm water BMPs is a key, but often under funded element in many storm water management programs. Proper maintenance is necessary to ensure continued water quality protection and to extend the effective life of permanent storm water BMPs. Again, cooperative partnerships between you and private facility owners can increase the effectiveness of limited staff resources for these inspections.

Going for the Green

Maryland Department of the Environment's Nonpoint Source Program conducts a "Responsible Person Training and Certification Program" for Erosion and Sediment Control. This program, which was implemented in 1980, teaches best management practices associated with erosion and sediment control. Since its inception, approximately 15,000 people have taken the training course. Training is typically provided during the winter months when construction and earth-moving workload is light. Once a person completes the one-day seminar and passes an exam, he or she is certified and receives a "Green Card." Certification is valid for three years and is automatically renewed unless the Department of the Environment notifies the certification holder that additional training is required. A Green Card holder must be on a construction site at all times.

The program helps to ensure that construction activities within the State meet minimum sediment and erosion control standards without overburdening developers or inspection staff within the regulating agency.

Enforcement

Formal inspection procedures are performed to identify violations of regulations. In these instances enforcement mechanisms should be in place that give you:

- The legal authority to act;
- The procedures to follow; and
- The flexibility to use enforcement methods appropriate for the situation.

The vast majority of municipalities surveyed as part of this project use civil rather than criminal penalties as an enforcement tool. Even with civil penalties available, most communities note challenges with implementing the enforcement mechanisms. Unless the local government has established an "Environmental Court" (dedicated to enforcement of a wide range of environmental code violations), enforcing environmental laws is likely to be a low priority in the local justice system.

Data from a 1997 research effort conducted by the Watershed Management Institute suggests that over half of the municipalities with legal authority to enforce storm water management facility maintenance requirements have failed to take legal steps to facilitate the needed maintenance. In fact, the State of Florida estimates that over 70 percent of storm water management systems constructed since 1982 are not being maintained and operated properly.

Common Enforcement Tools

- Positive recognition of those complying with regulations
- Written notification to project manager
- Stop work orders
- Withholding permits
- Performance bonding
- Action by the locality upon failure of the developer to act, with costs levied against the developer
- Civil penalties
- Criminal penalties

Do We Need an Inventory of our Municipal Storm Sewer System?

The phase II regulations require minimum control measures to detect and address illicit discharges of non-storm water into your MS4. To accomplish this task, the regulations require that you have a storm sewer map showing the location of outfalls, and the name and location of the waters of the US that receive discharges from these outfalls. Inspection, enforcement, and spill response programs also need system maps in order to detect illicit discharges. These system inventory maps are also necessary to operate and maintain the system in accordance with the minimum control measures for pollution prevention and good housekeeping.

Getting the Most out of GIS

A Geographic Information System (GIS) was once considered a high-tech tool used essentially for planning and mapping. Now GIS is becoming a handy instrument for nearly every aspect of local government service. Communities use GIS for:

- Code enforcement
- Emergency response and management
- Recreation and parks management
- Roads and streets management
- Utilities management
- Infrastructure and facility management
- Police protection
- Land use management
- Ecosystem study and management
- Pollutant effect tracking

Using GIS allows municipal departments to more easily share data. Resulting policy decisions can be made, and projects that require inter-departmental coordination can run more efficiently. An added bonus is that a GIS allows officials to show citizens planned or completed improvements to the community.

The applications of GIS programs for water quality management are exciting. The Commonwealth of Massachusetts, for example, is using a GIS to monitor the water quality of the entire Merrimack River basin. The location of each sampling station, landfill, incinerator, pond, and tributary is stored in the GIS database. The GIS can plot the relationships between test sampling station water quality and potential sources of pollutants.

Although GIS systems are more affordable than they once were, the costs of developing and maintaining a sophisticated GIS may be unwarranted for smaller communities. As a result, many communities are developing GIS systems jointly, thus sharing in costs and responsibilities. Cities and towns often find counties, regional planning districts, or councils of governments to be good teaming partners for GIS projects.

If you are considering jointly developing a GIS program, you should resolve issues such as:

- How the cost of developing and maintaining the system will be shared;
- Who will have access to the system;
- What types of data will be included in the system;
- How priorities will be established for collecting and entering data and using the system;
- How users will pay for access to the system; and
- Whether data will be sold to outside entities.

Communities that share in developing a GIS system not only create a valuable policy tool that they might not otherwise be able to afford, but they also help each other through the kinks of developing the system and open opportunities for other cooperative efforts.

What Types of Operations and Maintenance Are Required?

The Phase II minimum control measure for pollution prevention/good housekeeping for municipal operations requires an operations and maintenance program for your MS4. You must develop this operations and maintenance program with the goal of preventing and reducing pollutants in storm water runoff from municipal operations.

At a minimum your maintenance program must include:

- Training local government employees to prevent or reduce pollutants in storm water from municipal operations; and
- Implementing regulations requiring private property owners to maintain their systems if a policy decision is made to require that.

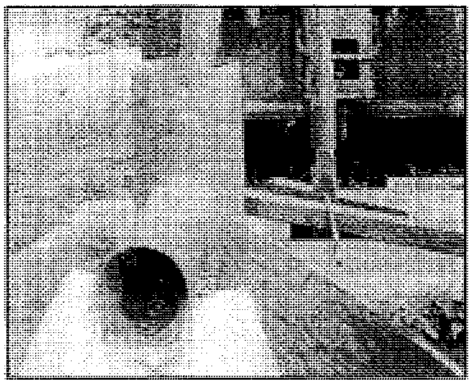
EPA also encourages communities to:

- Schedule maintenance activities and inspection procedures; and
- Dispose of wastes from maintenance activities in a proper manner.

Maintenance activities performed by a typical storm water management program include:

- Cleaning catch basins, manholes and outfalls;
- Cleaning pipes and culverts;
- Removing sediment from roadside ditches (only as necessary — avoid disturbing vegetated ditches that help remove pollutants in storm water);
- Controlling vegetation in roadside ditches;
- Sweeping streets;
- Cleaning detention structures;
- Controlling vegetation in above ground detention ponds;
- Repairing and replacing infrastructure;
- Performing inspections; and
- Properly disposing of waste from maintenance activities, such as catch basin cleaning.

In addition to its use to help locate illicit discharges, a map of the MS4 is necessary to carry out an effective maintenance program. From this map an inventory of system components can be created and used to schedule maintenance.



Cable toll rig used to clean storm drains

Catch basin cleaning

Elements of a Maintenance Program

- The number or length of each system component that needs maintenance
- The frequency with which each maintenance activity needs to be completed
- The crew sizes and equipment needed to perform each maintenance activity
- The production rate for each maintenance activity

What Types of Capital Projects Will Be Required?

The Phase II minimum control measure for pollution prevention/good housekeeping for municipal operations encourages communities to consider storm water controls from public facilities. This minimum measure also encourages communities to consider water quality BMPs in flood management projects.

Compliance with these requirements may require capital facilities construction. It is important to remember that, in addition to the NPDES program, there are other regulatory requirements and citizen concerns that establish the need for your capital improvements program.

Capital improvement programs are not specifically required by the NPDES Phase II regulations, however most storm water management capital improvement programs are driven by local interest in solving flooding, water quality, and sensitive aquatic resource problems. Community interest in solving these problems may be the source for much of the support for your program. Many of these problems you already know about because of citizen feedback. You may also be confronted with agency concerns and possible enforcement actions when there is a problem that impacts water quality.

Capital projects may include:

- Detention facilities;
- Water quality treatment facilities;
- Conveyance systems;
- Pumping stations;
- Dikes or berms;
- Culverts;
- Fish passage structures;
- Stream channel habitat restoration projects;
- Neighborhood drainage projects; and
- Retrofits of existing facilities.

The mandate from the public and elected officials for both new and existing storm water management programs may be to assume responsibility for both typical drainage problems, as well as water quality problems, associated with storm water runoff. Managing the drainage, or water quantity, part of your storm water program can require significant investment in capital projects that must be balanced with other program needs.

Capital projects can be a highly visible and popular part of your program, but you need to manage the public's expectations that there are quick fixes to longstanding problems. Oftentimes these expectations are inconsistent with the rate at which funding is available to implement new capital projects. You can educate your community on how quickly you can afford to resolve the problem, explaining that speeding up the process will require additional financial resources. In planning your capital program, it will also be important to show the community that everyone benefits by distributing projects in neighborhoods throughout your service area.

What Should We Do About Planning?

Although it is not specifically required as part of the Phase II regulations, you may want to plan your surface water program to make it more effective. This planning activity could consist of a comprehensive planning process that includes all the storm water policy, programmatic, funding, and technical issues. You may also decide that you want to perform the technical analysis for each of your watersheds or sub-basins separately and have the comprehensive plan include the results of those efforts.

What is Included in a Comprehensive Plan?

Storm water program comprehensive planning is a process of developing a unified vision for your community that, at a minimum, identifies and addresses:

- Goals;
- Policies for managing your storm water;
- Programs needed to accomplish your goals;
- Program costs; and an
- Implementation strategy.

Your goals will most likely include complying with regulations and meeting other local needs such, as flood protection. Policies will be needed, such as determining who is responsible for maintaining private storm water facilities. You will need to establish the specific duties associated with most of the program elements presented in this chapter. In order to develop an implementation strategy you will need to determine what it will cost to put these programs in place. Your implementation strategy will need to consider a number of possible funding mechanisms and how to obtain the necessary support from your community.

Your storm water management program will affect and be affected by other plans and policies in your community and region. The comprehensive planning process can help to ensure that your storm water management program interacts appropriately with other local and regional philosophies and programs. In addition, if the storm water management program can be demonstrated to mesh appropriately with existing comprehensive plans, both public and political support is more likely.

What is Included in a Watershed or Drainage Basin Plan?

Drainage basin or watershed planning is a process that uses data gathering and technical analysis methods to:

- Characterize the environmental, hydrologic, and hydraulic features of a surface water drainage area and its water bodies;
- Define problems with those features;
- Analyze solutions to those problems;
- Recommend a preferred set of solutions; and
- Determine the costs to implement the recommended solutions.

Drainage basin or watershed planning should determine needed capital projects, special regulations, maintenance, monitoring, and costs.

It is preferable to have the drainage basin or watershed technical analysis completed prior to finalizing your comprehensive plan. In this manner, your comprehensive plan contains a more accurate projection of your program costs. But oftentimes it is necessary to prepare a comprehensive plan prior to completing the drainage basin planning because the comprehensive plan is needed as a basis to obtain funding for the overall program (which includes the drainage basin planning).

Comprehensive plans can be used as a powerful tool to obtain community support for your program, especially if your planning effort shows a strong link between the goals established by the community at the outset and the various program elements. Your comprehensive plan can then include a level of service analysis that defines costs associated with each program element. In this manner the community can clearly see what can and cannot be provided with the resources available to implement the plan.

Why Is Public Education and Involvement Important?

An effective public education and involvement program will enable you to meet the following objectives:

- Satisfy the Phase II minimum requirements for public education and involvement;
- Improve water quality by modifying community awareness and behavior; and

• Obtain the necessary community support to fund your program.

Because public education and involvement is so crucial to the success of your program, Chapter 4 is devoted to this topic. Chapter 4 describes specific techniques that can be used to involve the community in your storm water program and educate them about the importance of adequate storm water management.

What are the Administrative Requirements of a Storm Water Management Program?

The Phase II regulations specify requirements for:

- Designating an entity responsible for implementation;
- Seeking public input into the storm water management planning process and communicating with the public about storm water management issues;
- Defining measurable goals for each of the six required minimum control measures;
- Establishing an implementation schedule that includes frequency of actions; and
- Establishing appropriate evaluation, record keeping, and reporting procedures.

In addition, you will need funding for your storm water management program. And all of these steps need to be evaluated within the framework of planning processes and programs that may already be underway in your community.

Chapter 5 of this workbook addresses selecting the implementation entity that makes sense in your community. Chapter 6 describes some common approaches to funding and financing storm water management programs. The sections that follow discuss the other key elements of storm water management program administration.

