4.10 AGRICULTURE

Agriculture is an important land use in many parts of the Lahontan Region. Agricultural uses include ranching, dairying, aquaculture, and the production of irrigated crops[1]. Rangeland livestock grazing is a major agricultural use in the Region that is discussed separately in the "Range Management" discussion of the "Resources Management and Restoration" section of this Chapter. Public fish hatcheries are discussed separately in the "Fisheries Management" discussion of the "Resources Management and Restoration" section of this Chapter.

Agricultural activities can affect water quality in a number of ways. Agricultural drainage contributes salts, nutrients, pesticides, trace elements, sediments, and other by-products that can degrade the quality of surface and ground waters. There are unique problems associated with irrigated agriculture, animal confinement operations, aquaculture facilities, and the use of agricultural chemicals.

Irrigated Agriculture

Irrigation drainage can contain significant amounts of pesticides, fertilizers, salts, trace elements, and sediment. (Control of pesticides and fertilizers is discussed in the following section entitled "Agricultural Chemicals.")

Trace elements (such as molybdenum, boron, arsenic, selenium, etc.) can have both chronic and acute toxic effects on humans and other animals. Sedimentation impairs fisheries and, by virtue of the characteristics of many organic and inorganic compounds to bind to soil particles, it serves to distribute and circulate toxic substances through stream, lake, and riparian systems. The cost of pumping and treating water for municipal and industrial use also increases with increasing sediment load.

Salts contained in irrigation water become concentrated as evaporation and crop transpiration remove water from soils. Depending on the fraction of applied irrigation water that is leached through the soil, salts may either accumulate in the crop root zone or be carried with the drainage water. Salt accumulation in the root zone can result in reduced crop yield and quality. Salts present in drainage waters may reach surface or ground water via natural flows or via discharge of surface drains (e.g., tailwater ditches) or subsurface drains (e.g., tile drains).

Improved irrigation efficiency can substantially reduce the rate of salt accumulation, allowing crop production to continue into the foreseeable future even in the low rainfall areas. Water saved through implementation of irrigation efficiency programs could be used for dilution of agricultural wastewater, recharge of ground water, and/or non-agricultural uses.

However, in areas experiencing chronic salt accumulation, agriculture can be sustained in the long-term only if degraded waters are removed at a sufficient rate to maintain low salt levels and to achieve a satisfactory balance between imports and exports of salts. This may be achieved by installation of drainage systems and by export of saline drainage to temporary or permanent "salt sinks." Salt sinks are designated acceptor areas for saline wastewaters, where such waters can be stored and evaporated. Both the North and South Lahontan Basins contain a number of alkali and dry lakes that could possibly be adapted for use as salt sinks. However, any such proposal(s) must comply with the water quality objectives contained in this Basin Plan, and with all other applicable laws, regulations, and policies.

Salt inputs to a basin can be reduced in part by improved management of salt sources such as fertilizers, animal wastes, and soil amendments. Regulation may be required, but an appreciable improvement can also be expected from education of farmers to understand and better utilize existing information and Best Management Practices.

In the North Lahontan Basin, areas where irrigated agriculture is important include the East and West Walker Rivers, Carson River, and lower Susan River watersheds. In the South Lahontan Basin, the majority of irrigation occurs in the Antelope, Owens, and Fremont Valleys, and along the Mojave and Amargosa Rivers.

Until about 1960, irrigated agriculture constituted the South Basin's major developed land use, with the greatest acreage in the Antelope Valley. Around 1950, however, rising ground water-pumping costs, resulting from dropping ground water levels in parts of the Antelope Valley, caused a decline in agricultural acreage. The 30,000-acre reduction in

[1] **Note:** Other agricultural activities include, but are not limited to: operations associated with confined animal and concentrated animal feeding, confined animal feeding, confined animal holding, confined and concentrated aquatic animal production facilities, and the treatment and/of disposal of agricultural wastewater.

the Basin's irrigated agriculture experienced from 1950 to 1970 is largely attributed to the declining ground water levels in Antelope Valley. Irrigated acreage in Antelope Valley will probably continue to decline until the year 2000, and agricultural waste loads will decline correspondingly.

The effect of irrigation drainage on the receiving ground water is highly variable. For instance, in the Owens Valley, irrigation has produced no appreciable effect on the ground water quality due to the low mineral content of the irrigation supply water and the relatively minor amount of irrigated acreage. However, in the Little Rock area and along the Mojave River, irrigation drainage has noticeably contributed to localized increases in mineral and nitrate content of the underlying ground water.

Water supply wells are discussed in the “Ground Water Protection and Management” section of this Chapter. The use of reclaimed water is discussed in the “Wastewater” section of this Chapter.

Control Measures for Irrigated Agriculture

Regional Board Actions

The Regional Board shall take all appropriate measures, as required by the California Constitution (Article X, § 2) and the California Water Code (§ 275), to prevent waste of water, unreasonable use of water, unreasonable method of use of water, and/or unreasonable method of diversion of water within the Lahontan Region. Irrigation practices shall also be regulated by implementing relevant provisions of the State Board's “Sources of Drinking Water Policy,” and Nonpoint Source Management Plan. Both the Policy and Plan are summarized in Chapter 6 of this Basin Plan.

Specific Control Actions for the Susan River Watershed

1. The Regional Board shall work with the Resource Conservation District, the Soil Conservation District and private agricultural landowners to formulate a plan to begin implementation of Best Management Practices on agricultural lands to reduce pollutant loading to the Susan River.

2. The State Board, with assistance from the Regional Board and the Department of Water Resources, should examine water rights on the Susan River to determine if violations are occurring which threaten beneficial uses. As water rights permits are renewed, the Regional Board will work with State Board staff to ensure that beneficial uses are adequately protected.

3. In cooperation with agricultural users of the CSD effluent, the Susanville CSD with assistance from Regional Board staff, shall establish a monitoring program for the effluent ditch/Brockman Slough system to quantify point and non-point sources of pollutants that are contributing to the degradation of the sloughs and hence, the Susan River.

Federal Control Measures for Irrigated Agriculture

1. Under the authority of the amended Coastal Zone Management Act, the U.S. Environmental Protection Agency has developed guidance specifying management measures for sources of nonpoint water pollution (including agriculture) in coastal waters (USEPA 1993). Measures have been proposed for sediment control, animal waste management, nutrient and pesticide management, grazing, and irrigation. This guidance may be applicable to many non-coastal waters as well.

2. In April 1992, the U.S. Environmental Protection Agency and the U.S. Department of Agriculture signed a Memorandum of Agreement (MOA) to implement increased pollution prevention in the agricultural sector. The MOA calls for the development of a pollution prevention strategy which targets the areas of nutrient management, total resource management planning, voluntary livestock or poultry management agreements, safer pesticide registration, and voluntary action projects in selected watersheds. The strategy emphasizes reduced risk to human health and natural ecosystems from agricultural activities through voluntary action. The federal Conservation Reserve Program (CRP), administered by the USDA, takes fragile farmland out of production for between 10 and 15 years. The land owners receive an annual rental payment for idling the land, as well as cost-share assistance for establishing permanent vegetative cover. Stream corridors, wellhead protection areas, and other environmentally critical lands are also eligible for CRP.

Recommended Future Actions for Irrigated Agriculture

In cooperation with other appropriate local, state, and federal agencies, and private landowners, the Regional Board should:

1. Develop a monitoring program to detect water quality trends, identify problem areas, and determine the needed levels of action.

2. Encourage the use of irrigation methods designed to reduce deep percolation and nitrate leaching, and to eliminate surface runoff and erosion (e.g., drip irrigation systems, surge valves on furrow irrigation systems, etc.).

3. Support efforts by the Soil Conservation Service, Resource Conservation Districts, University Cooperative Extension, and others to develop guidelines to improve irrigation practices and to educate individual farmers about the principles of irrigation efficiency, and methods of controlling salt inputs.

4. Regulate the reclamation of new lands which could contribute large quantities of salts or pollutants to waters of the State.

5. Regulate the importation and reuse of wastewater to minimize the application of waters which are of poorer quality than existing or imported supplies. If such import or transport to upslope areas for reuse is allowed, the Regional Board should take suitable steps to mitigate short- and long-term adverse effects of increased salt load resulting from wastewater recycling.

6. Restrict the use of reclaimed waters, where water supplies are limited, to existing irrigated acreage rather than developing new irrigated acreage to utilize the reclaimed water.

Agricultural Chemicals

Agricultural chemicals include pesticides (insecticides, herbicides, fungicides, rodenticides, etc.), fertilizers, soil amendments, and other compounds. Pesticides and fertilizers can contaminate surface and ground water supplies, posing health hazards to humans and animals. Fertilizers can also contribute to the eutrophication of streams, lakes, and rivers by adding nutrients to these systems.

Pesticides

The California Department of Pesticide Regulation (DPR) is the lead agency responsible for pesticide registration and regulation in California. The DPR maintains a computerized data base that contains information on the kinds and quantities of pesticides used in the State, including the location and acreage of chemical applications, and the type of crop treated.

Local administration of the DPR's pesticide regulatory program is the responsibility of the County Agricultural Commissioners (CACs), with coordination, supervision, and training provided by the DPR. The CACs enforce pesticide laws and regulations, and evaluate permit requests for the use of restricted pesticides. In addition, the CACs monitor and inspect pesticide handling and use operations, investigate suspected pesticide misuse, and take enforcement action against violators. The CACs are required by law to consult quarterly with Regional Board staff to report any problems resulting from pesticide use.

Effective control of problems related to pesticides is difficult because application practices tend to vary, depending on the particular chemicals and crops involved. Furthermore, the types of pesticides and formulations that are currently in use tend to change rapidly, as often as every three to five years.

On March 19, 1997, the State Water Resources Control Board and DPR entered into a Management Agency Agreement (MAA) and approved a “California Pesticide Management Plan for Water Quality” for implementation of the MAA. The MAA provides for cooperation and communication between the two agencies, and summarizes their respective roles and responsibilities. In the MAA, the State Board conditionally agrees to accept the MAA and plan as measures consistent with the State’s Nonpoint Source Management Plan. Both agencies commit to exchange information, and to work together in the development of plans, policies, and “reduced risk practices” for the protection of water quality from the impacts of pesticides. Implementation of “reduced risk practices” is to be initially on a voluntary basis, followed by regulatory action if necessary. The MAA includes a section on “Reservation of Authority” which provides that nothing in its text shall be construed as limiting the authority of the State and Regional Boards “in carrying out their legal responsibilities for management, regulation, coordination, and control of water quality.” The plan describes more specifically how DPR and the CACs will work with the State and Regional Boards. It includes provisions for outreach programs, compliance with water quality standards, ground and surface water protection programs, self-regulatory and regulatory compliance, interagency communication, and conflict resolution. Appendices to the plan include a list of “reduced-risk practices” for minimizing the potential for offsite pesticide movement and transport of residues to surface or ground waters, and summaries of applicable state and federal regulations.

The Director of the DPR, in consultation with the State Board, the Regional Boards, and the California Office of Environmental Health Hazard

Assessment, is required under the Pesticide Contamination Prevention Act (AB 2021) to annually report the following information to the California Legislature:

- The location and number of ground water wells sampled for pesticide active ingredients, and the agencies responsible for drawing and analyzing the samples.
- The location and number of well samples with detectable levels of pesticide active ingredients, and the agencies responsible for drawing and analyzing the samples.
- An analysis of the results of well sampling described above to determine the probable source of the residues. The analysis shall consider factors such as the physical and chemical characteristics of the economic poison, volume of use, method of application, irrigation practices, and types of soil in areas where the economic poison is applied.
- Actions taken by the DPR and the State and Regional Boards to prevent economic poisons from migrating to ground waters of the State.

Regional Board responsibilities in the AB 2021 Program include compiling and transmitting to the State Board any of the activities described above that have occurred in the Region during the year. The State Board combines information from all of the Regional Boards to assist in the preparation of the annual AB 2021 report to the California Legislature.

Fertilizers

Nutrients contained in fertilizers (including animal manure) can reach surface water via storm runoff, irrigation drainage, or by natural subsurface flows. Fertilizers can contribute to nitrate accumulation in ground water, resulting in violations of the drinking water standard. Fertilizers can also contribute to cumulative nutrient loading, along with other sources such as septic systems and urban runoff.