Establishing Measurable Goals

As part of your Phase II permit, you will identify and implement specific BMPs to meet the six minimum control measures. The effectiveness of each BMP must be assessed using measurable goals. Examples of measurable goals for the six minimum control measures are listed below:

Minimum Control Measure	*Sample Measurable Goals*
Public Education and Outreach	• Distributing a specified number of brochures or utility bill inserts addressing storm water management • Participating in a specified number of community meetings • Issuing a specified number of press releases on storm water management topics • Providing contractors with technical assistance
Public Involvement/ Participation	• Conducting a specified number of meetings with a citizen advisory committee • Soliciting a specified number of volunteers to participate in storm water management related activities • Stenciling a specified number of storm drains • Receiving a certain number of calls to an illicit discharge hotline
Illicit Discharge Detection and Elimination	• Surveying municipal rights of way a specified number of times over a specified time period • Inspecting or repairing a specified number of drain inlets per year • Performing dry weather testing a specified number of times
Construction Site Runoff Control	• Conducting a specified number of training programs for non-governmental inspectors • Conducting a specified number of inspections per year (% of construction permits)
Post-Construction Storm Water Management Control	• Conducting a specified number of inspections per year (% of occupancy permits)
Pollution Prevention/Good Housekeeping for Municipal Operations	• Conduct a specified number of training programs for municipal operations staff per year • Sweep a specified number of miles of road per year • Vacuum each storm drain outlet a specified number of times per year • Inspect and clean a specified number of gulches, regional ponds, and municipal facilities

Developing an Implementation Schedule

Your implementation schedule will be closely linked to your measurable goals for each minimum control measure. Availability of staff and other resources should be carefully weighed as you set frequencies for key activities and determine your overall timeline.

Evaluating Your Program

You are required to evaluate the effectiveness of your BMPs and achievement of measurable goals. Your storm water program should be monitored to determine the effectiveness of program elements and to provide a feedback loop to guide program changes. Monitoring must evaluate your program delivery systems, as well as their effectiveness.

Monitoring your program delivery systems can involve:

- Strategic planning;
- Comprehensive planning;
- Tracking the number of capital projects implemented;
- Determining actual maintenance frequencies and production rates;
- Linking goals to outcomes in program evaluation methods;
- Measuring regulatory compliance; and
- Achieving public participation goals.

Monitoring your program effectiveness includes physical measurements that determine how well your program is meeting its goals. Common steps involve:

- Stream gauging;
- Water quality sampling and testing;
- Channel bank erosion monitoring;
- Fish habitat/population monitoring; and
- Sediment deposition monitoring.

Keeping Up with Record Keeping

Your NPDES permit will require you to keep records for at least three years. These records should include information on what your storm water management program has accomplished, such as:

- Monitoring information;
- Inspection and enforcement records;
- Your public involvement program;

- Operations and maintenance records;
- Records of capital expenditures for storm water quality control facilities; and
- Monitoring data.

Reporting to Appropriate Agencies

You will be required under Phase II to submit annual reports to your NPDES permitting authority in the first permit term. The rules provide for more limited reporting in subsequent permit periods. This reporting must contain information on:

- Status of compliance with your permit;
- Monitoring data; and
- Summary of activities to be accomplished the next year.

Are There Other Programs Linked to Your Storm Water Management Program?

Although it is not included in the Phase II requirements, many jurisdictions manage storm water related environmental programs as a part of their overall surface water management program. Many of these programs involve fish, wildlife, and wetlands preservation. In some instances these programs are prompted by endangered species listings. In other instances, these programs are prompted by public input where preservation of environmental resources is an important quality of life issue for the community. It is important to take advantage of the public support that can be achieved for the program by implementing these types of environmental programs.

Local Land Use Policy Links with Watershed Protection

Mount Joy Borough, Pennsylvania, is a small municipality in the Chesapeake Bay watershed. In 1989, the Borough amended its zoning ordinance to provide for and encourage cluster development. Provisions in the ordinance permit cluster development (for residential use only) as follows:

- The cluster development may occur as a unified development of a lot that is 15 acres or more;
- The development must be served by public water and sewer;
- The overall density of the cluster development cannot exceed six units per acre;
- Special consideration will be given to the use of slant curbing to facilitate storm water management controls;
- At least 30 percent of the parcel to be developed must be preserved as common open space, wherever possible making open space interconnected with open space on adjacent parcels;
- The common open space must be improved for active residential use, unless the areas contains natural features, such as wetlands or wildlife habitat;
- The common space must be owned and maintained to ensure its preservation; and
- Depending on the maintenance method, the Borough may request that owners bordering the open space be assessed to provide reserve funds for maintenance or capital improvements of the open space.

This approach helps to ensure that land use in the Borough is compatible with environmental and quality of life priorities of the community and the watershed.

There may also be other mandatory water quality management programs that your community may be required to implement, such as a TMDL (total maximum daily load) on an impaired body of water. The requirements of the TMDL program may be in excess of what you are required to do under your Phase II NPDES permit.

Acquiring Land to Protect Water

As one example of how storm water management programs can link to other conservation and preservation activities, consider the Southwest Florida Water Management District's land acquisition program. In order to enhance water management, improve or protect water supply, or protect water resources, Florida's Water Management Districts are given the statutory authority to acquire land under two programs:

- "Save Our Rivers" Program ; and
- "Preservation 2000" Program.

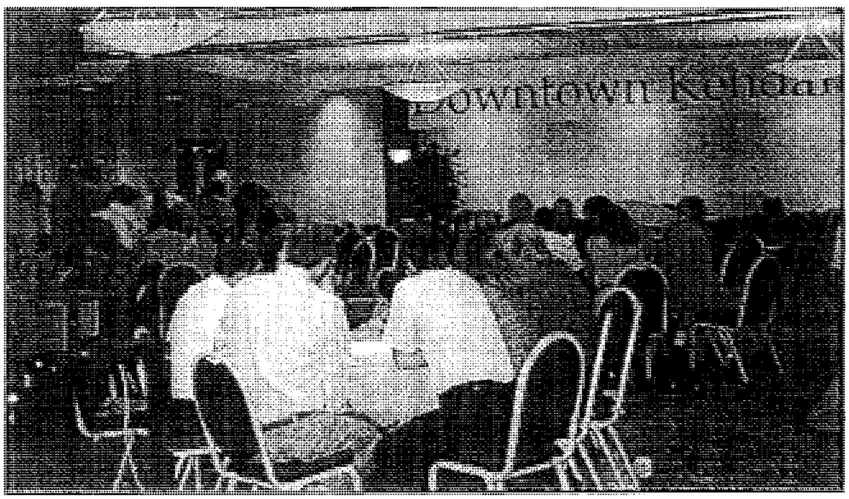
Anyone can nominate land for acquisition, and a site identification model is used to determine which properties would yield the best environmental impact. To date, the Southwest Florida Water Management District has acquired over 268,000 acres of land. A small portion of this acreage - approximately 13 percent - is acquired through conservation easements. Under this approach, owners agree to leave the designated land undeveloped or to develop only minimally on the selected property. The remainder of the acquired land is purchased outright by the District.

Of the land that has been acquired by the District to date, over 95 percent is open for public use. Thus, the acquired land provides recreational opportunities, such as hiking, camping, equestrian paths, biking, boating, and picnics. The District is also using some of the acquired land for cattle, hay management, and timber production.

Is There a Need for Interlocal Cooperation?

Storm water runoff does not start and stop at jurisdictional boundaries. Developing regional solutions for elements of your storm water program will be critical for success. Regional cooperation is discussed in more detail in Chapter 7.

Chapter 4
How Can We Build Support For Our Storm Water Management Program?



As anyone who has ever tried to site a landfill or get political support for major capital improvements knows, finding the right technology is only part of the problem. The same is true with storm water management programs.

Building public support and getting political consensus for Phase II storm water management programs will require planning, communication, and perseverance. This chapter addresses effective strategies to help you involve citizens in decision making, develop public outreach programs that work, and grow support for the storm water management program within your organization, including:

- Defining your target audiences;
- Understanding the importance of stakeholder involvement;
- Selecting a stakeholder involvement approach;
- Developing effective outreach and education programs; and
- Evaluating your public outreach efforts.

Who Needs To Be Involved?

The Phase II rules place certain requirements on your community to develop a storm water management program. Who needs to know about those requirements and have a say in what your program looks like?

At a minimum, Phase II communities must make efforts to involve citizens from diverse economic and ethnic backgrounds in the storm water management planning process. But citizens are just one of the target audiences who need to be involved and educated in order for storm water programs to be successful. Consider the following internal and external audiences who could be affected by your storm water program.

Internal Audiences	*External Audiences*
Elected officials	Builders/developers
Other decision-makers	Private facility owners
Department heads	Environmental activists
Economic development agencies	Taxpayer groups
Public works and planning department staff	Industries that may depend on surface water quality (e.g., tourism, fishing, etc.)
Inspectors Operations and maintenance personnel	Entities who will be most impacted by your selected funding approach
Public information staff	School-aged children/educators
Customer service personnel	General public
Utility billing staff	Neighborhood leaders

Including representatives from major stakeholder groups in the planning process, from visioning to planning, results in "ownership" of a plan and willingness to participate in its implementation. Involving diverse stakeholders can, however, pose some challenges. People will not always agree, and involving many people in the process can add a sense of disorder. Therefore, the process must be managed carefully.

What Is Stakeholder Involvement and What Can It Do for Me?

Stakeholder involvement is allowing those groups and individuals that care about, or will be affected by, your storm water management program's outcome to participate in planning and implementing the program.

"Participation" is a largely subjective word. It means different things to different people. For some people, participation may mean being informed every step of the way, others may only want a project update from time to time, still others will want their voices heard and will want to contribute expertise.

Typically, stakeholder involvement programs fall into two main categories:

- **Procedural:** Procedural programs fulfill federal, state, or local requirements for public involvement through such procedural steps as mandatory legal notices, public meetings, or hearings. Typically, these steps follow substantial effort on the part of the local government in developing a proposed plan or system. The public notices and meetings are designed to explain what will happen unless anyone can show cause why it should not.

- **Substantive:** Substantive stakeholder involvement efforts provide for open dialogue and exchanges of information, expertise, and concerns during planning and implementation processes. This approach allows stakeholders to more thoroughly shape the outcome of the plan or system from the beginning.

Local governments often approach stakeholder participation projects with a degree of trepidation. While almost everyone can acknowledge the potential benefits associated with getting up-front buy-in from residents and other constituents, there are often misconceptions about what stakeholder involvement can and should do. Responses to the concept of public involvement may include:

- We want our stakeholder involvement program to guarantee public support for our preferred plan of action and limit our political liability for controversial programs.

- We already know what needs to be done. Why do we need to involve a bunch of stakeholders who will try to influence us into making decisions that may not be sound in the long term?

- Go ahead and start some kind of citizen involvement committee, but make sure that you don't get any "whackos" on the thing. We just need some reasonable folks who will let us do what we know we need to do.

Phrased another way, some communities mistakenly believe that stakeholder involvement will eliminate controversy. Other communities believe that local governments have the responsibility to take action to protect the environment and public health, with or without public buy-in for those actions. These communities mistakenly believe that stakeholder involvement will automatically "water down" local government resolve to "do the right thing." Still others want to go through the motions of stakeholder involvement, mistakenly believing that a "rubber stamp" committee is a substitute for the give-and-take of real stakeholder involvement.

The solution to this dilemma is relatively simple. Stakeholder involvement is no substitute for leadership and vision. Nor can stakeholder involvement eliminate political risk or guarantee widespread acceptance. Real stakeholder involvement, where participants can affect the course of their community's plan or system, takes time and flexibility. However, the lack of a well-designed and implemented stakeholder involvement program can almost certainly derail projects that are otherwise sound from a technical, economic, and environmental perspective.

> ***"The public will not support you unless you are trusted."***
>
> ***– George Noble, P.E., land use expert***

What is Consensus?

Don't be fooled. Consensus is rarely the same as complete agreement.

A consensus process includes parties who have a stake in the outcome working together and maximizing their ability to resolve differences. When parties reach consensus, it means that they have agreed to accept the total package even though individual stakeholders may not agree with all components of the total package.

Assessment
Defining the *need* to talk

↓

Getting Started
Talking about *how* to talk

↓

Running the Process
Talking

↓

Implementing and Monitoring Results
Turning the talk into action

Source: Adapted from the Canadian Roundtable and "A Successful Model for Regional Consensus Building," Kathryn Baskin, Southern States Energy Board.

Why Is Stakeholder Involvement So Important?

Stakeholder involvement is vital to the success of a storm water management program. Involving members of various groups, as well as citizens at large, helps to ensure that key stakeholder groups feel involved in the decision-making process. As a result, your storm water management program will be more likely to receive widespread support and be implemented successfully. Additional benefits of stakeholder involvement include:

- People with different areas of expertise and philosophies contribute ideas, resulting in well thought-out storm water management programs and better solutions.
- Elected officials are more likely to support programs that have widespread public support or stakeholder buy-in.
- Project planners and decision-makers have the opportunity to think "outside the box."
- Using "citizen experts" helps communities implement change, even in the face of ever-constricting budgets.
- The process of working together helps different groups understand each other's cultures, philosophies, and attitudes, resulting in a more cohesive community.
- Acceptable funding approaches require equity, which can only be accomplished if stakeholders are represented in the planning process.
- Citizens are increasingly demanding to be involved and informed. They have greater knowledge, and expect to be informed of the decisions being made.
- Interested stakeholders can often help sustain the momentum of a project. A "closed" project, on the other hand, typically relies on the enthusiasm of one or more project champions, who are likely to be overburdened government officials or municipal employees.
- Storm water management program approval and implementation is facilitated when stakeholder comments are heard and responded to early in the process.

"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has."

– Margaret Mead

How Can I Involve Stakeholders?

Approaches to stakeholder involvement vary widely depending on your storm water management problems, how you want to implement your program, and the resources of your community. Typical stakeholder involvement strategies fall into two categories: (1) those that promote information exchange; and (2) those designed to collect information.

Stakeholder Involvement Strategies that Promote Information Exchange

Promote Information Exchange	***Collect Information***
Community visioning	Surveys Focus groups
Commissions and standing advisory committees	Commissions and standing advisory committees
Task forces, blue ribbon panels, and other special committees	Task forces, blue ribbon panels, and other special committees
Community meetings	Public hearings
Charrettes Public hearings	

Stakeholder involvement strategies can accomplish two important goals at once by allowing you and your staff to provide information to stakeholders and local leaders at the same time that you are collecting information about local needs and values. Examples of these interactive approaches are described below.

Community visioning processes: Most common when a community is undergoing a comprehensive planning process, community visioning allows diverse stakeholder groups and representatives from the general public to participate in policy making that could affect multiple areas of community life. While public works staff is less likely to initiate a community visioning process, the need to develop a storm water management plan can facilitate a broader planning process. Alternatively, a community visioning process may already be underway within your community on a parallel track - being spurred by concerns such as transportation, or growth management, for example. One important element of developing a community vision is getting stakeholders to help define local environmental values. Storm water management programs and related environmental programs will be affected by this local vision.

Commissions and Standing Advisory Committees: Many communities already have environmental commissions or similar standing committees, such as environmental or public works advisory committees. These groups typically comprise volunteers and receive support from governmental staff or other paid advisors.

If you don't already have this type of permanent community outreach mechanism in place, you may need an ordinance or proclamation from your elected body to establish the commission or committee. Typically, members will be appointed for specific terms and provide non-binding input to your elected officials. You may select members based on their personal interest in participating, one or more areas of relevant expertise, and/or their ability to represent one or more constituent groups. You can use these groups to help address specific issues, such as storm water management planning and implementation.

Creating a Community Vision

'Would you tell me, please, which way I ought to go from here?'

'That depends a good deal on where you want to get to,' said the Cat.

'I don't much care where' said Alice.

'Then it doesn't matter which way you go,' said the Cat.

- Lewis Carroll, Alice in Wonderland.

A community vision is a "wish list" of what citizens want for their community. In most instances, results from discussions of representative groups of stakeholders are synthesized into a community vision statement or vision points, which ideally lead to actions toward achieving the goals of the vision. Key characteristics of an effective vision statement include the following:

- Focuses on a time period 15 - 25 years into the future;
- Uses strong visual descriptions;
- Uses positive, present tense language;
- Gives a sense of what is unique about the community;
- Encompasses the desires of diverse community members;
- Is easily understood; and
- Focuses on people and quality of life.

Task Forces, Blue Ribbon Panels, and Other Special Committees: You may want to establish a special committee, panel, or task force to help solve a particular planning challenge. These types of committees are usually invited to form at the request of the local elected body, with a specific intent, timeframe, and outcome in mind. For example, a storm water management planning committee could be formed as a subset of an existing standing committee or as a new temporary entity. Again, you would seek volunteers who would represent the diverse interests of your community and/or contribute specific expertise to the process.

Some Key Steps to More Effective Committees

Establish a mission statement, including: What is the role of the committee? What are the specific tasks to be accomplished? Under what timeframe? To whom does the committee report? What is the structure of the committee?

Determine what guidelines or requirements will affect the committee, including open meeting laws, open record laws, public notice requirements, ADA accessibility regulations, and financial disclosure requirements

Define resource needs, including facilitation services, meeting rooms, audio-visual equipment, staff time, and consultant or advisor input

Develop a stakeholder assessment, including: Who will be affected by the decisions made by the committee? How will those stakeholders be included in the process? How will decisions and outcomes be communicated to stakeholders?

Develop a recruitment plan, including establishing demographic goals for the committee, a timeline for recruiting all members, and a clear appointment or application process Develop a "job description" for committee members, including: a statement of responsibilities, a clear definition of the role members will play, a statement of how much time is involved, and information on how the process and outcomes will be evaluated

Develop committee guidelines, including clarifying conflicts of interest, defining representation and reporting, and defining how the open process will work (for example, will input from non-committee members be accepted throughout committee meetings or at specified times?)

Develop communications guidelines, including distribution of minutes, notice of meetings, press releases and other communication with the print and broadcast media, and updates to other committees or elected officials

Establish evaluation/reporting procedures, including self-evaluation by the committee, constituent evaluation, evaluation by the originating bureau or official, and follow-up reports stating the impact of he work of the group

Source: Adapted from "Committees, Some Important Considerations" in An Outreach and Involvement Handbook for City of Portland Bureaus. Office of Neighborhood Associations, City of Portland, OR.

Community Meetings: Neighborhood associations meetings, civic groups, religious organizations, and business-related coalitions (such as Chambers of Commerce or trade groups) typically conduct regular meetings that can provide an opportunity to share information about storm water management planning and hear local stakeholder concerns. In addition, you may want to call a series of special community meetings to publicize your planning process and get needed feedback. You will probably want to develop a presentation that includes slides, overheads or other visual aids that can help meeting attendees grasp the importance of storm water management planning to clean water and other environmental issues. You can use techniques, such as consensus voting, to encourage meeting participants to rank their ideas and comments related to the storm water management program. You may also want to train a cadre of select volunteers who can make presentations as well. This approach can extend limited staff resources.

Simple Rules for Meeting Success

- Pick a meeting location that is accessible, has breathing room, and is stocked with needed equipment (electrical outlets, AV equipment, easel and pads, markers, masking tape, etc.).
- Confirm meeting times, sending reminders to key participants.
- End every meeting with an action check (What did we accomplish or agree on? What will we do at our next meeting? What follow up is required? Who will do what?)
- Bring extra copies of agendas and any other materials that have been sent to invitees in advance.
- Develop and use meeting agendas; start every meeting with a recap of the intended purpose and agenda items.
- Develop meeting summaries to document decision, agreements and consensus and define action items.
- Notice if someone is not participating — ask for his or her opinion directly.
- Notice members who come late, leave early or miss meetings. Confirm the importance of their participation in the process.
- Start and end on time.

Charrettes: A charrette is an intensive planning process that includes interaction of technical experts, affected governmental agencies, and citizens or other stakeholders. A planning charrette could include a full-day meeting with representatives from the community and a full-day meeting of representatives from various governmental departments, with a follow-up feedback meeting scheduled with community members. As a result of these focused meetings, recommendations for plans, projects, and codes can evolve. Charrettes can provide a forum for non-technical stakeholders to interact in small groups with planners, engineers, architects, and other related professionals who understand the technical issues of storm water management systems and actively work on a plan for your community.

Ground Rules for an Effective Charrette (Public Involvement Component)

- Go fast—produce lots of ideas
- Don't get hung up on intricate details
- Don't just say it – put it on paper (sketch or write)
- Everyone can write or draw at once, but everyone can't talk at once
- No one cares how well you spell or draw
- Build up ideas – don't say "no" to ideas yet
- Stay positive, don't complain – make a suggestion instead
- Be respectful – everyone's ideas count
- No speeches
- For at least the day, everything is on the table – pretend the sky is the limit

Public Hearings: Often a procedural requirement, public hearings are a more formal way to get stakeholder feedback. You may ask interested parties to submit questions or comments in advance.

Stakeholder Involvement Strategies for Collecting Information

Some stakeholder involvement approaches are designed specifically to collect information and opinions from stakeholders without providing a lot of information or direction. Examples of these approaches are discussed below.

Surveys: A good way to find out how much a broad audience knows about storm water management issues or how they might feel about specific storm water management strategies is a survey. You can develop a specialized survey that focuses specifically on storm water management issues, or you may want to include related questions on a broader survey that addresses a wide range of municipal plans, policies, and services.

Focus Groups: Used to collect more subjective information from stakeholders, focus groups can provide more in-depth information about how and why customers respond to a storm water management policy or outreach strategy. Typically not represented as "statistically valid," focus groups instead provide a richer context of information in which to evaluate stakeholder reactions.

Which Stakeholder Involvement Strategy is Right for Our Community?

The answer to this question depends on many locally specific factors, including:

- Time and resource availability
- Local experience with various stakeholder involvement techniques
- Flexibility and willingness on the part of decision-makers for stakeholders to significantly affect the outcome of the planning process

A combination of approaches may be most appropriate, as different involvement strategies may seem best at different stages in your storm water management program development. Remember the importance of internal stakeholders as you evaluate involvement strategies.

Survey Savvy

- How do you select a survey approach?
- What makes a good survey?
- How many people should you survey?
- How many responses should you expect?

The answers, of course, vary with your program goals, the amount of time and money you have available, and local demographics. Typically, however, some of the following guidelines can be helpful.

- **Survey approach** – Direct mail surveys typically involve less direct staff time than phone surveys, but often have a lower response rate. However, local governments that send out direct mail surveys under the signature of a high-ranking official have found that their response rates have been impressive. While standard industry wisdom would suggest that response rates to most mail surveys fall in the 3 to 10% range, many local governments receive responses from 30 to 50% of the survey audience. In addition, many local governments are increasingly sensitive to the potentially intrusive nature of phone surveys – especially given the increase in direct phone solicitations and computer-generated phone sales techniques that are prevalent today.

- **Designing the survey** – Almost anyone can design a survey. But designing a GOOD survey is a specialized skill. To make sure that you have minimized survey bias and that you are asking the right questions in the right way, you may need to rely on the help of survey professionals. Local universities, public relations firms, or market research firms can all be excellent sources of expertise in survey development.

- **Open-ended questions** – Open-ended questions, such as "What can we do to improve storm water management in your neighborhood?" provides residents with the chance to document specific problems and provide more qualitative feedback. If residents believe that these questions will result in positive actions, it may increase your response rate and provide valuable information about specific storm water concerns in your community. On the flip side, open-ended questions are more difficult to tabulate and use to draw conclusions.

- **Selecting the sample** – For most fairly homogenous populations, a survey sample of 300 to 400 responses is considered sufficiently large to be statistically representative. To determine the best sample size for your community, consult with market research firms or universities in your area. Statisticians can work with you to develop criteria for sample selection that meet the needs of your survey effort and population.

Communication is Key in Stafford Township, New Jersey

High levels of citizen involvement are not dependent on Madison Avenue-style advertising or big city budgets. Small communities often have the advantage of accessibility in their favor.