Because the primary agricultural land use in the Lahontan Region is range livestock grazing, agricultural fertilizer use is relatively low compared to that in some other parts of the State. However, localized water quality problems have resulted from agricultural fertilizer applications. For example, increases in salinity and nitrates in ground waters of the Mojave River and Antelope Valley areas are believed to have resulted in part from excess applied fertilizers. Off-site application of manure from dairies also has resulted in water quality degradation.

More efficient application of fertilizers could help to reduce the amount of nutrients reaching surface and ground waters with agricultural drainage and runoff.

Vector Control and Weed Control

Agricultural chemicals are often employed for non-agricultural uses. For instance, aquatic herbicides are sometimes used for the control of aquatic weeds to improve vehicle access, to enhance recreational opportunities, or for aesthetic reasons. The use of terrestrial herbicides may be proposed for forest management, landscaping, fire control, golf course maintenance, or for other similar purposes. Pesticides are also used by public agencies for vector control (i.e., to eliminate pests and disease-carrying organisms such as mosquitoes).

The Regional Board has asked to be notified by public agencies of any large-scale applications of such chemicals within their jurisdiction. For example, the U.S. Forest Service is expected to notify the Regional Board of plans for chemical applications associated with timber harvest or other forest management activities. The California Department of Food and Agriculture, which is currently responsible for certain pest control programs such as that for the gypsy moth, has been asked to notify the Regional Board of plans for pesticide applications in this Region. The U.S. Bureau of Land Management, in implementing its Noxious Weed Control Program, has been asked to notify the Regional Board of aerial herbicide applications and of any spills in, or near, surface waters. Upon such notification, the Regional Board is able to become involved in the environmental consultation process required by the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). In this way, the Regional Board can ascertain whether potential water quality impacts from such activities will be mitigated.

For smaller-scale applications, such as the use of herbicides for golf courses or other turf areas, the Regional Board has adopted waste discharge requirements which include control measures for herbicide use. The Regional Board may wish to have staff review projects on a case-by-case basis, in order to determine whether there is any potential for water quality impacts and if waste discharge requirements are necessary.

In some instances, use of these substances will have unavoidable water quality impacts, particularly in situations where the chemicals are applied directly into or near surface water (such as aquatic

weed control or vector control). In these cases, the use of such chemicals can result in the violation of water quality objectives for toxic substances, as well as in the violation of waste discharge prohibitions. Federal regulations (40 CFR § 131.13) allow the Regional Board to grant conditional variances to water quality objectives under certain circumstances. Additionally, the Regional Board may allow the use of pesticides for purposes of vector control provided the project is conducted under the circumstances described in Chapter 4 under the section entitled, "Circumstances Eligible for Prohibition Exemption" under the subsection entitled "Vector Control" and according to the criteria described in Chapter 4 under the section entitled "Exemption Criteria for Aquatic Pesticide Use" under the subsection entitled "Exemption Criteria for Vector Control." Furthermore, pursuant to Section 13269 of the California Water Code, the Regional Board may waive the need for waste discharge requirements and reports of waste discharge, for specific types of discharge, where such a waiver is in the public interest. Such actions nevertheless must conform to State and federal nondegradation requirements. Although these policies do allow limited decline in water quality when the State finds that an overriding public benefit will result, both the federal and State policies require that water quality be maintained at a level sufficient to protect existing beneficial uses. USEPA guidance on variances from water quality standards is summarized in Chapter 3 of this Basin Plan under "General Direction Regarding Compliance With Objectives."

Control Measures for Agricultural Chemicals

Regional Board Control Actions

Chapter 4 includes a prohibition against discharges of pesticides to surface or ground waters. The Regional Board may grant an exemption to the pesticide prohibition for projects that propose to apply aquatic pesticides for purposes of protecting public health (e.g., vector control) or natural resources (e.g., fisheries management, control of aquatic invasive species infestations) provided the project is proposed under the circumstances and according to the criteria detailed in Chapter 4.

The use of agricultural chemicals shall be further regulated by relevant provisions of the State Board's Nonpoint Source Program Plan, which guides implementation of the State Board's 1991 MOU with the Department of Pesticide Regulation. Some pesticides are also included in the California Department of Health Services' Proposition 65 list of carcinogens which should not be present above "action levels" in sources of drinking water. (Proposition 65 is discussed in the "Spills, Leaks, Complaint Investigations and Cleanups" section of this Chapter.)

The pesticide waste discharge prohibition and the applicable exemption criteria that must be satisfied to grant a prohibition exemption, are important considerations in the Regional Board's regulation of discharges of pesticides.

Federal Control Measures for Agricultural Chemicals

1. Under the authority of the amended Coastal Zone Management Act, the U.S. Environmental Protection Agency (USEPA) has developed guidance specifying management measures for sources of nonpoint pollution (including agriculture) in coastal waters (USEPA 1993). Measures have been proposed for nutrient and pesticide management. This guidance may be applicable to many non-coastal waters as well.

2. In April 1992, the USEPA and the U.S. Department of Agriculture (USDA) signed a Memorandum of Agreement (MOA) to implement increased pollution prevention in the agricultural sector. The MOA calls for the development of a pollution prevention strategy which includes safer pesticide registration. The strategy emphasizes reduced risk to human health and natural ecosystems from agricultural activities through voluntary action.

3. The USEPA and USDA are cooperating in the development and implementation of environmentally-sound pest management practices, and in the identification of the best methods of applying integrated pest management in agriculture. As a first step, both agencies sponsored a public/private Integrated Pest Management Forum in June 1992.

4. In April 1992, a *Federal Register* notice and public workshop solicited public comments on possible criteria, policies, and procedures for encouraging the development and registration of negligible-risk pesticides and replacement pesticides than are less hazardous than currently-registered products. Options suggested included faster review of applications, lower fees and registration costs for safer pesticides, reconsideration of current registrations for riskier pesticides, and public listing of risky pesticides as targets for replacement.

5. The Agriculture in Concert with the Environment (ACE) grant program is administered by the USEPA's Office of Pollution Prevention and the USDA Cooperative State Research Service. ACE grants have been awarded for projects whose objective is adopting sustainable agriculture practices and reducing the use of herbicides and other pesticides.

6. The USDA's Sustainable Agriculture and Research Program gives grants to develop and distribute to farmers practical, reliable information on alternative farming practices.

Recommended Future Actions for Agricultural Chemicals

In cooperation with other appropriate local, state, and federal agencies, and private landowners, the Regional Board should:

- Encourage the State Board to develop a monitoring program to detect water quality trends related to agricultural chemicals, identify problem areas, and determine the needed levels of action.

- Review proposals for weed control and vector control and invasive species control on a case-by-case basis, and consider allowing qualified projects to proceed by granting an exemption to the pesticide prohibition.

- Support efforts by the Soil Conservation Service, Resource Conservation Districts, University Cooperative Extension, and others to educate individual farmers about Best Management Practices for fertilizer and irrigation management, including, but not limited to, developing fertilizer management plans and/or other strategies to optimize the type, amount, rate, and timing of application.

- Develop Best Management Practices or other guidance for the control of aerial applications of agricultural chemicals.

Confined Animal Facilities

Confined animal facilities are used to raise or shelter high population densities of animals such as cattle, pigs, chickens, turkeys, sheep, horses, commercial furbearers, and pets. A number of such facilities presently exist in the Lahontan Region.

Confined animal facilities may potentially impact water quality in a number of ways. Stormwater runoff can carry by-products of such operations into surface waters. Such pollutants include washwater from milking areas, salts present in animal feed and manure, nutrients and pathogens found in manure, and sediment that has been detached by trampling and other land disturbances. Manure disposal can also affect ground water quality by increasing concentrations of total dissolved solids (salt) and nitrate.

Manure and wastewater from confined animal facilities may generally be applied to disposal fields or crop lands, provided that the quantities applied are reasonable. “Reasonable” is defined as the amount the land or crops can beneficially utilize. Overloading may be detrimental to the application site, as well as nearby receiving waters.

The confined animal facilities presently of most concern in the Lahontan Region are dairies. Studies have shown that the total dissolved solids (salt) content of the ground water along the Mojave River has become elevated both along the length of the river and over time. Dairy manure is one likely contributor to the overall salt loading of this closed basin.

In the early 1980s, dairy operators in the increasingly urbanized Chino basin began looking to the high desert along the Mojave River to relocate. A proposal to establish a large number of dairies in Summit Valley (the headwaters of the Mojave River) prompted the Regional Board to commission a study to identify and evaluate potential areas of concern associated with the location/siting of confined animal facilities. That study, conducted by the Department of Water Resources, concluded that a two- to three-mile band along the Mojave River would most rapidly be impaired by percolation of dairy and other wastes, and that other areas outside of the Mojave River floodplains could also be impacted by dairy waste, but at a slower rate. The Regional Board responded by adopting waste discharge requirements for large dairies located along the Mojave River.

Control Measures for Confined Animal Facilities

(For confined animal facilities regulations which apply in the Lake Tahoe Basin, see Chapter 5.)

The State and Regional Water Boards have authority under the California Water Code, in general, and regulations contained in the California Code of Regulations, Title 23, Chapter 15, Article 6, in particular, to fully regulate waste disposal activities at confined animal facilities.

Regional Board Control Actions

The Regional Board has adopted waste discharge requirements (WDRs) for several dairy operations in the Lahontan Region. Regional Board staff will periodically inspect all confined animal facilities for which WDRs have been adopted. Based on inspections and other information, the WDRs will be periodically evaluated to determine if they are protective of water quality and in conformance with the minimum standards contained in the California Code of Regulations (23 Cal. Code of Regs. § 2560-2565). Control systems must be designed to minimize surface runoff, minimize percolation of field-applied wastewater to ground water, and minimize percolation of water through manure into ground water. Any control system utilizing retention ponds should either be lined or situated over soil of relatively low permeability to allow slow infiltration and percolation. Additional and/or more stringent measures may be required in areas overlying threatened or impaired sources of drinking water. The need for construction/retrofit of pollution prevention or ground water monitoring facilities (including time schedules) will be considered on a case-by-case basis.

The State Board's Dairy Waste Task Force issued guidelines in 1991 to facilitate consistent regulation of waste management at dairies throughout California. Those guidelines (and any future amendments) will be used by the Regional Board to assess and respond to the potential water quality impacts of dairy operations. The regulatory process for existing dairies is initiated by surveying dairy owners and encouraging the use of Best Management Practices. If a dairy owner does not voluntarily implement BMPs, a conditional waiver of waste discharge requirements may be issued. Waste discharge requirements may be adopted for those facilities that fail to comply with the conditional waiver. Regardless of the tier under which a facility is regulated, all confined animal operations are required to comply with the minimum standards contained in the California Code of Regulations and this Basin Plan.

All proposed new or re-opening dairies must file a report of waste discharge with the Regional Board. The Regional Board will require that the report of waste discharge include the information outlined in the Dairy Waste Task Force guidance. Based on the report of waste discharge (and other information as available), the Regional Board will either adopt waste discharge requirements or a conditional waiver stipulating that, at a minimum, facilities will be designed, constructed and operated to meet the minimum criteria contained in the California Code of Regulations and this Basin Plan. Monitoring programs may be required to assure compliance.

The Regional Board relies heavily upon the USDA Soil Conservation Service (SCS), which has the technical expertise and congressional authority to assist farmers in developing pollution prevention plans to comply with state regulations, including this Basin Plan. In some cases, matching funds are available through the SCS to assist the owners of confined animal facilities in the design and construction of pollution prevention measures.

The process described above for the regulation of dairies will also be utilized to assess and regulate other types of confined animal facilities, whenever deemed appropriate by the Regional Board's Executive Officer.

Regulation of confined animal facilities by the Regional Board shall account for cumulative effects such as salt and nitrate accumulations in ground water from other sources.

Waste discharge requirements adopted for a specific confined animal facility may not effectively regulate the off-site disposal of manure. Potential water quality degradation due to such disposal shall be regulated by implementing relevant provisions of the State Board's Nonpoint Source Management Plan.

Federal Control Measures for Confined Animal Facilities

1. Under the authority of the amended Coastal Zone Management Act, the U.S. Environmental Protection Agency has developed guidance specifying management measures for sources of nonpoint water pollution (including agriculture) in coastal waters (USEPA 1993). Measures have been proposed for animal waste management. This guidance may be applicable to many non-coastal waters as well.

2. In April 1992, the U.S. Environmental Protection Agency and the U.S. Department of Agriculture signed a Memorandum of Agreement (MOA) to implement increased pollution prevention in the agricultural sector. The MOA calls for the development of a pollution prevention strategy which includes voluntary livestock or poultry management agreements. The strategy emphasizes reduced risk to human health and natural ecosystems from agricultural activities through voluntary action.

Recommended Future Actions for Confined Animal Facilities

1. In cooperation with other agencies, the Regional Board should develop a monitoring program to detect water quality trends, identify problem areas, and determine the needed levels of action.

2. Where appropriate, the Regional Board should begin actively regulating all confined animal facilities that may adversely affect water quality or beneficial uses.

3. To aid in the development of BMPs for dairy systems, the Regional Board should cooperate with other agencies to collect and review, whenever feasible, field-scale data on salt and plant-available nitrogen for cropped or pastured dairy production systems.

4. The Regional Board should encourage the use of plant nutrients in liquid and solid animal wastes as a resource, rather than a waste to be disposed of.

5. The Regional Board should encourage and assist in the development of criteria for allowable animal units/acre for different site-specific crop, soil, climate, and management variables.

Aquaculture Facilities

(Public fish hatcheries are addressed in the "Fisheries Management" discussion within the "Resources Management and Restoration" section of this Chapter.)

Discharges from aquaculture operations can contain waste products (nutrients and suspended solids) as well as pesticides and other substances. Potential water quality impacts downstream of these discharges include increased productivity and algal growth, increased biological oxygen demand, and impaired aquatic habitat. The temperature of discharged waters can also affect receiving waters.

Another concern with aquaculture facilities is the release of exotic species. If commercial species are not properly contained, they could escape and become established outside of the facility, potentially violating objectives for species diversity and nondegradation of aquatic communities.

Regional Board Control Actions for Aquaculture Facilities

All aquaculture facilities which include point source discharges to surface waters shall be regulated under National Pollutant Discharge Elimination System (NPDES) permits.

Recommended Future Actions for Aquaculture Facilities

The Regional Board should be advised of routine and other applications of pesticides or other substances potentially containing toxic substances.

4.11 RECREATION

Tourism related to outdoor recreation is a major sector of the Lahontan Region's economy. Recreational activities range from backpacking in wilderness areas to golfing, boating, and skiing at highly developed resorts. Water quality concerns associated with outdoor recreation include sanitation, erosion/stormwater problems (related to disturbance of soils and vegetation), and water contamination due to the use of pesticides at golf courses and fuel and paint at marinas.

Impacts of recreation are of special concern in the Lake Tahoe Basin, which receives as many as 20 million visitors annually. The application of special control measures to recreational projects on sensitive lands in the Lake Tahoe Basin is discussed in Chapter 5.

Water quality problems associated with specific recreational activities are discussed below, together with recommended regionwide control measures.

Backcountry Recreation

The Lahontan Region includes at least part of nine National Forests and ten designated wilderness areas within these forests. Wilderness recreation in the eastern Sierra Nevada is so popular that quotas for overnight use have been established for several areas. Much of the National Forest land which is not designated wilderness is managed for dispersed recreation, with few developed facilities such as parking lots, restrooms, etc. Much of the Bureau of Land Management land within the Region is also managed for dispersed recreation. Dispersed recreation can include hiking, backpacking, packing with livestock, fishing, hunting, camping at undeveloped areas, recreational use of natural hot springs, cross-country skiing, snow camping, etc. (Problems related to use of offroad vehicles are discussed in a separate section below.)

Problems related to dispersed and wilderness recreation include disposal of human and animal waste too close to surface waters, littering, destruction of meadow and riparian vegetation by trampling from humans and livestock, erosion of trails, and watershed damage by human-caused wildfires. One unusual type of problem results from the unauthorized “development” of natural hot springs for spa use, including physical alterations to create pools, and use of disinfectant chemicals and soaps which may be harmful to unique hot spring biota.

Relatively little quantitative information is available on the baseline quality of backcountry water bodies to enable the evaluation of the extent of problems related to recreation.

Control Measures for Backcountry Recreation

Designated wilderness and national park areas are of special concern. Land use practices in these areas must assure protection of beneficial uses of water. Erosion control in the vicinity of surface waters must be implemented for all human activities which disturb the natural ground surface. Animal wastes must be managed to prevent nuisance and to protect beneficial uses of water.

Recommended Control Measures for Backcountry Recreation

1. The USFS and BLM have ongoing programs of trail maintenance and watershed restoration, including the restoration of wetlands disturbed by recreational use. Information is provided to wilderness users at trailheads regarding sanitation, etc., and wilderness rangers patrol backcountry areas to increase public awareness. These programs should be continued.

2. The USFS and BLM should conduct additional water quality monitoring to determine the impacts of dispersed recreational use. Where problems are apparent, the Regional Board should work with land managers to prevent further impacts and to ensure the implementation of remedial measures.

3. Regional Board staff should review and comment on recreation and wilderness management plans prepared by public agencies, and should encourage these agencies to mitigate water quality problems that have been identified by monitoring and/or public complaints.

Campgrounds and Day Use Areas

Developed recreation areas such as campgrounds, picnic areas, vista points, and interpretive centers generally have roads and parking lots and may have restrooms and recreational vehicle waste dumping facilities. They generally result in more soil disturbance and compaction, and a greater amount of impervious surface, than undeveloped recreational facilities. They are often located near surface waters, and heavy foot traffic may damage streambanks and lakeshores. Pesticides may be used at such facilities to control mosquitoes or rodent vectors of disease.

Control Measures for Campgrounds and Day Use Areas

1. The Regional Board regulates developed recreation facilities on public lands under MOUs and MAAs (see Chapter 6). It may also issue waste discharge requirements where necessary to protect water quality. Wastewater disposal at developed recreational facilities is subject to the control measures discussed in the "Wastewater" section of this Chapter, and to the regionwide septic system density limits and areawide waste discharge prohibitions where applicable.

2. New private recreation facilities involving soil disturbance of 5 acres or greater are subject to the statewide stormwater construction NPDES permit (see "Stormwater" section of this Chapter).

Recommended Control Measures for Campgrounds and Day Use Areas

1. In portions of the Region where erosion and stormwater problems threaten sensitive surface water bodies, waste discharge requirements (WDRs) should be considered for the construction of new private recreational facilities even when the statewide construction permit does not apply. WDRs may also be necessary to require installation of BMPs by existing private facilities in such areas. Waivers of WDRs may be appropriate in less sensitive areas.

2. New campgrounds and day use recreation facilities should be designed to minimize water quality impacts by avoiding disturbance of steep slopes, highly erodible soils, and riparian/wetland areas. Best Management Practices can be applied to new and existing campgrounds and day use areas to reduce erosion and provide treatment for stormwater. Control of erosion from unpaved roads and parking areas is particularly important. Interpretive displays and programs at recreational facilities should address water quality impacts of recreation and request public cooperation (e.g., use of designated fishing trails rather than random trampling of streambank vegetation).

   Campgrounds and other recreational facilities on public lands are occasionally closed and remodeled or relocated to allow the recovery of compacted soils and natural vegetation. Public agencies operating developed recreational facilities which have encroached on wetlands or riparian areas should be encouraged to relocate facilities outside of these sensitive areas, and to restore riparian/wetland functions where feasible.

3. Where other disposal facilities are not locally available, public and private campgrounds which attract significant numbers of recreational vehicles should provide waste dumping stations to reduce the extent of illegal dumping.

4. Additional monitoring of the water quality impacts of developed recreation in the Region should be performed in order to facilitate the implementation of control measures, as needed.

Boating and Shorezone Recreation

Water quality problems related to boating result both from discharges of wastes from boats, and from construction and operation of facilities to support recreational and commercial boating. "Support" activities and facilities include dredging, piers, marinas, boat launching facilities, boat parking and storage facilities. (The term "boats" for purposes of this section includes river rafts, jet skis, and other watercraft.) Lake Tahoe has the greatest number of developed support facilities, including a U.S. Coast Guard station. Large commercial tour boats operate on Lake Tahoe, and there are plans for expanded "waterborne transit." However, boating is popular at other large lakes in the Region (e.g., Arrowhead, Eagle, Crowley), and there are public and private marinas and launching facilities at many smaller lakes. There are many private piers at some lakes which are surrounded by residential development, such as Donner Lake. When flows permit, the Truckee and East Fork Carson Rivers are very popular for rafting.

Waste discharges associated with boating include human sewage, garbage and litter, fuels from leaks, spills, and engine exhausts, and antifouling chemicals in boat paints. Boat wakes and propwash in shallow waters can also erode shorelines or suspend bottom sediment, increasing turbidity and mobilizing nutrients and contaminants in the sediment.

Almost all surface waters in the Lahontan Region are designated sources of drinking water pursuant to Proposition 65 (see "Spills, Leaks, Complaint Investigations, and Cleanups" section of this Chapter), and many of them, including Lake Tahoe, Donner Lake, and some of the Mammoth and June Lakes, have existing surface water intakes for municipal supply. (The Mammoth and June Lakes, and Crowley Lake, a very popular boating area, are part of the Los Angeles Department of Water and Power's domestic supply system.) It is thus very important to protect these domestic supplies from vessel wastes.

Dredging, whether it is done to create marinas or to maintain or increase boat access to marinas and piers under low water conditions, can have a number of potentially significant water quality impacts. It disturbs sediments, smothers bottom-dwelling organisms, and releases nutrients and contaminants which had settled out of the water. The sediments may also be redeposited elsewhere. Disposal of dredged material in the shorezone of a lake may allow leaching of dissolved nutrients and contaminants back into the lake.

The construction of piers and other shorezone structures can involve localized erosion, suspension of bottom sediments, and destruction of valuable riparian vegetation. Even after construction, piers, jetties, and marinas constitute physical alterations in natural shorezone conditions. Impermeable (e.g., rock crib) piers can alter natural patterns of sand and sediment transport along the shore, adversely affecting habitat values. Even permeable shorezone structures may have cumulative impacts on sand transport.

Many marinas are enclosed areas which trap sediment, nutrients and contaminants. Higher water temperatures within enclosed marina areas may lead to algae blooms and/or dissolved oxygen depletion. Some pollutants may accumulate in marina sediments, and affect biological processes both through gradual long-term release and through resuspension of sediment upon dredging. Pollutants may enter marinas from boats, maintenance activities near or over water, and stormwater runoff from parking lots and other onshore impervious surfaces. In some cases, disposal of fish-cleaning wastes can increase biochemical oxygen demand (BOD). The level of pollutant accumulation in the marina depends on the level of flushing; however, flushing merely redistributes pollutants elsewhere in the lake.

Metals and metal containing compounds are widely used in boats and marina related activities. Examples include lead as ballast, arsenic in paint pigments, pesticides and wood preservatives, zinc anodes used to deter corrosion of metal hulls and engine parts, and copper and tin in antifoulant paints. Boatyard hull pressure washing operations may release metals in concentrations of environmental concern (USEPA 1993).

Elevated levels of petroleum hydrocarbons may occur in marina waters as a result of refueling activities and bilge or fuel discharges from boats. Petroleum hydrocarbons tend to adsorb to particulate matter and become incorporated into sediments. They persist for years, with long-term impacts on benthic organisms (USEPA 1993).

Shorezone structures near stream inlets to lakes can act as barriers to fish migration and/or alter currents and the transport of sediment from streams. The visual presence of large numbers of piers and shorezone structures can alter the quality of visitors' recreational experiences and thus affect recreational beneficial uses.