In Stafford Township, a community on New Jersey's coastal plain with fewer than 20,000 residents, a comprehensive storm water management program was implemented over a decade ago. To get buy-in for their ordinance and plan, the Township used several stakeholder involvement approaches:

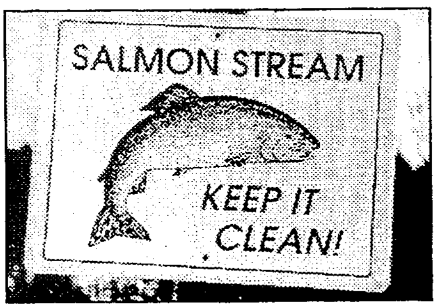
- **Special task force:** An Auxiliary Environmental Commission was formed to assist the standing Environmental Commission in evaluating storm water management practices and developing the recommended plan.
- **Community meetings:** The Mayor and members of the Environmental Commission made presentations about the program to civic, community, and religious groups throughout the Township.
- **Surveys:** Citizens were surveyed to assess their understanding of storm water management issues and gauge approval for the storm water management initiatives under consideration.

"Communication is the key to our success," notes Mayor Carl Block. "We get a lot of media coverage and spend a lot of time talking with people about our environmental programs." In an era where many local governments fear getting tough on environmental issues, Block notes that the Council member who consistently gets the most votes in each election is the man behind their strict environmental codes.

Getting the Word Out

Stakeholder involvement is only half of the story. The Phase II regulations require that you use public outreach as a component of your storm water management program. You will probably want to develop public education strategies to accomplish these key goals (at a minimum):

- Increase general awareness of storm water and the importance of storm water management;
- Inform the public about the specifics of your storm water management plans, policies, and systems; and
- Increase awareness of things that residents and businesses can do to improve water quality and volunteer their resources.
- Common outreach strategies could apply to either element of your public information plan.



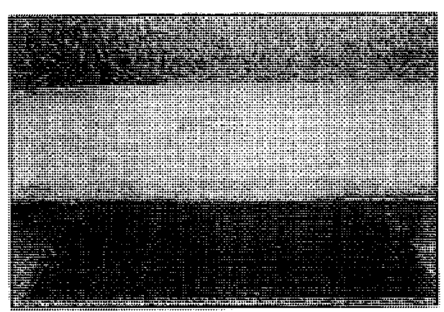


Illustration Source: Hampton Roads Planning District Commission, *Nonpoint Source Pollution... Be Part of the Solution: A Guide for Hampton Roads Citizens.*

Sample Public Information Strategies

Media Relations
- Press releases
- Media kits
- News conferences and related media events
- Articles and editorials
- Editorial Board meetings
- Appearances on local television, city cable channel, or radio programs

Advertising/promotion
- Logos/mascots/themes
- Print and broadcast public service announcements
- Paid advertisements
- Legal notices
- Illegal dumping hotline

Special events and public forums
- Environmental fairs
- Clean-up days
- Conferences or symposia
- Other speaking engagements

Direct mail
- Brochures
- S Flyers
- Utility bill inserts
- Newsletters Signage
- Drain stencils/signs
- Manhole labels
- Point of purchase displays

Educational Programs (Schools)
- Field trips
- Educational curricula. Use of volunteers
- Water quality monitoring
- Labeling storm sewer inlets
- Adopt a Tree, Adopt a Drain, Adopt a Highway, Adopt a Stream programs
- Clean up programs

Volunteers to the Rescue

Many communities have implemented volunteer programs that address storm water management issues. Some of these programs may already be operating in your state or locality, for example:

- Lakewatch -- a statewide program in Florida that recruits volunteers to monitor the water quality of lakes.
- "Adopt-A-Tree" Program – Stafford Township, New Jersey has implemented this program, and as a result 1,000 trees have been planted in the community in the past 8 years.
- "Adopt-A-Highway" Program – Many communities, including Griffin, Georgia, implement this program in which community groups take responsibility for cleaning certain stretches of highway, resulting in less debris in waterways.
- "Adopt-A-Stream" Program – Like Adopt-A-Highway, volunteer groups take responsibility for properly maintaining a stretch of stream.
- Waterwise Program – In Virginia, the Extension Service offers this program, which teaches residents how to treat lawns and gardens with water quality in mind. Similar programs exist through county extension offices in other states.

Picking the Right Channel

Deciding which combination of public outreach strategies is most appropriate in your community will depend on your target audience and the resources that you have available to design, distribute, and pay for public information materials. Many of the items listed above are available for little or no money, but staff time will be required (for example, to develop relationships with your local media contacts and respond to media inquiries).

It is important to match your distribution medium with your target audience. For general information about your program, your will want to ask yourself: "How do people in this community get information about government services and programs now?" You may have a sense of the answer to this question from previous surveys or your general understanding of the community. Local opinion leaders may also be able to provide insight.

In addition, you may want to launch special educational programs designed to address specific storm water problems in your area. For example, if you want to remind do-it-yourselfers that automotive fluids should not be dumped down storm drains, you may consider several specific media:

- Point of purchase displays at local retailers where motor oil and antifreeze are sold;
- Signs or stencils on storm drains (perhaps in multiple languages, depending on your local demographics); and
- Public service announcements that air during prime commute times or during popular sports or automotive programming.

You don't need to be a media expert to take advantage of Madison Avenue know-how. Your local newspapers, magazines, and radio stations already track detailed information about who views or listens to their programs or reads their materials. This information includes not only demographics (such as age, education, and income level), but also spending habits, reading/listening/viewing patterns, and related behavioral information. This type of data is called "psychographics," and the psychographic profiles in your media market are available to you for the asking. Armed with this information, you can design a public education program that best meets the needs of your target audiences.

> ***"The best approach to take in our overcommunicated society is the oversimplified message."***
>
> ***– Al Ries and Jack Trout, Positioning: The Battle for Your Mind***

Choosing the Right Message

"A picture paints a thousand words" may seem trite, but it couldn't be more apt.

If you serve communities with language or literacy barriers, drawings, photographs, and symbols will be critical to your public information materials. Clear, easy-to-follow guidelines with concise pictures or illustrations will help to minimize confusion and promote more widespread understanding of your message.

> ***"The mind rejects new information that doesn't 'compute.' It accepts only that new information which matches its current state of mind. It filters out everything else."***
>
> ***– Al Ries and Jack Trout, Positioning: The Battle for Your Mind***

Even if language or literacy challenges are not an issue in your community, most people have little time for reading complicated sets of instructions or densely written documents. Your information will be competing with thousands of other messages.

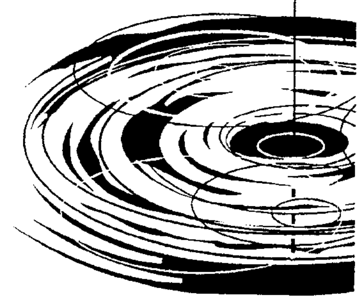
Consider the fact that the average American consumes over 94 pounds of newsprint per year — that's more than 10 million words per year from the newspaper alone. When you couple that estimate with 750,000 television images viewed by the average American EACH DAY, you begin to understand the importance of clear and simple messages that can help blast through our clogged communication highways.

What's the Appeal?

There are three main types of messages - those that use rational, emotional, or moral appeal.

- **Rational:** These messages are directed to the rational self-interest of the audience and are used to demonstrate the functional benefits of storm water management. For example, "Proper storm water management helps prevent water pollution and environmental degradation."

- **Emotional:** These messages encourage support for storm water management by stirring up emotions. For example, "Would you drink water contaminated with dangerous chemicals? Without a storm water management plan, every rain shower carries motor oil, bacteria, pesticides, and other chemicals from our neighborhoods into our water supply."



- **Moral:** These messages appeal to a person's sense of what is right or wrong. For example, "It makes sense to invest in effective storm water management systems now, rather than leaving a legacy of pollution and expensive remediation for our children."

The WII-FM Test

According to Susan Peterson, a media consultant in Washington, D.C., WII-FM is a "communication channel" that everyone in North America tunes in to every day. Sound impressive?

In order to get your messages on the WII-FM channel, they have to pass a simple test. It's been nicknamed the WII-FM (pronounced whiff 'em) test by Peterson and her associates. What's involved?

WII-FM stands for What's In It For Me.

To be effective, your informational materials must communicate the need for a storm water management program to stakeholders in ways that are meaningful to them.

Too often, we tell our customers what the changes mean to us. For example, we might say "In order to meet federal mandates, we must assess a fee to households and businesses for developing and maintaining a storm water management system." This message emphasizes the burden placed on the local government by the federal mandate. But it does little to address the concern/needs of the ratepayer. In other words, it fails the WII-FM test.

A better message might be: "Clean water is important to all of us. Every building and paved surface in our community contributes to increased storm water run off. This run off carries pollutants and contaminants that can foul our water supplies and negatively affect the entire watershed. A small fee is being assessed, based on the amount of impervious surface on each property, to help pay for needed storm water controls. This small fee will help protect one of your most precious resources – clean and abundant drinking water. Isn't it worth the price?"

Be Prepared

Public meetings may provide an excellent opportunity to explain your storm water management program and get stakeholder feedback. However, if elements of your proposed storm water management plan are controversial - for example, storm water assessments or related development impact fees - it is important to be prepared for the possibility of public hostility and negative media coverage.

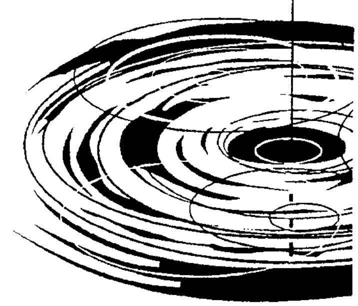
Media consultants suggest a preparation technique known as "rolodexing." The steps are simple:

- Identify likely areas of concern.
- Get your technical facts straight. Have facts and figures at your fingertips.
- Brainstorm your possible responses to those concerns (using the WII-FM technique described above).
- Pick up to three of the best responses and hone them to sound bites.
- Write the sound bites on a rolodex or business card (the small size will make it easy to carry and will limit the number of words that you use).
- Practice. Remember — tone of voice and body language account for over 90% of an audience's response to your message.
- Remember that groups who oppose your storm water management program may be well-funded, with spokespersons that are comfortable in front of the camera. You need to take advantage of similar levels of media savvy.
- Consider the use of consultants to add technical credibility and help "take the heat."

Can You Believe It?

Source credibility is a factor that affects how audiences will perceive your message. Three factors will typically determine a speaker's perceived credibility. You should carefully weigh these factors as you select one or more spokespersons for your storm water management program.

- **Expertise:** Does your spokesperson have the authority to back up what he or she claims?
- **Trustworthiness:** Is your spokesperson likely to be perceived as honest and objective? Will audiences believe that he or she has a hidden agenda or ulterior motives?
- **Likability:** Does your spokesperson have personal charisma? Do people generally like him or her?



Evaluating Your Public Outreach Program

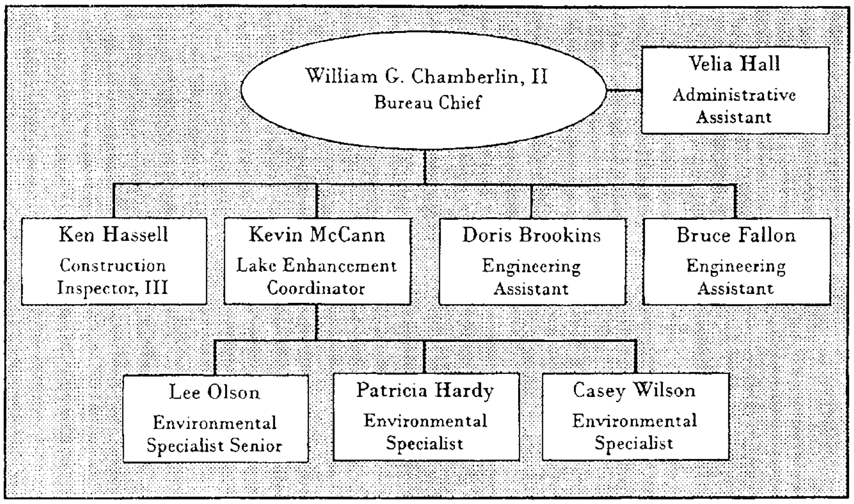
How will you know if your public outreach program is effective?