Beach use is popular at Lake Tahoe and at other lakes around the Region. Water quality problems associated with beach use can include sanitation, littering, and stormwater problems related to nearshore parking facilities. Because the beaches of Sierra lakes are often rocky, resorts sometimes import sand to create beaches. Lake currents may repeatedly transport the sand away from the beach, making ongoing replenishment necessary. Sand used for replenishment may contain nutrients, salts, or contaminants. Private landowners with rocky beaches may also rearrange underwater rocks offshore to create a sandy bottom for swimming and wading, with detrimental impacts on fish habitat.

Control Measures for Boating and Shorezone Recreation

1. *Vessel Wastes.* Direct discharges of wastes, including sewage, garbage, and litter into surface waters of the Lahontan Region are prohibited (see “Waste Discharge Prohibitions” section of this Chapter). Control of discharges of human sewage from boats is discussed in detail in the “Wastewater” section of this Chapter. Briefly, the Regional Board should determine needs for specific marinas and public launching facilities serving larger boats with holding tanks to have wastewater pumpout facilities; and should request the State Board to use its authority under the Harbors and Navigation Code to require installation of these facilities. Dumping stations for “portapotties” from smaller boats should also be readily available onshore, and floating latrines may be appropriate in some areas. Public land managers and river rafting businesses should provide restrooms or chemical toilets at heavily used raft put-in and take-out points; these facilities will be subject to regionwide onsite disposal system criteria and any local discharge prohibitions.

2. Public education programs are needed to increase use of wastewater disposal facilities and to prevent the dumping of garbage and litter from boats and rafts. Local governments should strictly enforce anti-litter laws. Voluntary beach and stream litter cleanup operations should be encouraged.

3. Most boat engines are designed for operation near sea level. These engines operate on a "rich" (very high) fuel-to-air ratio on high mountain lakes. Soot and unburned fuel can be discharged from engines not adjusted for high altitude operation. Boats based year-round at high elevations should have their engines adjusted for high altitude operation.

4. Regional Board staff should obtain additional information about the extent and impacts of petroleum product discharges from boat engine exhausts to surface waters of the Region. If the problem appears to be significant, the Regional Board should work with the State Board, the Department of Boating and Waterways, the Department of Fish and Game, county and state health departments, and other appropriate agencies to develop control measures. Statewide and possibly national action, like that used to control tributyltin (TBT), may be necessary to promote or require alternative fuels and more efficient engines.

5. The use of paint containing the antifouling agent TBT on smaller boats is now prohibited by State and federal legislation. Vessels painted with TBT before January 1, 1988 may continue to be used, but may not be repainted with TBT paint. Maintenance activities on older boats need careful controls to prevent TBT paint from entering lakes in stormwater (see marina discussion below). Regional Board staff should attempt to stay aware of new information on other antifouling paint ingredients (e.g., copper) which could have significant water quality impacts.

6. Local governments, resource management agencies, and other entities with authority to regulate boating activity should exclude motorized vehicles from shallow water areas which support important habitat in order to prevent sediment and shorezone disturbance from propwash. Speed limits and "no-wake zones" can also be used for this purpose.

7. *Dredging and Underwater Construction.* The following guidelines apply primarily to dredging in connection with recreational activities. However, dredging is also performed for other purposes, such as removal of sediment from reservoirs and hydroelectric facilities. Many of the considerations below apply to these types of projects as well; see also the separate discussions of these facilities elsewhere in this Chapter.

8. For regulatory purposes, Regional Board staff divide dredging activities into "maintenance" and "new" dredging. Maintenance dredging involves areas and sediment depths which have been previously dredged. The depth of dredging is important to water quality because the concentrations of nutrients, organic matter, and toxic substances in sediment may vary with depth depending upon physical, chemical, and biological processes. (In Lake Tahoe, maintenance dredging may not be done below an authorized lake bottom elevation; see Chapter 5.) New dredging is that done outside of maintenance dredging boundaries, or below any applicable approved lake bottom elevation. Waste discharge permits for marinas may include conditions for allowable ongoing maintenance dredging; new dredging generally requires a new or revised permit.

9. There are two major types of dredging equipment: bucket ("clamshell") dredges, and suction dredges. Bucket dredging involves the scooping and transfer of sediments to a dewatering site, and the subsequent removal of sediments to an approved disposal site. Such operations typically create highly turbid water due to bucket drag on the lake bottom as it pulls free from the sediment. Turbidity barrier installation is usually required to isolate water disturbed by mechanical dredging operations.

10. Suction dredges are operated like a vacuum cleaner. Sediments are removed in a slurry, which is pumped through a semi-flexible pipeline to a dewatering and/or settling area. ("Bypass" dredging may involve redeposition of sediments in another area of the lakebed.) Experience has shown that water quality impacts can be minimized if suction dredging is employed and the slurry is pumped out of the lake; in such cases, turbidity barriers may not be necessary.

11. Dewatering and settling areas must be designed to accommodate the expected flow and to provide necessary removal of suspended and dissolved solids. If dewatering and/or settling areas are not designed to accommodate the expected flow, temporary shutdown of dredging operations may be necessary to avoid overloading the system. Overloading the system may lead to the failure of containment berms and/or the release of water which may violate water quality standards. It is important to note that dewatering and settling areas need not be adjacent to the dredging site. Slurries can be pumped for distances of several thousand feet to

several miles, depending upon particle size. In some dredging operations in Lake Tahoe, dredged sediments have been pumped from an outer channel area and discharged within a marina to be removed mechanically. In these cases, turbidity barriers are usually required to isolate the disturbed water from the lake.

12. Suction dredging is often the most effective and most environmentally safe method, especially with offsite disposal. However, even with turbidity barriers, suction dredging followed by interim storage of dredged material in an “inner harbor” situation may create more problems than bucket dredging. Localized problems related to turbidity may result from repeated disturbance of stored material for final disposal. Practical limitations, such as land availability for dewatering and/or settling, may also make bucket type dredging more appropriate in some cases.

13. In the Lake Tahoe Basin, Regional Board staff may apply stormwater effluent limitations to nutrient discharges from dredged material dewatering and settling areas (see “Stormwater” section of this Chapter; see also Chapter 5). In other watersheds, effluent limitations for such operations should reflect the characteristics of the slurry, and receiving water standards. In all cases, the Regional Board may require additional site-specific analysis of the material proposed to be dredged (e.g., analysis of the proportion of colloidal material or silt to sand) and may require additional mitigation as necessary.

14. Turbidity barriers must be designed and used with caution. Failures or breaches of turbidity barriers are usually the result of wind and current loadings which cause the barrier to pull away from its bottom anchoring. A breach in the turbidity barrier is always accompanied by a release of waters which may violate water quality standards. To avoid failures, turbidity barriers should be designed to withstand expected wind and current loadings. Care must be taken to ensure that the barrier conforms to the lake bottom, forming an adequate seal. A recommended method of bottom anchoring is to sew a heavy chain into the bottom of the barrier. It is important to realize that the weight of an object decreases when placed under water. For example, the weight of a sand bag is reduced to 1/3 when placed in water, and additional bags must be used to effectively anchor the barrier. Turbidity barriers may contribute to localized temporary water quality problems since they trap nutrients from suspended sediments, and reduced water circulation increases water temperature inside the barrier; both of these factors can lead to algae blooms.

15. Entanglements with dredging machinery are often the cause of breaches in the barrier. A ten-foot buffer zone between the barrier and machinery could prevent such occurrences.

16. Freeboard is the distance between the water surface and the top of the turbidity barrier. The amount of freeboard should be based on site-specific characteristics. In some cases, it may be desirable to allow some splash over the barrier, while in others it may be impossible to limit splashover without violating water quality standards. Too much freeboard can allow the barrier to act as a sail, catching the wind, which puts additional stress on the barrier and bottom anchoring. Too little freeboard could allow splashover to occur, leading to a violation of water quality standards. Fastening the tops of turbidity curtains to sections of floating piers can be very effective. In all cases, turbidity barriers should be designed with a freeboard which will limit the stress placed on the bottom anchoring and ensure that splashover discharges do not result in violation of standards.

17. Turbidity barriers are classified into two types, permeable and impermeable. Permeable barriers allow water and dissolved solids to pass through while stopping all but the smallest of suspended solids; impermeable barriers prevent passage of water and dissolved or suspended constituents. In dredging of an area with a high concentration of nutrients and/or toxics, and low wind and current loadings, an impermeable barrier might be more effective at isolating the nutrients and/or toxics. In cases where nutrients and/or toxics are not in high concentrations and wind and current conditions are high, permeable barriers may be preferred. Permeable barriers also have the advantage of preventing barrier failure due to excessive water pressure behind the curtain.

18. Site specific design is the key to successful dredging operations. The configuration of the area to be dredged, land type and availability for dewatering and or settling, types and amount of material being dredged, nutrient concentrations within the sediments, and expected weather conditions should all be considered. By tailoring the dredging operations to the specific site, violations of water quality standards can be avoided.

19. Dredging and filling activities within surface waters may require a Section 401 or 404 permit from the U.S. Army Corps of Engineers (see "Wetlands" discussion in the "Resources Management and Restoration" section of this Chapter). Most lakebeds and streambeds in California are owned by the State, and their disturbance may also require a permit from the State Lands Commission and/or the Department of Fish and Game.

20. Proposals for dredging, filling, or dredged material disposal should continue to be evaluated on a case-by-case basis; the Regional Board should consider issuing waste discharge requirements where necessary to protect beneficial uses.

21. *Beach Creation and Replenishment.* Because it disturbs natural shorezone habitats and associated wetland/riparian values, the importation of sand to create new recreational beaches at natural lakes and reservoirs should be discouraged. Replenishment of existing sand beaches should use only clean sand.

22. *Shorezone Protection.* Eroding shorelines should be stabilized. Vegetative methods are strongly preferred unless structural methods are more cost-effective, considering the severity of wind and wave erosion, offshore bathymetry, and the potential adverse impacts on other shorelines and offshore areas.

The USEPA (1993) summarizes information on a variety of shoreline protection practices. General considerations include design of all shorezone structures so that they do not transfer erosion energy or otherwise cause visible loss of surrounding shorezones; establishment and enforcement of no wake zones to reduce erosion potential from boat wakes, establishment of setbacks for upland development and land disturbance, and direction of upland drainage away from bluffs and banks so as to avoid accelerating slope erosion.

23. *Piers.* The Regional Board has historically regulated piers serving single family homes to a lesser extent than public piers, breakwaters, jetties, marinas, and other large in-lake construction projects. Pier construction projects throughout the Region should meet the following conditions:

    - The disturbance of lake bed materials should be kept to a minimum during construction. Best practicable control technology should be used to keep suspended earthen materials out of the lake. (This may involve techniques such as installation of pilings within caissons.)

    - No petroleum products, construction wastes, litter or earthen materials should enter surface waters. All construction waste products should be removed from the project site and dumped at a legal point of disposal. Any mechanical equipment operating within the lake should be cleaned and maintained prior to use.

    - No wood preservatives should be used on wood which will be in contact with lake water.

    - The pier owner should ensure that the project contractor is aware of these and any other applicable conditions.

Regional Board staff should continue to review proposals for shorezone and underwater construction on a case-by-case basis through the Section 401 water quality certification process, and the Board should consider waste discharge requirements where necessary to protect water quality.

24. *Marinas.* Certain types of marinas in California are subject to the statewide industrial stormwater NPDES permit (see the "Stormwater Runoff, Erosion, and Sedimentation" section of this Chapter). These include marinas which are primarily in the business of renting boat slips, storing boats, cleaning boats, and repairing boats, and which generally perform a range of other marine services (USEPA 1993). The NPDES permit applies only to point sources of stormwater from the maintenance areas at the marina. The NPDES program does not apply to marinas that are not involved in equipment cleaning or vehicle maintenance activities, or to "marine service stations" which are primarily in the business of selling fuel without vehicle maintenance or equipment cleaning operations (USEPA 1993). Marina construction or maintenance activities which do not fall under the statewide industrial stormwater NPDES permit may be subject the statewide construction stormwater NPDES permit and/or areawide municipal stormwater NPDES permits (e.g., at Lake Tahoe).