Annual surveys can help assess how levels of awareness of storm water management issues have changed. Other strategies that can help you monitor effectiveness include:

- Tracking media coverage;
- Tracking requests for publications, speakers, and information about storm water management that come into your agency;
- Tracking responses to "how did you hear about our program?" inquiries;
- Tracking the number of volunteers or groups/citizens involved in your clean up programs or drain labeling programs;
- Tracking changes in enforcement patterns (e.g., increases or decreases in violations of your ordinances);
- Surveying residents and businesses to document changes in levels of awareness and/or behavior; and
- Collecting anecdotal and informal information from staff, stakeholder groups, and your own interaction with representatives from the community.

> ***"You have to do more than just get your message in the media; you have to design a message that will have an impact on the audience."***
>
> ***– Dr. Pete Sandman, Communication Theory and Persuasion***

Chapter 5
What Type of Institutional Framework Will Work for Our Community?



- Who will develop your storm water management program and select locally appropriate BMPs for the minimum control measures required under Phase II?
- How will program responsibilities be shared?
- Who will be responsible for monitoring the program and fulfilling reporting requirements?
- Who will develop and manage the budget for the storm water program?

As you consider the answers to these questions, there are a variety of institutional frameworks available to you, and no one approach is inherently better than another.

In order to select the approach that is right for your community, you must examine the characteristics of your community, determine which structure will best suit local needs, and assess which structure will work most successfully within your resource base.

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This chapter addresses organizational and institutional issues related to implementing a Phase II-compliant storm water management program, including:

- Strategies for developing and implementing a storm water program independently, assuming the responsibility for addressing all six minimum control measures internally; and
- Strategies for seeking cooperation of an umbrella entity, such as a county, commission, or regional district.

Chapter 6 addresses funding strategies, which are closely related to organizational structure.

Internal or External?

An internal program is a program housed in within your jurisdiction. External programs are administered outside of the boundaries of your jurisdiction. Your storm water management program may rely solely on internal resources, or you may find it beneficial to use a combination of internal and external resources to achieve your storm water management objectives.

Internal Programs

If you will be developing and managing your storm water management program with local governmental resources, you may select one internal entity to design and implement your program. Alternatively, several departments or entities within your municipality may work jointly. Common approaches to storm water management program organization at the local level include:

- Developing a storm water department;
- Giving responsibility to a multi-functional department, such as the public works department;
- Sharing responsibility for implementing the program among several departments within your community; and
- Creating a storm water district.

Each of these alternatives is discussed briefly in the sections that follow.

Storm Water Department

Some communities form a storm water department to perform most or all of the functions required in a storm water management program. Forming a storm water department generally requires that a group of staff be dedicated solely to storm water management activities. This group of staff is usually responsible for program administration but may share the responsibility of implementing some elements of the storm water program with other departments.

The obvious advantage of forming a storm water department is the availability of dedicated staff resources to focus exclusively on storm water management issues. However, most smaller communities may have difficulty justifying establishing a separate department. In many areas of local government, consolidation among departments is the trend, designed to reduce administrative requirements and achieve economies of scale between departments with common functional responsibilities.

Department of Public Works

In many Phase II communities, the department of public works will take the lead role in developing and implementing a storm water management program.

Because critical departments –such as engineering, code enforcement, and streets and maintenance - often fall under the authority of the public works department, this arrangement makes sense. In addition, the department of public works generally has the proper equipment to construct and maintain storm drains and storm water conveyance systems. Another advantage to coordinating your storm water management program through the public works department is the natural synergy between streets and drainage systems. Conveyance systems and storm drains are located along streets, so coordinating repair and maintenance is crucial to program cost-effectiveness.

Alternatively, because public works is a multi-functional department, your storm water program may not have dedicated resources - people and equipment will be shared for different types of projects. In most small communities, however, the need to share staff and equipment among programs is nearly universal.

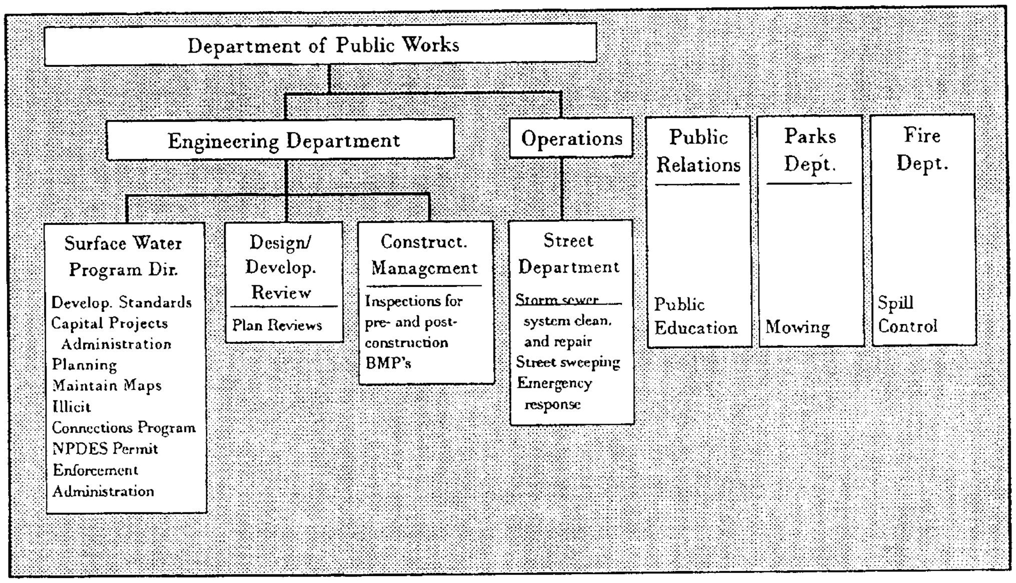
Housing your storm water program under the department of public works makes particularly good sense if your community:

- Does not have the resources to establish a new department, such as a storm water department;
- Already has a public works department that handles streets and drainage, engineering, and code enforcement activities;
- Can perform storm water management functions in the most efficient manner by using existing and possibly additional resources within the department; and
- Does not have access to a regional entity that would implement a comprehensive storm water management program on your behalf.

When storm water management falls under the department of public works, a staff person within the department may be designated as the lead person to ensure that all aspects of the program are being accomplished. For example, many communities designate the City Engineer or a deputy engineer to coordinate all aspects of the storm water management program.

It is important that all sub-departments within the department of public works maintain good communications with each other regarding storm water projects. An inter-departmental newsletter, regularly scheduled meetings, a storm water bulletin board, and other informational resources dedicated solely to storm water management could prove helpful.

Sample Organizational Chart



Intra-Departmental Cooperation

Because storm water has an impact on (and is impacted by) so many other resources and aspects of your community, your storm water management program may require the coordination of several different departments.

Coordinating between different departments can be challenging, but often it is the most logical approach - particularly in communities with limited resources. Naturally, combining resources from a variety of departments to manage one program requires excellent communication and clear understanding of who is responsible for implementing which elements of the program.

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Barriers to Cooperation

In 1987, the Watershed Management Institute surveyed 30 jurisdictions (combination of state, regional, county, and municipal governments) to assess the impacts of various institutional arrangements on storm water and sediment and erosion control programs. Over 70 percent of the respondents noted that there were conflicts with other programs than hindered effective implementation of storm water management programs.

Common challenges included:

- Ideological differences between advocates of development and advocates of increased environmental protection;
- Conflicts between wetlands management and storm water management (typically found when wetlands are filled or converted to open ponds);
- Conflicts with roads departments related to transportation corridor planning. Because storm water BMPs are often land-intensive, roads departments may be required to obtain more right-of-way, which increase costs. In addition, if roads departments are assessed storm water utility fees (see Chapter 6), additional tensions could arise; and
- Conflicts with other environmental programs that may be competing staff resources, funding, volunteer assistance, and public support. Overlapping areas of responsibility are sometimes a key cause of tensions between environmental programs, as well.

Although it is not necessary to interact with all of the following entities to meet the requirements of the Phase II storm water management regulations, a mature, comprehensive storm water management program might include interacting with the following departments within your community:

- Department of Public Works
    - Streets and roads maintenance
    - Municipal good housekeeping measures
    - Storm sewer system maintenance
    - Street flooding issues
    - Household hazardous waste program
- Sanitary Sewer Department
    - Detect illicit discharges and connections

- Engineering
  - Inspection/design permitting
  - Erosion and sediment controls
  - Construction contract administration
  - Code enforcement
- Department of Education
  - Public education activities for school-age children
- Department of Parks and Recreation
  - Mowing detention ponds
- Fire Department/Police Department
  - Illicit discharge detection
  - Spill containment
- Other municipal departments
  - Planning
  - Building Inspection
  - Accounting
  - Legal
  - Administrative
- Neighborhood organizations
  - Public outreach/education activities
  - Citizen involvement

When in Rome...

The City of Rome, GA, is an example of a community that implements their storm water management program with the cooperation of two departments.

The Public Works Department is responsible for most of the plan, including public education and developing pre-construction and post-construction storm water requirements. The Code Enforcement Division, under the Department of Building Inspections, undertakes inspection and enforcement activities. In addition, the Code Enforcement Division conducts illicit discharge monitoring. Citizens are supposed to direct complaints to the Code Enforcement Division, however, if the Department of Public Works is contacted, they forward the information to Code Enforcement.

When a developer applies for the proper permits, the storm water management plans are submitted along with the permit application to the Division of Code Enforcement. Code Enforcement ensures that all information is complete, then sends a copy of the storm water management plan to the Engineering Department, which is part of the Public Works Department. The Engineering Department ensures that the plan is adequate, then sends a copy back to the Code Enforcement Division, along with a letter stating that the plan is acceptable. The Code Enforcement Division is then responsible for permit issuance and enforcement. Code Enforcement staff conduct weekly on-site inspections of ongoing projects and have the authority to issue notices of complaint, notices of violation, and citations if proper BMPs are not followed.

City staff report that the arrangement works out fairly well, and both the Public Works Department and the Code Enforcement Division realize that cooperation is needed in this small city of 31,000 residents. Neither entity has the resources to implement the entire program single-handedly.

External Programs

In many cases, communities have found it advantageous to pool resources to more effectively design and implement storm water management programs. You may decide to be responsible for some or most of your storm water management program elements, but that other elements - such as some aspects of public education, or construction of regional storm water management facilities - may be appropriate for regional entities that are external to your program. Examples of such regional entities include quasi-governmental entities and other forms of inter-governmental cooperation. Additional discussion of regional cooperation is presented in Chapter 7.

Quasi-Governmental Entities

Many communities throughout the country have formulated special districts, commissions, and authorities to establish and implement storm water projects. State enabling legislation may be necessary to form such entities. Special districts, commissions and authorities may be formed along watershed boundaries, or may consist of a group of municipalities. The functions that these quasi-governmental entities undertake vary widely. In some cases the entity addresses a broad array of water issues - such as flooding, drainage, and water quality. In other cases, the entities focus on a much more specific concern, such as the quality of water in shellfish beds or diking practices.

Examples of quasi-governmental entities that address storm water issues include:

- The Urban Drainage and Flow Control District (Denver, CO)
- Water Management Districts (five such districts have been created by the Florida State Legislature)
- The Hampton Roads Planning District Commission (VA)
- The Green River Flood Control District (WA)
- Kent County Conservation District (DE)
- Kitsap County Shellfish Protection District (WA)
- Lake County Storm Water Management Commission (IL)

Regional Planning for Hampton Roads

The Hampton Roads Planning District Commission (HRPDC) in Virginia serves as a regional cooperative effort for its fifteen member cities and counties. The HRPDC Stormwater Management Committee meets monthly to cooperate on a variety of storm water management programs. The committee is made up of: (1) representatives from each of the fifteen member communities; (2) a representative from the Hampton Roads Sanitation District, which provides monitoring and laboratory analytical support for the permitted communities' programs; and (3) a representative from the Virginia Department of Environmental Quality.

The meetings provide a forum in which members can share information and education regarding storm water management projects. The six Phase I permitted communities are providing significant education to the non-permitted localities, which are expected to be affected by the Phase II regulations.

The following activities take place at HRPDC Storm water Management Committee Meetings:

- Representatives of state and federal agencies brief the committee on developing issues, regulatory guidance and technical programs.
- Localities exchange information regarding their experiences with various funding mechanisms.
- Educational materials, such as pamphlets and promotional items, are exchanged. Communities may adapt the materials, giving appropriate credit to the community that developed the material, and use it in their own program.
- The six permitted communities participate in a joint water-sampling program through the Hampton Roads Sanitation District.
- The communities participate in the Hampton Roads Tributary Strategies Project, which aims to work with the state and others to reduce nutrient loadings to the Chesapeake Bay.