25. Because of the sensitivity of the affected surface waters, the Regional Board should keep individual waste discharge requirements in effect for all larger existing marinas, in order to

effectively regulate the maintenance of fueling and wastewater disposal facilities, maintenance dredging, and other operation and maintenance activities which could adversely affect water quality. Proposals for new or significantly expanded marinas should be evaluated on a case-by-case basis against applicable water quality objectives, prohibitions, and effluent limitations.

26. Boat maintenance areas at marinas should be designed and operated to prevent the entry of toxic pollutants from marina property into surface waters. The USEPA (1993) recommends the designation of discrete impervious areas for maintenance activities, the use of roofed areas to prevent rain from contacting pollutants, and the diversion of offsite runoff away from the maintenance area for separate treatment. It also recommends source controls to collect pollutants and thus keep them out of runoff, such as sanders with vacuum attachments, the use of large vacuums to collect debris from the ground, and the use of tarps under boats which are being sanded or painted. Infiltration of runoff from non-maintenance areas is recommended; in some parts of the United States hull-cleaning waste is required to be pretreated and discharged to a sewer.

27. Over-water boat maintenance activities by marina tenants should not require opening more than a pint-size paint can. Engine oil changes should not be done while a boat is in the water. The State Board's BMP handbook for industrial NPDES permits (APWA Task Force 1993) contains additional recommendations to prevent problems from over-water maintenance activities.

28. Liquid and solid wastes produced by marina operation, maintenance, and repair activities, including waste oils, solvents, antifreeze, and paints, should be properly disposed of. Marinas with heavy use by fishermen should also manage fish waste disposal. Fish waste management can include establishment of fish cleaning areas with waste receptacles, issuance of rules controlling or prohibiting fish cleaning at the marina, education of boaters about waste problems, and implementation of composting where appropriate (USEPA 1993).

29. The USEPA (1993) recommends the use of automatic shutoff nozzles, and fuel/air separators (on air vents or tank stems of inboard fuel tanks), to reduce the amount of fuel spilled into surface waters during fueling of boats. It also recommends the use of oil-absorbing materials in the bilge areas of all boats with inboard engines. These materials should be examined at least once a year and replaced as necessary.

30. Marina fueling stations should be designed to allow for ease in cleanup of spills. This includes allowance for booms to be deployed to surround a fuel spill. Marinas should have fuel spill contingency plans meeting local and State requirements. These plans should include health and safety procedures, notification, and spill containment and control. Appropriate containment and control materials should be stored in a clearly marked, easily accessible location. Materials should include absorbent pads and booms, fire extinguishers, a copy of the spill contingency plan, and other equipment deemed suitable. Marina tenants and employees should be educated on spill prevention and cleanup (USEPA 1993, APWA Task Force 1993).

31. Some marinas have chemical over-water fire retardant systems. In reviewing marina projects, Regional Board staff should investigate the types of chemicals being used and their potential water quality impacts in relation to applicable water quality objectives.

32. Marina water treatment systems (to remove nutrients and turbidity) have been suggested as mitigation for the impacts of marina expansion at Lake Tahoe. The Tahoe Keys subdivision currently has a treatment system to remove phosphorus from the waters of its artificial lagoons. Any new proposals for marina water treatment systems in the Lahontan Region should be evaluated based upon site specific conditions and water quality risks associated with the proposed treatment (see discussion of lake restoration in the “Resources Management and Restoration” section of this Chapter.)

33. Additional monitoring should be conducted in areas of heavy boating and rafting use to document the water quality impacts of vessel wastes, shorezone construction, and dredging. In particular, marina sediments should be sampled for TBT when dredging is proposed.

Offroad Vehicles

Offroad vehicles (ORVs), (also called "off-highway" vehicles or OHVs), include, but are not limited to, any of the following: bicycles, motorcycles, "all terrain vehicles," snowmobiles, and any other vehicle (including passenger trucks and cars) operated off of paved roads. While the impacts of "mountain" bicycles are still being debated, motorized vehicles can cause serious erosion problems, directly (through soil detachment, compaction, or creation of ruts) or indirectly (through damage to vegetation or by starting wildfires). Operation of over-the-snow vehicles can also disturb soils and vegetation if there is insufficient snow cover.

Control Measures for Offroad Vehicles

1. The U.S. Forest Service and Bureau of Land Management designate ORV routes on public lands and prohibit operation away from these routes. ORV use may be further restricted during extremely dry conditions in order to prevent fires, and during wet (i.e., winter/spring) conditions when excessive soil disturbance is likely. However, illegal use can and does occur. Compliance should be encouraged via well planned and targeted public education efforts, as well as strict enforcement of regulations.

2. Regional Board staff should continue to review and comment on proposed changes in ORV management plans of public agencies. These agencies should be encouraged to monitor the water quality impacts of legal ORV use, and to modify or close routes where water quality problems are occurring. Modifications could include rerouting of trail segments away from surface waters and wetlands, or installation of bridges at stream crossings. Closed routes should be stabilized and revegetated.

3. Some local governments have ordinances regulating ORV use, although these may be directed at problems unrelated to water quality (e.g., noise). All local governments in the Region should be encouraged to adopt and enforce ordinances which will prevent erosion from ORV use on private lands.

4. Although waste discharge requirements are generally an infeasible means of controlling the impacts of private ORV use, the Regional Board can issue requirements or cleanup orders to landowners whose property is contributing to water quality problems as a result of ORV damage. Waste discharge requirements can also be issued to commercial ORV facilities to ensure proper operation (e.g., to ensure that snowmobiles are operated over snow deep enough to prevent soil damage).

Ski Areas

Alpine skiing facilities are found on public and private lands in the San Bernardino and San Gabriel Mountains and in the Sierra Nevada, including the Mammoth Lakes, June Lakes, Lake Tahoe, and Truckee areas. Some of these ski areas have stimulated neighboring private resort development, which can include facilities such as golf courses and bike trails designed to attract summer visitors. The potential exists for the expansion of existing ski areas and the creation of new ones.

Downhill skiing facilities tend to be located at high elevations on steep terrain with poorly developed soils, in areas receiving high amounts of precipitation. Water quality problems associated with ski areas include: erosion and sedimentation from construction and maintenance activities, disturbance of wetlands, stormwater runoff from parking lots and other impervious surfaces, and disposal of domestic wastewater in areas which are remote from urban wastewater treatment plants and which are usually unsuitable for septic systems. Snow-making and snow-grooming are also of concern. Installation of pipelines and excavation of storage ponds for snow-making can lead to severe erosion. Some ski areas use bacteria as nucleating agents for snow crystals; the bacteria can contribute nitrogen to surface runoff. Salts such as ammonium nitrate and sodium chloride may be used to groom ski slopes. Upon snowmelt, these salts may adversely affect instream uses and/or riparian vegetation.

Older ski areas were constructed with little consideration of water quality impacts. Preparation for the 1960 Winter Olympics at Squaw Valley involved channelization of a creek, filling of a wet meadow to support parking, and construction of a wastewater treatment plant which raised nitrate levels in a sole-source municipal aquifer. Later ski area developments have been more carefully planned. However, even the use of Best Management Practices (BMPs) for erosion and stormwater control cannot completely eliminate water quality impacts. The fragile soils, harsh climates, and short growing seasons at ski areas make the revegetation of cleared roads, trails, and ski slopes very difficult. Disturbed areas at most older ski resorts are still not adequately stabilized. A State Water Resources Control Board study of one ski area which used "state-of-the-art" BMPs showed an erosion rate six times higher than natural levels (White and Franks 1978).

The U.S. Forest Service uses conceptual models to evaluate the risk of Cumulative Watershed Effects (CWE) and adverse impacts on beneficial uses of water from land management activities. The methodology is primarily used to evaluate the effects of proposed timber harvest activities; however, it has recently been adapted to predict the impacts of new land disturbance during construction of skiing facilities. Chapter 20 of the U.S. Forest Service's Soil and Water Conservation Handbook (R-5 FSH 2509.22) provides a general overview of CWE methodology and analysis recommendations. The U.S. Forest Service's 1993 report entitled *Cumulative Watershed Effects Analysis for Heavenly Valley Ski Area* discusses the potential use of CWE procedures for ski areas in the Lake Tahoe Basin.

Analyses are performed by an interdisciplinary team, and include some degree of professional judgement. CWE analysis involves quantifying existing and proposed watershed disturbance as “Equivalent Roaded Acres” (ERA). (An acre of road is assigned an ERA of 1.0. An acre of well-vegetated ski run on a gentle slope might be assigned an ERA coefficient of 0.2; an acre of badly eroding ski run on a steep slope might be given a value of 2.0 ERA.) Disturbed areas can be analyzed after the performance of remedial erosion or drainage control work, and the ERA value can be revised downwards. CWE analysis also involves determination of a “Threshold of Concern” (TOC) for each watershed affected. The TOC is an upper limit of tolerance to disturbance (in ERA). The risk of initiating adverse cumulative water quality effects greatly increases as this upper limit is approached or exceeded. Determination of the TOC is an interactive and multi-step process which involves comparison of several watersheds with respect to the extent of land use disturbance and the occurrence or nonoccurrence of adverse cumulative impacts.

Where CWE analysis indicates that the TOC of a subwatershed in a ski area is currently exceeded or is expected to be exceeded as a result of proposed development, conditions may be placed in the ski area permits on additional new projects. These conditions can be used as a means of phasing new projects in relation to the accomplishment of remedial erosion control programs. This approach is being used by the U.S. Forest Service, Lake Tahoe Basin Management Unit and the Tahoe Regional Planning Agency for proposed ski area expansions in the Lake Tahoe Basin, and may be applied to Forest Service ski area permits elsewhere.

Control Measures for Skiing Facilities

1. The Regional Board has adopted waste discharge requirements (WDRs) and/or NPDES permits for all large ski areas in the Region, to address the problem areas identified above in relation to locally applicable water quality objectives, discharge prohibitions, and effluent limitations. These WDRs are updated periodically to address proposed ski area expansions and/or changes in operation and maintenance activities which could affect water quality. Permit conditions include the use of temporary and permanent BMPs, the prevention and cleanup of fuel and sewage spills, and in some cases, remedial measures to correct water quality problems created by past development. Permit conditions also regulate the use of snow-making chemicals and bacteria in addition to snow-grooming chemicals.

2. The Regional Board shall review proposed new skiing facilities and issue WDRs and/or NPDES permits as appropriate.

3. Skiing facilities in the Lake Tahoe Basin shall continue to be regulated under the provisions of Chapter 5, Section 5.15 of this Basin Plan, in addition to the general control measures outlined in Chapter 4.

Recommended Control Measures for Skiing Facilities

1. The U.S. Forest Service and local governments with permitting authority over ski areas should consider placing conditions in their permits to require:

    - the effective implementation of all applicable temporary and permanent BMPs

    - measures to prevent, report, and clean up fuel and sewage spills

    - measures to limit the use of snow-making and snow-grooming chemicals where appropriate, in order to protect water quality

    - sufficient monitoring to assess water quality impacts and the effectiveness of mitigation measures

2. Land management agencies and local governments which have lead agency

responsibility for permitting new or expanded ski areas outside of the Lake Tahoe Basin should encourage the preparation of comprehensive master plans and master environmental documents which recognize and mitigate the potential direct, indirect, and cumulative water quality impacts of each new project.

3. New and expanded ski areas should be designed to minimize soil and vegetation disturbance, particularly the disturbance of wetlands. Modern techniques permit ski lift installation without road construction. Logging for clearance of ski slopes and trails can also be done by helicopter, cable, over-the-snow vehicles or other means that minimize soil disturbance. Stream crossings should be kept to a minimum. Because of the difficulty of revegetation, native herbaceous and shrubby plants should be left in place on ski slopes and trails to the greatest extent possible.

4. Local governments, land management agencies, and the Regional Board should use the Cumulative Watershed Effects (CWE) model as a means to evaluate the water quality impacts of, and the adequacy of mitigation for, development of new skiing facilities outside of the Lake Tahoe Basin. Where appropriate, CWE analyses should be prepared for existing ski areas to determine necessary remedial improvements. Where CWE analysis indicates that current or projected disturbance is in excess of the Threshold Of Concern (TOC) for subwatersheds within the ski area, further development should be permitted only in conjunction with remedial erosion control programs and monitoring plans which ensure that the ERAs within those subwatersheds are substantially reduced and driven toward or below the TOC.

Golf Courses and Other Turf Areas

For visual amenity and to provide water hazards, golf courses are often located near surface waters. Construction of golf courses may include hydrologic modification, such as diversion or damming of streams or alteration of wetlands. Golf courses involve intensive management of turf, including the use of pesticides and fertilizer which may run off into surface waters or percolate into ground water. Mowing of turf creates large volumes of clippings containing nutrients and pesticides which must be considered in decisions on disposal or composting. Golf course turf demands large amounts of water for irrigation. In some portions of the Region, reclaimed water is used to irrigate golf courses; however, as noted elsewhere in this Chapter, the use of reclaimed water is not without a risk of water quality problems.

Other large turf areas, such as athletic fields and urban parks, can pose water quality problems similar to those created by golf courses, and should be addressed through similar control measures.

Control Measures for Golf Courses and other Turf Areas

(Control measures concerning the use of pesticides and fertilizers are discussed separately in the “Agriculture” section of this Chapter.)

1. The Regional Board has adopted waste discharge requirements (WDRs) for golf courses in the sensitive Lake Tahoe and Truckee River watersheds, and should consider issuing similar WDRs for any golf courses which have the potential to cause significant impacts on surface or ground waters. WDRs should include effective implementation of Best Management Practices, record-keeping of fertilizer and pesticide use, and monitoring of surface and/or ground water quality. Construction stormwater NPDES permits may be required for new or expanded golf courses.

2. New and remodeled golf courses should be designed to minimize the need for hydrologic modification and disturbance of wetlands and riparian vegetation.

3. New and remodeled golf courses should also be designed to require minimal fertilizer and pesticide application (e.g., through the use of target greens which require intensive maintenance on only a small portion of the course).

4. Water use for irrigation of golf courses should be minimized to the greatest extent possible. In addition to making limited water supplies available for other uses, such conservation will reduce the loading of nutrients and pesticides to surface and ground waters. New technology in irrigation systems can greatly reduce water use. Any proposed use of reclaimed water for golf course irrigation should be evaluated carefully in relation to site-specific water quality constraints.

5. In addition to irrigated turf, golf courses include buildings such as clubhouses and maintenance facilities, and parking lots, all of which may contribute to erosion or stormwater problems. Pretreatment of any pesticides and/or petroleum products in this stormwater may be necessary

before such discharges could be permitted. Stormwater containment and treatment should be an integral part of golf course design in portions of the Region where surface waters may be affected. Although water hazard ponds may be used as stormwater retention or detention basins, eutrophication is likely to be a problem and these basins may need frequent maintenance. In desert areas of the Region, stormwater control for golf courses may be a less important consideration; however, toxic substances should be protected against the hazard of washout from flash floods.

6. Local governments should evaluate proposals for new or expanded/remodeled golf courses, or for zoning to facilitate such projects, against the water quality concerns outlined above, and should incorporate appropriate water quality mitigation measures into their conditional permits.

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4.12 MILITARY INSTALLATIONS

Military installations have created some of the nation's largest and most complex environmental contamination problems. Executive Order No. 12580, adopted in 1987, directs all federal facilities to investigate and remediate areas of environmental contamination. As a result, the U.S. Department of Defense (DOD) has assumed responsibility for investigation and remediation at military installations.

The Regional Board is actively involved in investigation and remedial activities at military installations, including seven active military sites, one recently closed site, and six formerly used defense sites. All but two of these installations are in the South Basin and include three of the world's largest bases. Following are lists of active military bases in the Lahontan Region with one noted as being recently closed. (These lists are current as of 1994).

- South Lahontan Basin:
- Fort Irwin National Training Center
- George Air Force Base (closed)
- Edwards Air Force Base
- Air Force Plant #42, Palmdale
- Marine Corp Logistics Base, Barstow
- China Lake Naval Air Weapons Station
- North Lahontan Basin:
- Sierra Army Depot
- Marine Corps Mountain Warfare Training Center

The operations of the above military installations for the past 60 years have yielded hazardous substance releases that have degraded water quality within, and in some cases, outside of base properties. The manner in which these hazardous substances were handled was, in fact, common practice at all federal facilities across the nation during this time. As a result of past waste disposal practices, spills, and inadequate regulations, the military installations have created significant water quality problems.

Adverse impacts to water quality can result from discharge of petroleum hydrocarbons, heavy metals, solvents, acids and alkalis, landfill leachate, explosive organic compounds, and low-level radionuclides. These pollutants originate from the following sources:

- gas stations
- fuel pipelines
- stormwater retention basins
- contaminated wells
- fire training facilities
- evaporation ponds
- target ranges
- waste piles
- washwater/solvent catchment basins
- storage tanks (above and underground)
- waste disposal sites (solid, hazardous, pesticides, munitions, low-grade radioactive)

These releases have created substantial soil, surface water, and ground water contamination affecting or threatening to affect wildlife and aquatic habitats and causing domestic wells to be abandoned.

Control Measures for Military Installations

The Regional Board has the regulatory responsibility under the federal Clean Water Act and the California Water Code to protect water quality on federal property in the State, including military installations. Past control measures on bases included adoption of waste discharge requirements (WDRs) for discharges related to storm runoff, construction activities, and municipal wastewater treatment facilities. The WDRs included surface and ground water discharge limitations for water quality parameters such as nutrients, turbidity, pH, taste, odor, temperature and algal growth, as well as BMPs to prevent discharge of waste earthen materials. Other control measures by the Regional Board have been to review and regulate military base compliance in detecting and removing leaking underground storage tanks, uncovering and eliminating toxic pits, and issuance of Cleanup and

Abatement Orders or other actions to remediate polluted ground water.

The State of California entered into a Memorandum of Agreement (DSMOA) with the DOD that identified 92 federal facilities within California for site remediation. The purpose of site remediation is to characterize and remove hazardous pollutants that pose a potential or actual threat to human health and/or the environment. Upon completion of site remediation, the facilities may be available for unrestrictive use. The DSMOA acknowledges the State's role for providing oversight of the site remediation and provides for the State to receive payment for its oversight costs.

At military installations where water quality is threatened due to the release of hazardous substances, both the Regional Board and the Department of Toxic Substances Control (DTSC) have overlapping jurisdiction to order cleanup of sites. A Memorandum of Understanding (MOU) was executed in 1990 between the DTSC, the State Water Resources Control Board, and the Regional Boards, which specified each agency's responsibilities in hazardous waste site cleanup. Under that MOU, the Regional Board retained lead responsibility for certain cleanup operations at military installations. Subsequently, in 1994, the Secretary of Cal/EPA designated DTSC as the lead agency for all DSMOA military installations in California. DTSC is now responsible for coordinating cleanup activities and for ensuring that the Regional Boards' concerns regarding water quality issues are addressed. The Regional Board remains the state lead agency for regulation of active sites permitted by WDRs (such as landfills and sewage treatment plants), cleanup of leaking underground storage tank sites, and other programs mandated by the federal Clean Water Act.

The Regional Board acts as state lead agency at George Air Force Base.

Recognizing that a large number of federal facilities have been contaminated by hazardous substances which may pose a risk to human health and the environment, Congress has passed many acts to provide funding, regulations, and guidelines for site cleanup.

Installation Restoration Program

The Department of Defense (DOD) developed the Installation Restoration Program (IRP) to comply with the federal Resource Conservation and Recovery Act (RCRA) of 1976. (RCRA required federal agencies to comply with local and state environmental regulations concerning waste disposal practices at federal facilities.) The objective of the IRP is to assess hazardous waste disposal and spill sites at military installations and to develop remedial actions consistent with the National Contingency Plan (NCP) for those sites which pose a threat to human health and the environment. The IRP is the DOD's primary mechanism for response actions at all military installations.

Federal "Superfund" Program (CERCLA)

The federal "Superfund" program was established in 1980 with the passage of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The CERCLA provided funding and guidelines for the cleanup of the most threatening hazardous waste sites in the nation. High priority sites scheduled for cleanup under this program are placed on the National Priority List (NPL). In California, a large number of federal facilities have been placed on the NPL; a significant proportion of these are military installations.

As of 1994, three federal facilities within the Lahontan Region are on the NPL, all being military bases in the South Basin. They are: the Marine Corps Logistics Base near Barstow, Edwards Air Force Base, and George Air Force Base.

Over the years, provisions of the IRP have been developed and modified to insure DOD compliance with other federal enactments such as the CERCLA, and the Superfund Amendment and Reauthorization Act (SARA), an amendment to the CERCLA. SARA requires that all federal facilities on the NPL enter into a Federal Facilities Agreement (FFA) with the USEPA. States can also be a party to the FFA but this is not a requirement. The FFA is a site-specific document which defines the USEPA's and the State's expectations as to site investigation and problem remediation. It specifies tasks and compliance schedules, describes a dispute resolution process, and stipulates penalties for compliance schedule violations. In the Lahontan Region, all three military bases on the NPL have signed a FFA of which the Regional Board is a signatory party.

Response Process. All military bases in the State with historical discharges that threaten or have potential to threaten human health and the environment are being cleaned up in compliance with the CERCLA guidelines. The guidelines include a response process consisting of removal, remedial, and enforcement programs. The rigorous response process includes the following actions:

- *Preliminary Assessment,* to determine release sites and the extent of contamination or threat of

contamination to the environment.

- *Remedial Investigation/Feasibility Study (RI/FS),* evaluates all information obtained during the Remedial Investigation (an investigation to fully characterize the contaminant sources requiring remediation), identifies ARARs (Applicable or Relevant and Appropriate Requirements, which are numerical constituent limits for cleanup and/or discharge, and other action-, location-, or chemical-specific requirements), compares treatment technologies and recommends a Preferred Alternative for the cleanup operation.

- *Record of Decision,* a document disclosing the cleanup action to be pursued, including ARARs which list the numerical final constituent limits for cleanup or discharge.

- *Remedial Design/Remedial Action,* is the design of the cleanup technology used at the site and the remedial activities to take place.

- *Operation and Maintenance,* is the operation and maintenance of the cleanup activities at the site during the time of remediation.

SARA requires federal facilities with FFAs to comply with applicable state standards in performing remedial actions. Thus, applicable state agencies can be involved in the CERCLA response process regarding ranking, long-term planning, RI/FSs, remedial action selection, and other negotiations.

The Regional Board takes an active role in the response process for the military installations with FFAs to assure that ground water investigations and cleanup activities are completed in accordance with Regional Board policies for the protection of water quality. This is achieved by establishing ARARs, providing input for remedial design and remedial actions, overseeing operation and maintenance of cleanup activities, and conducting inspection of bases to insure compliance with FFAs. Sometimes, however, disagreements will occur between signatory parties of FFAs regarding how and when to achieve compliance. In these cases, the parties enter the dispute resolution process under the FFA to alleviate disagreements and achieve resolution.

Non-NPL Federal Facilities

Another provision of SARA requires federal facilities not listed on the NPL to comply with all state laws for the cleanup of hazardous substances released into the environment. Section 120(a)(4) allows states to pursue all enforcement remedies, including assessment of civil liability against federal facilities not implementing acceptable remedial actions for contaminated sites. Federal facilities, including military bases, not on the NPL can sign into a state compliance agreement called a Federal Facilities Site Remediation Agreement (FFSRA). This is a document that formalizes a working agreement between the federal facility and state agencies. It establishes a schedule for site investigations and any necessary cleanup, and it provides the enforcement mechanism for commitments not met. As of 1994, one non-NPL military base in the Lahontan Region (Sierra Army Depot) has signed a FFSRA.

As of 1994, the other military bases in the Region (the Marine Corps Mountain Warfare Training Center, Fort Irwin, Air Force Plant #42, and the China Lake Naval Weapons Center) are not on the NPL and do not have FFSRAs. These facilities, however, have sites contaminated with petroleum products, heavy metals, and other pollutants that have led to degradation of water quality. Site agreement (FFSRA) negotiations are in progress for some bases.