In addition, other examples of HRPDC's activities include:

- The six permitted member communities are implementing programs in response to Virginia's Chesapeake Bay Preservation Act.
- The member communities are pursuing a comprehensive Regional Watershed Management Program, which will focus on protection of surface water components of municipal water supplies.
- The HRPDC Newsletter includes brief status reports on the storm water programs. The newsletter is distributed quarterly to local government officials, citizen groups, business groups, and state federal legislators.
- The HRPDC developed an educational booklet, Nonpoint Source Pollution...Be Part of the Solution: A Guide for Hampton Roads Citizens.
- The Regional Storm Water Management Committee actively participates in the state and federal regulatory process.

Some advantages of quasi-governmental entities are:

- They provide an opportunity for several communities to share ideas, expertise, and oftentimes funds for special projects.

- Often the quasi-governmental entity takes a leadership role and provides member communities with technical assistance and expertise that otherwise would not be available to them.
- A dedicated, unified funding source is created, protecting funds for storm water management projects and removing competition for money.
- A watershed approach is facilitated - important because storm water from one community can have an impact on many other communities.

Some of the disadvantages of a quasi-governmental agency implementing the storm water management program include:

- It may be difficult to prioritize projects.
- The district or commission may not be located close to certain communities, making them feel "out of touch."
- It may be difficult to decide on funding methods and proportions.

Inter-Governmental Cooperation

In some cases, jurisdictions will cooperate directly with each other to implement storm water management projects. One community may take a leadership role, or two neighboring communities may simply develop a partnership.

The cities of Orlando and Maitland, Florida, for example, maintain a good rapport and share test results of water quality experiments. In this manner, they avoid duplicating efforts and can learn from each others' experiences. Orange County and the Cities of Orlando, Maitland, and Winter Park (FL) also have round table discussions from time to time. These discussions allow the communities to share information regarding the issues that they all face and to learn from each other without having to duplicate efforts. The participants find these discussions very helpful.

In some communities, the state takes on a role. Many state environmental regulatory departments, for example, will provide technical assistance, training and grants for certain aspects of your storm water management program. Many states, too, have already implemented other regulations related to storm water, such as strict erosion and sediment control programs (such as Maryland and Delaware) and may offer training to developers.

Some counties also take the lead in helping local governments to cooperate. This leadership may take the form of serving as a lead agency for watershed planning or providing other regional needs.

Regional Cooperation - Who Should Get What?

Deciding how resources should be allocated to projects can be challenging for quasi-governmental agencies implementing storm water programs. The Lake County (IL) Storm Water Management Commission has devised the following prioritization criteria grid to help decide which projects to help fund.

		Project 1			Project 2		
Rank	**Prioritization Criteria**	**Weight**	**Score**	**Total**	**Weight**	**Score**	**Total**
1	Benefits multiple jurisdictions/has multi-jurisdictional impacts/drainage area > 100 acres	25%					
2	Beneficial results/ impacts for up to 100 year flood event	20%					
3	Remove, elevate or floodproof buildings	15%					
4	Improve surface water quality using BMPs	15%					
5	Natural resource protection/emphasis on non-structural strategies	10%					
6	Alleviates major nuisance flooding and/or blocked transportation access	5%					
7	Provides multiple use benefits	5%					
8	Utilized federal/state funding	5%					

Score: 0=no effect, 1=minimal effect, 2=below avg. effect, 3=avg. effect, 4=above avg. effect, 5=maximum effect practicableTotal=Score x Weight

Some advantages of taking an "external approach" to storm water management include:

- Expertise and resources can be combined to effectively plan and implement projects;
- A regional or watershed approach can be utilized, so that communities who have an impact on each others' watersheds are working together, not isolated from each other; and
- Programs can be carried out more cost-effectively.

Some challenges posed by taking an external approach include:

- Deciding how to fund joint projects can be challenging.
- You may feel disconnected with some external players, such as state agencies.
- Proper communication and establishment of roles and responsibilities is essential.

While there is no one right or wrong way to implement a storm water management program, there are certain activities that will promote a productive relationship between the entities involved. These activities include:

- Have one person responsible for overall coordination of the storm management program. Ensure that all departments involved know who the "program manager" is.
- Have one person responsible for the NPDES permitting portion of the program. This person may be the program manager or someone else.
- Ensure that needed ordinances or agreements that clearly define responsibilities and authorities of the cooperating entities are in place.
- Solicit the input of all involved departments while developing the storm water management program.
- Clearly define who is responsible for implementing what portion of the storm water management program.
- Discuss monitoring and reporting requirements in advance. Establish who will be responsible for keeping records, how records will be kept, and how often they will be submitted to the NPDES permit coordinator.
- Establish how activities will be funded.

- Establish an accounting system in advance. If storm water activities have a separate account, ensure all participating departments are able to charge storm water activities to the storm water account. Employees should also be informed of changes in procedures.

There are a number of advantages and disadvantages to various approaches to storm water management. In all likelihood, your program will incorporate a combination of those approaches that best meet your community's needs.

Choosing the Right Approach for Your Community

It is important that when you choose your storm water management institutional framework, that you consider the following:

- What resources (expertise) currently exist in your community?
- Where are the functions that relate to storm water management currently housed?
- Are there neighboring communities with similar storm water issues?
- Is there a regional group that could implement or help with such a program?
- Are there particular storm water issues that pertain to your community?
- Are there state or federal programs that could interface with your community's program?

Advantages and Disadvantages of Various Organizational Approaches to Storm Water Management

	Advantages	Disadvantages
Department of Public Works	• Communication may be easier • No need to form a new department • Many functions typically performed in this department relate closely to storm water management • Equipment may be used for multi-purposes, which could enhance its productivity	• Could be missing out on valuable research/expertise from external entities • Department has several interests, not dedicated solely to storm water needs • Communication among different branches of department may be an issue
Storm Water Department	• Communication may be easier if program housed in one department • People and equipment dedicated to storm water projects • Smaller department may facilitate communication· • You can focus on issues that apply to your community	• Could be missing out on valuable research/expertise from external entities • May be costly to form a new department • An ordinance may be required to form a new department
Intra-Govern. Cooperation	• Expertise of various staff in different departments can be called upon • May be most efficient use of resources – not necessary to form a new department • You can focus on issues that apply to your community	• Communication between departments may be an issue • Roles and responsibilities for implementing program need to be clearly define • Accounting issues may arise
Quasi-Governmental Entity	• Expertise from other jurisdictions can be used – learn from others' experiences • Partnerships can be formed, resulting in implementation of projects that might otherwise not occur • A watershed approach is feasible • A quasi-governmental entity may take a leadership/coordination role • Dedicated funding – competition for money is removed	• Deciding on a funding mechanism and proportions may be a challenge • Prioritizing projects can be problematic • Some issues the entity addresses may not pertain to your community • Roles and responsibilities need to be clearly defined • Enabling legislation may be required
Inter-Govern. Cooperation	• A watershed approach is feasible • Combined resources may create opportunities that wouldn't otherwise exist • Expertise from other jurisdictions can be used – learn from others' experienees	• Communication may be a challenge • Roles and responsibilities need to be clearly defined • You may feel "disconnected" with some outside entities

Chapter 6
How Can We Pay for Our Storm Water Management System?

Talking about storm water management strategies is one thing. But the bottom line for many program coordinators, elected officials, and concerned stakeholders is:

"Who is going to pay for these storm water management programs?"

This chapter addresses:

- Determining your storm water management system costs;
- Options for funding and financing storm water management programs; and
- Selecting the approach that is right for your community.

Determining Program Costs

Before you can select the best funding and financing strategies, you need to understand how much money your storm water management program is expected to cost, including start-up costs and ongoing costs.

Your program will need to include, at minimum, the elements described in Chapter 3 that are required to comply with regulations. Local pressures may require that your storm water management program is even more stringent than Phase II requirements.

The U.S. EPA developed detailed cost estimates for the incremental requirements proposed under the proposed Phase II rule which was published in January 1998. A discussion from this publication follows.

Measure	Percentage of Municipalities Expected to Incur Costs (%)	Low End of Per Capita Costs ($ per capita)	High End of Per Capita Costs ($ per capita)
First Permit Cycle:			
Public Education	39	$0.02	$0.34
Public Involvement	100	$0.19	$0.20
Illicit Discharge Detection and Elimination	90	$0.04	$2.61
Construction Site Storm Water Runoff Control	83	$0.04	$1.59
Post Construction Storm Water Management	4	$1.09	$1.09
Pollution Prevention/Good Housekeeping for Municipal Management	71	$0.01	$2.00
Second & Third Permit Cycle:			
Public Education	39	$0.01	$0.34
Public Involvement	100	$0.12	$0.20
Illicit Discharge Detection and Elimination	73	$0.04	$2.17
Construction Site Storm Water Runoff Control	80	$0.01	$0.83
Post Construction Storm Water Management	4	$1.09	$1.09
Pollution Prevention/Good Housekeeping for Municipal Management	67	$0.01	$1.08

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Proposed Rule: Cost Estimates for MS4s

Implementation of the six minimum measures was projected to represent the primary cost component. Using data from Phase I communities, EPA projected:

- The percentage of Phase II municipalities that would be affected (i.e., would bear increased costs associated with implementing BMPs to address the minimum measures); and

- The range of per capita costs that would be expected during the first permit cycle, as well as the second and third permit cycle.

Note that these cost projections were developed based on the following assumptions (and EPA has requested public comment on the validity of these assumptions):

- Data from a sample of 21 permit applications for Phase I communities was used to calculate cost projections for the six minimum control measures;

- Municipalities that did not show costs on their permit applications for a specific measure were assumed to already have programs in place to address that measure;

- Per capita costs that were more than two standard deviations above or one standard deviation below the mean were dropped from the analysis;

- In estimating costs for the second and third permit cycle, costs were dropped that would be expected to occur only once, such as development of municipal ordinances.

Several concerns were raised about EPA's methodolog during the public comment period including:

- Using Phase I permit application costs may lead to:
  - **Overestimating costs:** For example, Phase II communities may have fewer structures to maintain, systems to map, and connections to map. In addition, in some cases, Phase II communities may be able to reduce costs by coordinating with nearby Phase I communities.
  - **Underestimating costs:** Because of fixed costs and the economies of scale associated with implementation of the measures, the per capita costs for Phase II municipalities may be higher than those for Phase I communities. In addition, Phase I communities may not have reported all costs associated with compliance on their permit applications.

- Though some costs associated with the first permit cycle may not be repeated in subsequent permit cycles, there may be counteracting tendencies for subsequent permit cycles to be higher (such as population growth and more areas being classified as urbanized areas).

- It may not be appropriate to apply the percentages of Phase I communities who apparently incurred costs for the implementation of each measure to the estimation of Phase II costs. Because Phase II communities are smaller, they may be less likely than Phase I municipalities to already have adequate storm water management programs in place. Therefore, Phase II communities may be more likely to incur costs as a result of the proposed new rule.

Final Rule: Cost Estimates for MS4s

To address the concerns raised in the development of the original cost estimates for incremental impacts for MS4s (discussed above), EPA utilized data collected by the National Association of Flood and Storm Water Management Agencies (NAFSMA). NAFSMA conducted a survey of more than 1,600 potential Phase II municipalities that were identified in the draft rules. Their purpose was to solicit information about the rules and the impact. One hundred twenty-one surveys were returned to NAFSMA.

Using this information, EPA estimated average annual per household program costs for automatically designated Phase II communities. In addition, they estimated and annual average administrative cost to cover the application, reporting, and record keeping costs. The total per household cost of the final rule is expected to be $9.16 annually.

EPA utilized this number to estimate the national cost to municipalities, multiplying the per household average cost ($9.16) times the number of households (32.5 million) to generate the national annual cost of $258 million.