Formerly Used Defense Sites (FUDS)

There are six major FUDS in the Lahontan Region, all being in the South Basin. Most of the operations on these now-closed bases were similar to operations on other bases where investigations revealed serious water quality problems. As of 1994, these six FUDS have not been formally investigated by the Department of Defense to determine if contamination problems exist, and if water quality is being impacted or threatened. The U.S. Army Corps of Engineers is responsible for environmental investigations and cleanup of FUDS.

Recommended Future Actions for Military Installations

The Regional Board should continue to work with DTSC and other state agencies to obtain FFSRAs for the military bases in the Region without this document. Having a FFSRA can assist facilities in acquiring funding for remedial activities and insure that progress is made towards achieving compliance with State water quality standards. The agreements can also ensure that cleanup activities at the bases are performed in a timely manner, or that enforcement action will be taken and civil penalties pursued by the Attorney General's office. The Regional Board should continue to monitor compliance at all other bases to insure that remediation work is being performed to comply with FFSRAs and FFAs.

The Regional Board should work to see that all FUDS are investigated to determine if they pose a threat to water quality. If water quality is being impacted or threatened at these sites, the Regional Board must ensure that appropriate remediation actions are being pursued by the DOD.

4.13 TOTAL MAXIMUM DAILY LOADS

Section 303(d)(1) (A) of the Clean Water Act requires that "Each State shall identify those waters within its boundaries for which the effluent limitations... are not stringent enough to implement any water quality standard applicable to such waters." The Clean Water Act also requires states to establish a priority ranking for waters on the Section 303(d) list of impaired waters and to establish Total Maximum Daily Loads (TMDLs) for such waters. TMDLs are essentially strategies to ensure the attainment of water quality standards in impaired waters.

The requirements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the Clean Water Act. A TMDL is defined as "the sum of the individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2) such that the capacity of the water body to assimilate pollutant loadings (the "loading capacity") is not exceeded. TMDLs are also required to address seasonal variations and to include a margin of safety to address uncertainty in the analysis. In addition, federal regulations (40 CFR 130.6) require states to develop water quality management plans to implement water quality control measures including TMDLs.

The U.S. Environmental Protection Agency (USEPA) is required to review and either approve or disapprove the TMDLs submitted by states. If the USEPA disapproves a TMDL submitted by a state, the EPA is required to establish a TMDL for that water body. Upon establishment of the TMDL by the USEPA, the state is required to incorporate the TMDL, along with appropriate implementation measures, into the state water quality management plan.

This section of the Lahontan Basin Plan contains Total Maximum Daily Loads (TMDLs) for specific water bodies and pollutants. Future TMDLs will be added as they are approved. Background information used to develop each of the specific TMDLs will be retained with the administrative record of the Basin Plan amendments, and will be available to the public on request.

Heavenly Valley Creek, El Dorado County

Introduction. Heavenly Valley Creek is a tributary of Trout Creek in the southern portion of the Lake Tahoe watershed. The segment of Heavenly Valley Creek within the permit boundaries of the Heavenly Ski Resort is impaired by sedimentation related to historic ski resort development (including roads and ski runs). Sedimentation of Heavenly Valley Creek is of concern not only because of its impacts on instream uses but also because of its cumulative contribution to the degradation of Lake Tahoe. All of the subwatershed affected by the Total Maximum Daily Load (TMDL) for sediment is National Forest land administered by the U.S.D.A. Forest Service, Lake Tahoe Basin Management Unit (LTBMU) and within the permit boundaries of the Heavenly ski resort.

The purpose of this TMDL is to ensure attainment of all sediment-related water quality standards, especially narrative objectives related to protection of instream beneficial uses. (When this TMDL was developed, Heavenly Valley Creek was close to attainment of the numerical suspended sediment objective applicable to tributaries of Lake Tahoe.) The LTBMU has modeled sediment delivery to Heavenly Valley Creek, and reductions in sediment loading expected as a result of ongoing erosion control work. This TMDL is based on LTBMU modeling and monitoring data, interpreted by Regional Board staff to translate hillslope sediment delivery to instream loads. The TMDL implementation program is based substantially on continuation of existing erosion control and monitoring programs which are being carried out under an adaptive management approach by the LTBMU and the ski resort. Progress toward attainment of water quality standards in Heavenly Valley Creek will be evaluated in relation to monitoring data for Hidden Valley Creek, another tributary of Trout Creek with an undisturbed watershed within National Forest lands. A Regional Board staff report (California Regional Water Quality Control Board, Lahontan Region, 2000) provides the technical information supporting the regulatory elements of this TMDL. The staff report should be considered as the reference for all of the information in Tables 4.13-HVC-1 through 4.13-HVC-6 below.

Problem Statement. The water quality standards of concern in relation to this TMDL are beneficial uses related to aquatic life (COLD, RARE, MIGR, and SPWN; see Chapter 2 of this Basin Plan), and narrative water quality objectives for

sediment, settleable materials, suspended sediment, and nondegradation (see Basin Plan Chapter 5). Ski resort development began in the Heavenly Valley Creek watershed in 1956, and there is evidence of significant sediment-related impacts on water quality and beneficial uses in the early 1970s, before adoption of the North Lahontan Basin Plan. The creek has been significantly affected by hydromodification (including a snowmaking reservoir and diversion of part of the creek into a culvert). Monitoring data show that the creek has elevated suspended sediment concentrations and loads compared to the reference stream (Hidden Valley Creek). Problems have been identified with stream channel stability (although improving trends in channel conditions have been documented since the beginning of the erosion control program). The creek has been rated as "marginal" fish habitat since 1982.

Desired Conditions. A variety of parameters, reflecting desired instream and hillslope conditions, have been selected for tracking to evaluate the effectiveness of the TMDL. They are shown in Tables 4.13-HVC-1 and 4.13-HVC-2. Most of these parameters are already being monitored or tracked by the LTBMU. As used in the desired instream conditions, the loading capacity, and load allocations, the term "5 year rolling average" means the arithmetic mean of 5 contiguous annual load estimates (T/yr). For example, in the fifth year, the mean of annual averages for years 1-5 will be calculated. In the sixth year, a new mean, based on data for years 2-6 will be calculated, and so on. The terms "parameter" and "desired condition(s)," as used in this TMDL, are equivalent to the terms "indicator" and "target(s)" as used in USEPA guidance for the development of TMDLs (e.g., USEPA, 1999) and are not meant to have any additional regulatory meaning. The terms "indicator" and "target" will be used in future TMDLs.

Source Analysis. Modeled sediment delivery from various hillslope source categories to Heavenly Valley Creek is shown in Table 4.13-HVC-3. Monitoring data for 1996-99 were used to estimate the instream suspended sediment load, which was converted to a total (suspended plus bedload) sediment load using the assumptions that instream bedload sediment constitutes 20 percent of the total. Since there has been a concerted effort to implement Best Management Practices (BMPs) in the watershed since 1991, instream sediment loads in 1996-99 presumably reflect improved water quality compared to unmitigated conditions. Using information provided by LTBMU staff regarding BMP implementation to date, back-calculations were done to estimate the total unmitigated sediment load (150 tons) shown in Table 4.13-HVC-4. That unmitigated load was divided among hillslope sources using the same relative percentages shown in Table 4.13-HVC-3. Natural sediment loading in Hidden Valley Creek is included in Table 4.13-HVC-4 for reference.

The discrepancy between the estimated hillslope sediment delivery and the instream total sediment load can be attributed partly to the limitations of the sediment delivery model. Sediment delivery is a long term process; other factors contributing to the discrepancy may include temporary storage of eroded sediment on hillslope sites and in ephemeral channels before it reaches Heavenly Valley Creek.

Loading Capacity/Total Maximum Daily Load and Linkage Analysis. The loading capacity for total annual instream sediment loading to Heavenly Valley Creek, measured at the "Property Line" station near the resort permit boundaries, is 58 tons of sediment per year, expressed as a 5 year rolling average. The loading capacity was calculated by assuming an overall 65% efficiency for BMPs and therefore a 65% reduction in the unmitigated instream sediment load. After consideration of differences in watershed size, this figure is reasonably close to the estimated 45 tons/year total sediment load in the reference stream. Because the wasteload allocation is zero and the TMDL margin of safety is implicit, the loading capacity is also the Total Maximum Daily Load.

It is difficult to predict precise relationships between hillslope sediment delivery and instream conditions because these linkages are often indirect (e.g., temporal and spatial lags between erosion and instream impacts) and because of the seasonal and annual variability in ecosystem processes. This TMDL uses an "inferred linkage" based on comparison of conditions in Heavenly Valley and Hidden Valley Creeks, and a literature review, summarized in the staff report, which indicates that the loading capacity will adequately protect aquatic life uses. Compliance with standards will be measured through long term evaluation of all of the parameters in Tables 4.13-HVC-1 and 4.13-HVC-2. If the desired conditions are attained, erosion rates and sediment delivery should decline to levels which will allow instream habitat and beneficial uses to recover, over time, from the impacts of excessive sedimentation in the past.

Wasteload Allocations. There are no point

sources of sediment to the Section 303(d) listed segment of Heavenly Valley Creek, and the wasteload allocation for point sources is zero.

Load Allocations. Load allocations are shown in Table 4.13-HVC-5. The contributions to the mitigated instream sediment load from the "undisturbed lands" and "impervious surface" source categories are assumed not to change as a result of TMDL implementation. The allocation for new development is based on LTBMU modeling data and reflects estimated loading after full application of BMPs. The road and ski run source categories have been given a single load allocation as "historically disturbed lands".

Margin of Safety. The TMDL includes an implicit margin of safety to account for uncertainty in the analysis. Sources of uncertainty include: interpretation of compliance with standards, including narrative objectives and beneficial use support; limited data available for some parameters; limitations of the LTBMU sediment delivery model, and inherent seasonal and annual variability in sediment delivery and instream impacts of sediment.

The TMDL provides a margin of safety by: 1) interpreting compliance with standards through use of multiple parameters to evaluate progress toward desired conditions; 2) incorporating conservative assumptions in the source analysis and development of load allocations; and 3) incorporating a rigorous monitoring and review program and schedule which provides an ongoing mechanism to adjust the TMDL if adequate progress toward attainment of standards is not being made.

Seasonal Variations and Critical Conditions. The TMDL evaluates a variety of parameters in order to integrate the net cumulative effects of sedimentation over longer time frames. The loading capacity and the load allocations are expressed as 5 year rolling averages to account for natural seasonal and annual variation in sediment loads, with the recognition that trends may not be apparent within shorter time frames. Other parameters are also expressed as long term trends. The TMDL and load allocations are set at levels which, over time, will allow instream aquatic habitat to recover to a level which adequately supports aquatic life uses.

Implementation Measures and Schedule. Implementation is the responsibility of the U.S. Forest Service, Lake Tahoe Basin Management Unit (the landowner) and the Heavenly Ski Resort (an LTBMU permittee). The program of implementation summarized in Table 4.13-HVC-6 is based primarily on continuation of the existing LTBMU erosion control program which requires application of Best Management Practices to all disturbed areas in the ski resort under an adaptive management approach. The implementation program includes full application of Best Management Practices to all new and existing disturbed areas within the ski resort. Implementation also include the monitoring and review and revision programs discussed below.

The Regional Board will use its existing authority, including the Lake Tahoe Basin control measures outlined in Chapter 5 of this Basin Plan, and the three-tier compliance approach (ranging from voluntary compliance to regulatory action) in the statewide Nonpoint Source Management Plan, to ensure implementation of the TMDL. If needed, the Regional Board will use enforcement orders to ensure implementation. The LTBMU and the Tahoe Regional Planning Agency have authority, and have made commitments, to ensure implementation in the Nevada portion of the Heavenly Valley Creek watershed.

Erosion control work within the Heavenly Valley Creek watershed is expected to be complete by 2006. The consequent reduction in hillslope sediment delivery is expected to allow recovery of instream physical conditions to more natural levels, leading to gradual recovery of aquatic life uses. Attainment of instream standards is projected to occur within 20 years after final approval of the TMDLs (by 2021). The technical staff report includes additional information on authority for and commitments to implementation, and demonstrates that there is reasonable assurance of continued implementation and attainment of standards.