In addition, EPA reviewed actual costs from 35 Phase I communities, using municipalities that were close to the end of their five year permit period and were smaller in size. Of the 35 reviewed, only 26 had appropriate cost data. The cost range and annual per household program costs of $9.08 is very close to the NASFMA survey data

The cost projections developed by U.S. EPA provide a guideline for estimating local budget impacts on a macro level. Because local NPDES permitting authorities and regulated sources have significant flexibility in program implementation, actual costs may vary widely. You will need to undertake detailed budget planning to ensure that you have sufficient funds to develop a storm water management program that is right for your community.

Typical Funding/Financing Strategies

As with most local government programs, a wide array of funding sources and financing approaches is typically used to support storm water management programs. Some of the most common approaches are described below.

- **Debt Financing** - Typically used for capital-intensive projects, local governments can issue debt to finance storm water management programs and facilities. Revenue bonds - or bonds that rely on an ongoing source of revenue (such as assessments or utility fees) - may be used. Alternatively, you could choose to issue general obligation bonds, which are backed by the full faith and credit of your municipality (based on your ability to generate revenues through taxes and other fees).

- **Federal, State or Regional Grants and Loans -** Grant or loan funds may be available for some elements of your storm water program, depending on the BMPs that you select and your location. Grants and loans are usually applicable to specific projects and not on-going activities, such as operations and maintenance.

Grants and More

Griffin, Georgia, has been successful in creatively acquiring supplemental funds for their storm water management program. The community of 23,500 residents has a storm water utility, which is the mainstay of their program, providing $1.2 million per year in revenue from utility fees. In addition voters approved a special purpose local option sales tax for storm water capital improvements. The special tax will contribute $1 million to the City's program between 1997 and 2001. Griffin has also acquired a Section 319 grant to do extensive detention pond research and was awarded a grant from the Ford Foundation to enhance public outreach regarding storm water.

- **Utility Service Charges** - These charges are rates billed to customers for providing storm water management services. The service charges may be flat rates, or variable rates based on classes of customers. Utility service charges may represent a dedicated source of funding (i.e., collected fees are dedicated to the storm water management program via an Enterprise Fund or similar accounting structure) and an ongoing method of funding some or all storm water management program elements.

- **Special Assessments** - Properties can be assessed annually to fund a storm water management program. Often, special assessments are used to fund a special district or authority that can implement all or portions of a region's storm water management program.

Fort Worth's Approach

The City of Fort Worth, Texas, originally paid for their storm water management program entirely with general fund dollars. In 1991 the City established an environmental protection fee through the state legislature. This legislation enabled the City to charge households, commercial businesses, and industries $.50 per month on their water bill to go toward environmental issues. The environmental protection fee brought in about $750,000 to $800,000 per year. In 1997 Fort Worth restructured their rates to charge businesses and industries on a sliding scale. Rates are based on their water account category, such as commercial, commercial-multi-use, commercial-industrial, and multi-family. The rates range from $.50 per unit for multi-family housing to $35 per month. Now the fee contributes approximately $2.5 million to Fort Worth's budget. Approximately half of that funding is used to support the storm water management program. An additional $520,000 or so from the General Fund is also used to fund the program.

- **Local Improvement Districts** - Under this type of funding system, individual properties benefited by storm water projects are assessed to fund the project. Some states require special enabling legislation to establish this type of special benefits district.

- **General Fund** - General Fund monies are used for many storm water programs. If storm water programs are funded from your General Fund, the programs are at risk in each budget cycle. In addition, in order to increase funding levels for your program, other local government services may be affected or a general tax increase may be required.

- **Plan Review and Inspection Fees** - Communities may recover some or all of the direct costs associated with performing design reviews for pre and post construction BMPs by implementing plan review and inspection fees.

- **Fee-in-Lieu of On-Site Construction** - Instead of constructing on-site facilities to meet development requirements, developers may be given the option of paying a comparable fee to be used by the local government to build regional facilities that are designed to meet the same objectives as the developer-constructed on-site mitigation.

- **Developer Participation** - Developers construct needed facilities as a condition of development, and bear associated costs.

Developers Pay in Stafford Township

In Stafford Township, New Jersey, storm water management facilities associated with new development are implemented through developer participation. The Township passed an ordinance in the late 1980's requiring developers to install curbs in new developments, implement storm water BMPs (including giving preference to an underground infiltration system that successfully removes pollutants and recharges the aquifer), and meet landscaping requirements designed to provide further surface and groundwater protections. Initially developers fought the ordinance, claiming the infiltration system was too costly to install. The Township agreed to be flexible where their overall environmental requirements were still met. Township officials also commissioned a cost/benefit study to demonstrate to developers that the Township's preferred storm water management program is more cost-effective than more traditional treatment and control approaches when the cost of land is considered.

- **System Development Fees/Connection Charges** - One time charges assessed at the time of development to recover a proportionate share of the cost of existing facilities and planned future facilities. Applicability depends upon legislation in your state.

Developers Mind Storm Water in Rockville, Maryland

The City of Rockville, Maryland, has always been progressive in storm water management. The Phase II City, with a population of approximately 50,000 residents, implemented their storm water management program in the late 1970's. Their program is entirely funded by developers' fees. When a developer wishes to build in Rockville, they may either:

- Provide onsite storm water management (which the City prefers and encourages); or
- Contribute to the City's storm water management fund, so that a regional BMP can be built to effectively control runoff from the development.

Under the first scenario, the developer's storm water management plan must be approved by the City of Rockville's Engineering Department. The developer is charged 8% of the cost of construction, or what they'll bond. This option is utilized in most cases.

Under the second option, the developer must apply for a regional participation waiver. If the development project will contain more than 0.2 acres of impervious surface, then it must go to the Mayor and City Council for approval. The developer is then charged a storm water management fee of $40,000 per impervious acre for storm water quantity and $6,000 per acre for storm water quality.

The City strongly encourages the use of Option 1, as it is difficult to build BMPs in an already established area. In most cases, if there is room for the developer to put a BMP — such as a detention or retention pond on the site — the Council will not approve the regional participation waiver. A portion of the developer's fee is used to fund ongoing maintenance of the City's system.

- **Combination Approaches:** In many jurisdictions, a combination of funding sources is used for storm water management programs. The City of Rome, Georgia, is an example of a community that pays for the storm water management program from several different sources. The public works department, which is responsible for implementing acceptable construction and post-construction BMPs, good-housekeeping requirements, and public education efforts, is funded entirely by the General Fund. The Division of Code Enforcement, which is under the Department of Building Inspections, receives their funding from developers' fees.

Storm Water Utilities

Many communities develop storm water utilities to create a dedicated and reliable funding mechanism for their storm water management program. State enabling legislation is often required, and local implementation ordinances will be needed as well.

The basic philosophy behind the utility fee is that "users" should pay for storm water programs to the extent that they contribute to the problem. The term "users," in this case, includes property owners, particularly, property owners that have impervious surfaces on their property.

Most storm water utilities charge either a monthly or annual fee based upon the amount of impervious area on the property. A base rate is set for each household based on the average amount of impervious surface (known as equivalent residential units (ERUs)). A fee is then developed in association with this ERU. For example, the average amount of impervious surface per household may be 2,500 square feet, for which a resident pays $5.00 per month.

In most communities that use this method, each household is charged for one ERU. However, some communities charge households based on actual measurements of impervious surface.

Typically, the impervious surfaces of businesses and institutions are measured, and these customers are charged according to the number of ERUs calculated from their property measurements.

Some storm water utilities only charge if there is impervious surface on the property. Others charge all landowners, however if there is no development on the property the rate is typically lower than that charged for a single ERU.

Some communities are evaluating adding a water quality component to their utility fee rate formula. This quality factor would allow communities to have user pay for not only the quantity of storm water that they contribute, but also the quality.

Because a utility charges a user fee, not a tax, schools and churches typically are not exempted from paying the fee. Some storm water utilities receive additional funding from developers' fees and permit application fees.

Storm Water Credits

Many communities offer a storm water utility credit, typically available only to businesses and institutions, for implementing certain BMPs. In some communities, for example, if a business or institution wishes to construct a retention or detention pond on their property, they can earn up to a 50% storm water credit. It is important that communities establish strict guidelines for storm water credits, if they choose to have a credit program. They should have a clear application process, and BMPs that earn credits should not represent what is required under the program, but should go above and beyond what is required. A cost-benefit analysis should be performed to ensure that it is in the best interest of the municipality to grant the credit.

In Griffin, Georgia, for example, a school can earn up to a 50% storm water credit, as well as a reduced "educational water/wastewater rate" for teaching the Waterwise Curriculum.

Some advantages of forming a storm water utility include:

- A steady funding mechanism is dedicated to storm water management;
- Fees can be based on the amount of impervious surface on the property, which is a more equitable means of charging property owners than a flat fee;
- Financial incentives can be used to encourage businesses and institutions to implement storm water BMPs;
- Utilities tend to run more efficiently (more like a business); and
- Implementing a storm water fee is often more appealing politically than imposing a new tax or raising property taxes.

Some challenges associated with storm water utilities include:

- Some residents, businesses or institutions may resist paying the fees;
- The idea may face political opposition;
- Once rates are in place, it may be difficult to secure additional funding;
- Enabling legislation is often required;
- It may be difficult and/or time-consuming to devise an equitable rate structure, and to develop a database with required information, such as amount of impervious surface; and
- A billing system will be needed.

How Does a Storm Water Utility Create and Maintain its Customer Database?

To properly assess businesses and residents, most storm water utilities choose to calculate the amount of impervious surface on each residential, business and institutional property. How do storm water utilities obtain this information?

- 49% use property tax assessor records
- 41% use on-site property measurements
- 38% use aerial photography
- 23% use planimetric map take-offs
- 20% use geographic information systems
- 13% use other methods

Source: Black and Veatch, 1995-1996 Storm Water Utility Survey

Picking the Approach that Is Right for Your Community

Evaluating funding options and deciding which combination of revenue sources is most appropriate for your community is dependent on a number of criteria, including:

- **Political acceptance** - Elected officials or other persons responsible for adopting a storm water program must compare any proposed funding package to other local needs and resources.
- **Fairness and equity** - The degree to which the funding package is linked to a payee's specific contribution to storm water problems
- **Administrative simplicity** - The ease of administering the funding package
- **Feasibility of Implementation** - The relative ease or difficulty of making a funding package operational
- **Legal defensibility** - The probability of the funding package being defended in the courts
- **Revenue Generating Capacity** - The ability of the funding package to produce sufficient revenue for the program
- **Dedicated Funding Source** - The ability of the funding package to be available in future years to maintain an ongoing program.

Developing a funding and financing strategy will likely involve a number of funding sources. Your public involvement process may provide input about local attitudes about storm water spending levels and funding sources. Your ability to inform stakeholders about the need for your program and obtain the necessary community support may determine whether your elected officials approve a funding package. A good way to inform stakeholders about what they will receive for their fee is to do a level of service analysis. Costs associated with different elements of service can then be communicated clearly. If there are objections to the rate, it would then be easier to negotiate specific program changes and cost reductions with stakeholders.

Take it from Me...

Advice from those who have been involved in implementing a storm water utility...

"Encourage community involvement early on to get buy-in."

- Kansas City, MO

"You need to establish a fee structure so that it's acceptable... but know that it is hard to get more later for special projects."

- Littleton, CO

"Look at finances ahead of time and prepare a realistic plan..."

- St. Petersburg, FL

"It's important that you sell the concept and the reasoning for the program to the elected officials - get them on your side. It's also important to let citizens know in advance, educate them and make them aware of the reason for the utility. Also, plan in advance how you will handle undeveloped land."

- Orlando, FL

"Understand the complex amount of work it takes to establish... a fair fee for every property. Recognize, too, that once that work is done you have a reliable income stream...to fund maintenance and improvement of storm water facilities."

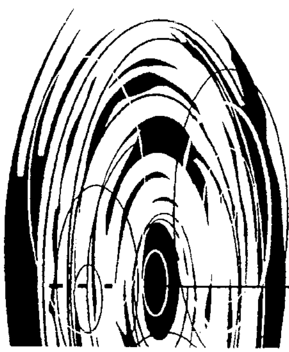
- Winter Park, FL

Funding Source Evaluation Matrix

Funding Source	Political Acceptance	Equity	Feasibility of Implementation	Ease of Administration	Legally Defensible	Revenue Capacity	Dedicated Funding Source
Debt Financing	Must have political will to implement dedicated funding source.	System paid for as it depreciates	Must have rates in place to support revenue bonds	Paid through rates &/or connection charges	Debt ceiling for G.O. debt, covenants for revenue bonds	Can be used for capital only	Assumes dedicated funding source is in place for revenue bonds
State/Federal Grants & Loans	Politically less risky to accept grants.		Highly competitive process for acquisition	Careful tracking required	Must meet terms of grant/loan scope	Can only be used for qualifying projects	Not a dedicated source
Utility Rates	Requires political will to implement a new service change.	Fees for service	Requires administrative support for billing	Depends on sophistication of rate structure	Must verify that it is allowed per State Statute	Can be used for operating &/or capital	This is a dedicated funding source
Assessments	Requires political will to implement a new assessment; may conflict with property tax lids.	May be unrelated to cost of service	Requires administrative support for billing	Not difficult	Allowed	Can be used for operating and capital	This is a dedicated funding source
Local Improvement Districts	Must be approved by the area to be served by the LID	Assigns costs of facilities to benefiting areas	May be cumbersome to initiate	May be cumbersome to track	Allowed	Can be used for specific capital projects only	Dedicated to specific projects only
General Fund/Street Fund	Difficult to allocate revenue to all the conflicting needs in the general fund.	May be unrelated to cost of service	Not difficult; political will	Not difficult	Allowed	Available for operating & capital	Not a dedicated source; subject to changing priorities
Plan Review & Inspection Fees	Politically less risky to charge fees for plan review.	Recovery of cost of direct services	Not difficult; requires isolation and calculation of fees	Not difficult	Allowed	Can be used for specific operating activities only	Dedicated to specific operating activities

Funding Source Evaluation Matrix (continued)

Funding Source	Political Acceptance	Equity	Feasibility of Implementation	Ease of Administration	Legally Defensible	Revenue Capacity	Dedicated Funding Source
Fees-in-lieu of Construction	Politically less risky if storm water ordinance is already in place that requires on-site facilities.	Option to meet development requirements	Need good SW ordinance in place, requiring on-site facilities	Fee paid at time of development	Allowed	Can be used for specific capital projects only; growth dependent	Dedicated to specific projects only
Developer Participation	May be difficult to get private development to pay for building your infrastructure.	May mitigate direct impacts of new development	Requires negotiation	Not difficult	Allowed	Available for specific capital projects only	Not a fund source, but a capital project contribution
System Development Fees/Connection Charges	Requires political will to assess a new fee on new development.	Add equity between existing and future customers	May be opposed by developers	Fee paid at time of development	Must verify that it is allowed per State Statute	Can be used for capital only; usually partial funding only; growth dependent	This is dedicated to storm water capital projects only
Local Gas Tax	Requires political will, particularly where taxes are already high	Justified because autos and roads contribute to water quality problems	Not difficult	Not difficult	May require State legislation	Depends on amount of tax and how much is dedicated to storm water programs	Dedicated to environmental programs, a portion of which could be earmarked for storm water programs.



Chapter 7
What About My Neighbor's Storm Water?

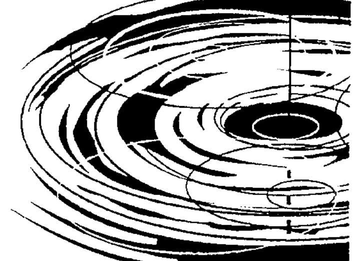
It's usually pretty easy to see why regional cooperation for storm water management programs makes sense. You can extend limited resources, extend your sphere of emphasis, and - particularly in the case of watersheds - improve the overall environmental benefits of your storm water management program. A watershed approach will help you to jointly address storm water flow, impacts and costs, producing benefits that cross jurisdictional boundaries as well.

In spite of these practical benefits, regional cooperation is often difficult to get off the ground. This chapter addresses reasons to cooperate, as well as issues associated with regional cooperation that may help you:

- Develop a framework for interlocal cooperation;
- Agree on activities that need to be accomplished;
- Agree on funding approaches;
- Agree on implementation schedules; and
- Overcome common barriers to cooperation.

Why Cooperate?

The Phase II regulations only specify what your storm water management program must accomplish within your jurisdictional boundary or service area. But in many instances, meeting these requirements will be very difficult or impossible without regional cooperation. Drainage basins, or watersheds, do not coincide with political boundaries. As a result, it is likely that the storm water



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you must manage either comes from or goes to your neighbors.

Interlocal cooperation, then, is a vital component of a successful storm water management program. Issues that arise that require interlocal cooperation may include:

- Agreeing on interlocal funding methods for capital facilities that provide a regional benefit for controlling storm water quantity and quality;
- Developing regionally consistent design standards that protect water quality as well as promote economic development;
- Determining if certain activities carried out by your storm water program can be performed more efficiently on a regional basis;
- Cooperating on regional initiatives or requirements to improve water quality;
- Cooperating on other water quality regulatory requirements, such as TMDLs; and
- Participating in regional planning for a wide range of water resource issues that could also include water supply or fish habitat restoration.

Developing a Framework for Cooperation

Depending on the issue, some type of forum is usually required to plan and implement projects or programs that require interlocal cooperation. These forums include:

- Interlocal agreements;
- Special districts;
- County or City governments acting as lead agency;
- Joint Powers Authorities
- Commissions; and
- Regional Councils of Governments.

In addition, some interlocal cooperation takes the form of sharing technical information or educational resources or developing a common ordinance throughout the watershed planning area.

You may already participate in a regional forum dealing with storm water issues. If not, choosing an appropriate forum will depend on the regional storm water issues that need to be addressed. For example, to resolve interlocal funding issues for a specific regional capital facility, a simple interlocal agreement between the affected jurisdictions may suffice. More complex storm water issues that encompass multiple jurisdictions may require a broader forum, such as a special district or commission created for this purpose.

It may be easier to implement certain projects or programs that are recommended by a regional forum that has the support of the community and key stakeholders. For example, an interlocal agreement among several jurisdictions could have been the forum for preparing a watershed plan that recommends storm water policies, operating procedures, projects, and funding. The plan recommendations may be much easier for each jurisdiction to implement if they have the force of all the participants in an interlocal process behind them.

Barnegat Bay Estuary Program

In May 1998, New Jersey's Barnegat Bay Estuary Program hosted two roundtables for mayors and other municipal officials to discuss widespread implementation of environmental programs and ordinances in the region. According to a newspaper article appearing in The SandPaper following the meetings, "the [participating] municipalities are aware they have a new address; it's not only Ocean County, but the Barnegat Bay Watershed."

The Barnegat Bay Estuary Program would seem to have several factors weighing in its favor – for example, it is located completely within one state (unique among the 29 other national estuaries) and completely within Ocean County. However, the development and implementation of a comprehensive conservation management plan to protect and preserve the Barnegat Bay hinges on local government involvement.

Even with the two roundtables planned to accommodate communities at the northern and southern ends of the region, only 19 of Ocean County's 33 municipalities sent representatives to the meetings.

"It's a race for [tax revenues]," claimed the Administrator from one participating community. "There's a lot of pressure. We all want to protect our environment, but when these multimillion [dollar] developers come around making these big offers, it's hard to resist."

According to the Barnegat Bay Estuary Program Director, Terry Fowler, "Developers want to cooperate. They just want to know what the rules are, how many trees per acre, and what kind of runoff system. ..." Fowler also added that developers would like some coordination among the various governing bodies in the region.

To spur this kind of cooperation, a clearinghouse of ordinances, technical information, and environmental program data is being developed. This central source of information, to be managed by the Barnegat Bay Estuary Program, will help to promote improved communication and understanding among the municipalities that make up the watershed.

Agreeing on a Program

A forum established to address regional needs should be limited to those activities that are best accomplished on a scale broader than local programs. The process of agreeing on an appropriate forum and activities for regional cooperation could involve a series of meetings/workshops among the affected jurisdictions to:

- Define regional needs;
- Determine the best forum for addressing regional needs; and
- Define the activities the forum might assume.

Activities such as watershed planning, construction of regional storm water control facilities, preparing public education materials, and technical assistance are potential activities that a regional forum might address.

Agreeing on a Funding Approach

Once the activities are defined for a forum designed to address regional storm water issues, the costs of conducting these activities can be determined as well. Funding a regional forum can consist of:

- Contributions from sponsoring local jurisdictions according to an agreed upon formula;
- Assessments on property within the regional forum service area;
- Service charges; and
- State or federal funding.

Reaching agreement on how to fund a regional forum may include an agreement on how the regional forum will expend funds, and how these funds will be distributed geographically. In some cases, regional forums are required to allocate funds throughout the service area according to the amount collected from each jurisdiction.

Developing an Appropriate Implementation Schedule

If a regional forum is implemented and recommendations are made for regional projects or programs, jurisdictions within the service area must also agree on an implementation schedule. The implementation schedule could be based on a process for evaluating and prioritizing projects. All the regional forum participants should be represented in this evaluation process, and agreed upon evaluation criteria should be used to establish priorities. Regional projects or programs may not have the same priority among all the participating jurisdictions. However, once the group decides on a schedule for implementation, all the participants should cooperate if the regional forum is to be successful.

The Urban Drainage and Flood Control District (Denver, CO)

The District is an independent agency, governed by a 17-member board of directors. The board of directors consists of 15 locally elected officials that represent the member jurisdictions and two registered professional engineers selected by the other board members. The District operates with an annual budget of approximately $12 to $18 million, employing 18 full-time employees and six part-time college student interns. Funding is derived from four mill levies.

The District operates five programs:

- Master Planning;
- Design and Construction;
- Maintenance;
- Floodplain Management; and
- South Platte River

Major activities targeted in each of the five programs are outlined below:

Major Activities Undertaken by the Urban Drainage and Flood Control District's Programs

Master Planning	Design/ Construction	Maintenance	Floodplain Management	South Platte River
Develop master drainage plans	Design and construction of master planned projects	Assist member communities with the maintenance of floodplains and floodways	Work with FEMA and local communities to make sure all communities have affordable flood insurance	Share in the cost of capital improvement projects on the basis of a minimum contribution of 25% from local government
Conduct outfall systems planning	Cost-share (50/50) with member communities	Maintenance projects are chosen on a priority basis	Help local governments develop their floodplain regulations	Will undertake maintenance projects, paying for up to 100% of the cost.
Support members' storm water discharge permitting efforts	District tax revenue from a community is spent on projects that will benefit that community	Private contractors are hired to do much of the work – the District does not have a public works department	Help communities develop flood warning plans	Involved in cooperative projects with property owners to stabilize river banks, & conduct inventories of properties along the river, as well as hydrologic data
Special projects such as wetlands issues and benefit-cost analyses	Once projects are completed, they are the property of the community, not the District		Publish detailed 100-year floodplain maps that incorporate expected growth and development	

The District is successful for several reasons. One contributing factor is that, although they have the authority to regulate in certain areas, they choose not to. Instead they choose to be a resource to the community. By avoiding taking on the role of enforcer and regulator, they encourage interagency cooperation.

In addition, the members of the board represent the member communities. Although deciding how to prioritize projects can still become an issue, all communities are represented fairly. The District also is committed to "paying out" to each community based upon what they pay in. Capital projects are planned to attain this goal.

The District does not operate and maintain capital projects. Once a project is completed, it is the property of the community. For this reason, and because the District does not have a public works department, there are no questions as to who is responsible for maintenance.

The District has its own source of funding. It also has a staff of talented professionals, which serves as a great resource to the member communities.

Overall, the District is able to provide communities with valuable resources that help them implement their storm water and flood control programs. Without such a resource, many of the projects would not ever have been undertaken. The District also provides member communities with a "big picture" scenario of the drainage issues for the entire area and can help communities implement their programs so that they complement each others' plans, rather than conflict with them.

Overcoming Barriers

One of the most important elements when structuring a forum to plan and implement regional storm water projects or programs is assigning appropriate roles to the forum that do not interfere with local responsibilities. Careful planning will assign responsibilities so there are no duplicate efforts between regional and local programs.

The key to success is to design a framework for regional cooperation that builds trust among all the stakeholders with a process that enhances and assists the local programs. A locally driven initiative to plan and implement regional storm water projects and programs may be the best way to support and maintain control of your local programs.