Monitoring. The TMDL monitoring program will focus on the parameters listed in Tables 4.13-HVC-1 and 4.13-HVC-2. Suspended sediment concentration and flow will continue to be monitored to enable calculation of annual sediment loads. With the exception of macroinvertebrate community health, all of these parameters are already being monitored as part of the LTBMU's adaptive management program. Most of these parameters are sampled annually; surveys for others, such as the Pfankuch stream channel condition index, are conducted at longer intervals to detect long term trends. TMDL monitoring will include stations in both the Heavenly Valley Creek and Hidden Valley Creek watersheds. The technical staff report for the Heavenly Valley Creek TMDL includes recommendations for sampling

locations and frequencies. However, because of the adaptive management approach to implementation, and the pending completion of the first comprehensive review of five years of monitoring data, this TMDL allows flexibility for modification of the monitoring program over time. No later than 120 days after the final approval of the Heavenly Valley Creek TMDLs, Regional Board staff will reach agreement with LTBMU and Heavenly ski resort staff on initial sampling frequencies and locations for all of the TMDL parameters. This agreement may be formalized either through a Memorandum of Understanding or through modifications to the monitoring program in the waste discharge requirements for the Heavenly ski resort.

Results of the TMDL monitoring will be reported in the annual reports produced by the LTBMU as part of its adaptive management program for the Heavenly ski resort as a whole, and in the projected comprehensive evaluations for this program which are to be produced at five year intervals beginning in 2001.

Schedule for Review and Revision of the TMDL. Regional Board staff will continue to participate in the interagency technical advisory group for the LTBMU's erosion control and monitoring programs. Staff will review the annual and five year monitoring and evaluation reports described above from the perspective of progress toward implementation of controls necessary to meet the load allocations, and toward attainment of water quality standards. If significant progress is not apparent at the conclusion of the second (2005-2006) review, Regional Board staff will evaluate the need for revision of the TMDLs and/or the implementation program.

Table 4.13-HVC-1
Desired Instream Conditions, Heavenly Valley Creek TMDL

Parameter	Desired Condition(s)
Instream Total Sediment Load[1]	Maximum 58 tons/year as a 5 year rolling average, as measured at the Property Line monitoring station.
Geomorphology Measures	
Pfankuch channel stability rating (composite rating includes numeric scores for 15 different indicators)[2]	Increasing trend over time from "fair-poor" to "good" (comparable with overall rating of Hidden Valley Creek)
USFS Region 5 "Stream Condition Inventory" (SCI)[2]	Improving trends in channel morphology over time
Biological Parameters	
Macroinvertebrate community health.	Improving trends in benthic invertebrate community metrics over time, approaching conditions in Hidden Valley Creek

[1] Incorporated by reference in CRWQCB, Lahontan Region ,2000 (technical staff report, Sections 3.2 and 3.5, with May 2002 supplement.

[2] Incorporated by reference in U.S. Forest Service, 1996 (pages 5-2 to 5-9); U.S. Forest Service, 1997, pages 5-1 to 5-9; Hazelhurst and Widegren ,1998, and Hazelhurst *et al.,* 1999 (annual U.S. Forest Service Heavenly Ski Resort environmental monitoring reports).

Table 4.13-HVC-2
Desired Hillslope Conditions, Heavenly Valley Creek TMDL

Parameter	Desired Condition(s)
Watershed disturbance[1]	Schedules in ski resort master plan mitigation program (TRPA 1995, 1996) for implementing and maintaining BMPs for roads and ski runs are met, with progress and BMP effectiveness reported annually and evaluated at 5-year intervals
Effective soil cover (vegetation, woody debris, organic matter, rocks) on ski runs and roads[2]	Cover meets modeled mitigation targets set for specific road/run segments in watershed, and overall cover rating is "good" or better using LTBMU evaluation criteria

[1] Incorporated by reference in Tahoe Regional Planning Agency (TRPA) Draft EIR/EIS/EIS for Heavenly Ski Resort Master Plan (1995), pages 4.1-50 to 4.1-72 (CWE Soil Erosion Reduction Program) and Appendices H and I; TRPA (1996), pages 6.4-1 to 6.5-6 (Revised Mitigation and Monitoring Plan); and U.S. Forest Service (1998), Appendix G (CWE Technical Memorandum No. 1).

[2] Incorporated by reference in TRPA (1995) Appendix I, Road and Run Segment Mitigation Tables; Hazelhurst and Widegren (1998) pages 3.1 to 3.13 (on effective soil cover evaluation); and Hazelhurst *et al*., 1999, pages 3.1 to 3.7 and 6.3 to 6.7 (on effective soil cover evaluation).

Table 4.13-HVC-3
Modeled Sources of Upland Sediment Delivery to Heavenly Valley Creek
(Sediment delivery figures are for the 1341 acre watershed. Data are from TRPA 1995, 1996, with changes by Regional Board staff as explained in the staff report.)

Source Category	Area (acres)	Sediment Delivery (tons/year)	Percent of Total Load
Roads	19	349	62
Ski Runs	182	176	32
Impervious surface	1	0[1]	0[1]
Undeveloped Area	1119	34[2]	6
TOTAL	1341	559	100

[1] Sediment delivery from impervious surface is considered "de minimis".
[2] Number rounded upwards

Table 4.13-HVC-4
Source Analysis for Instream Total Sediment Loading to Heavenly Valley and Hidden Valley Creeks
(Loads are estimated *unmitigated* values, rounded to the nearest ton.)

Source Category	Loading (Tons/Year)	Percent of Total Load
Heavenly Valley Creek		
Roads	93	62
Ski Runs	48	32
Undisturbed Lands	9	6
Impervious Surface	0[1]	0
TOTAL	150	100%
Hidden Valley Creek		
Undisturbed Lands	45	100%
TOTAL	45	100%

[1] Sediment delivery from impervious surface is considered "de minimis".

Table 4.13-HVC-5
Instream Load Allocations for Total Sediment in Heavenly Valley Creek
(measured at the Property Line Station)

Source Category	**Load Allocation** (tons/year as a 5 year rolling average)
Historically Disturbed Lands	48
New Development	0.7
Undisturbed lands	9
Impervious surface[1]	0
TOTAL	57.7[2]

[1] The contribution of impervious surface to sediment loading is considered *de minimis*. See the text.

[2] The discrepancy between the total load allocations and the loading capacity (58 tons/year) is considered to be within the margin of error of the calculations.

Table 4.13-HVC-6
Summary of TMDL Implementation Program

Implementation Measure	Schedule
Abandon and restore 7.59 acres of existing unpaved roads[1]	Complete by 2006
Stabilize 21.10 acres of existing roads which will remain in use[1]	Complete by 2006
Restore 182 acres of existing ski runs[1]	Complete by 2006
Maintain BMPs as necessary[1]	Annually
Review success of specific BMPs at specific sites; identify and implement improvements through adaptive management approach[1]	Annually
Conduct a comprehensive review of progress toward watershed restoration and attainment of water quality standards and identify needs for change through adaptive management program.[1]	At five year intervals beginning in 2000: (first evaluation report completed in 2001).

[1] Incorporated by reference in Tahoe Regional Planning Agency (TRPA) Draft EIR/EIS/EIS for Heavenly Ski Resort Master Plan (1995), pages 4.1-50 to 4.1-72 (CWE Soil Erosion Reduction Program) and Appendices H and I; TRPA (1996), pages 6.4-1 to 6.5-6 (Revised Mitigation and Monitoring Plan); Hazelhurst and Widegren (1998); Hazelhurst *et al.* (1999); and U.S. Forest Service (1998), Appendix G (CWE Technical Memorandum No. 1).

Indian Creek Reservoir, Alpine County

Introduction. Indian Creek Reservoir was constructed in 1969-70 on an ephemeral tributary of Indian Creek, a tributary of the East Fork Carson River. The location of the reservoir within the Carson River watershed is shown in Figure 3-7 of this Basin Plan. The reservoir was designed to store tertiary wastewater effluent exported from the Lake Tahoe watershed for later use in pasture irrigation and to support a trout fishery. The U.S. Bureau of Land Management (USBLM) operates a campground and day use facilities at the reservoir. The reservoir became eutrophic during the 1970s and was placed on the Section 303(d) list for eutrophication in the 1980s. It no longer receives wastewater, and its level is maintained with water diverted from the West Fork Carson River and Indian Creek.

The subwatershed affected by this TMDL is shown in Figure 4.13-ICR-1. It includes the lands that contribute surface runoff directly to the reservoir and the lands tributary to upper Indian Creek and to Snowshoe Thompson Ditch #1 downstream of the diversion point from the West Fork Carson River. Water entering the ditch at the diversion point is considered "background" quality for purposes of the TMDL. The TMDL implementation program does not include controls for nonpoint sources in the West Fork Carson River watershed above the diversion point. Nonpoint source problems in that watershed will be addressed through other Regional Board programs (e.g., the nonpoint source, stormwater, and Watershed Management Initiative programs).

The purpose of this TMDL is to ensure the attainment of all water quality standards for Indian Creek Reservoir that are affected by eutrophication, including beneficial uses for aquatic life and recreation. Attainment will be interpreted in terms of a change from eutrophic to mesotrophic conditions and maintenance of mesotrophic conditions over time. A Regional Board staff report (California Regional Water Quality Control Board, Lahontan Region, 2001), and a 2002 supplement to that report, provide the technical information supporting the regulatory elements of this TMDL.

Problem Statement. The South Tahoe Public Utility District (STPUD) discontinued wastewater disposal to Indian Creek Reservoir in 1989 and acquired water rights to maintain a minimum reservoir level to support recreational uses. Monitoring showed decreases in the concentrations of most wastewater-related constituents after wastewater disposal ceased. Concentrations of total phosphorus decreased but remained at levels which the scientific literature indicates will maintain eutrophic conditions, apparently due to internal loading from the sediment. The reservoir has continued to show symptoms of eutrophication including blooms of blue-green algae, low transparency, and depletion of dissolved oxygen in the hypolimnion.

Numeric Targets and Indicators. Total phosphorus was selected as the quantitative focus of the TMDL because frequent violations of the water quality objective for this constituent have occurred even after the cessation of wastewater disposal and because of the important role of phosphorus as a factor in the eutrophication of many north temperate lakes. Other parameters are also potentially important in control of eutrophication, and a variety of other indicators and targets have been selected for monitoring and periodic evaluation.

The primary numeric target for the Indian Creek Reservoir TMDL is an annual mean concentration in the water column of 0.02 mg/L total phosphorus. A scientific literature review, summarized in the staff report, indicates that this target represents the threshold between mesotrophic and eutrophic conditions. Mesotrophic conditions should adequately protect aquatic life and recreational uses of the reservoir. Based on the literature review and modeling of tributary water quality, the target can feasibly be attained if phosphorus loading from the sediment is significantly reduced. Phosphorus loading can be reduced by methods such as increased flushing, removal of phosphorus-rich sediment, or chemical treatment to prevent phosphorus release to the water column.

The current water quality objective for total phosphorus (0.04 mg/L expressed as a mean of monthly means) was based the water quality achievable when the reservoir was receiving tertiary wastewater effluent, rather than on criteria for protection of beneficial uses. An interim total phosphorus target based on this objective is proposed, and is projected for attainment by 2013. The Regional Board recognizes that potential reservoir management measures (oxygenation of the hypolimnion or significantly increased dilution and flushing) may lead to attainment and maintenance of mesotrophic conditions at an ambient total phosphorus concentration higher than the long term target. If monitoring demonstrates that beneficial uses are supported at a higher phosphorus concentration, the Board may

consider revising that target. Targets and indicators for the TMDL are summarized in Table 4.13-ICR-1.

Source Analysis. Indian Creek Reservoir does not receive phosphorus loading from any natural tributary streams. (The ephemeral stream reach dammed during construction of the reservoir was completely inundated.) Phosphorus enters the reservoir in water diverted from the West Fork Carson River and Indian Creek, in precipitation and direct surface runoff, and by internal loading from the sediment. Internal loading is the most important source of phosphorus. The estimated "existing" loads are based on modeling of tributary inputs using water quality and flow data for 1999. Literature sources were used to estimate precipitation and runoff inputs and internal phosphorus loading rates. Numbers are rounded to the nearest pound. The “tributary inflow” source represents combined diversions from the West Fork Carson River and Indian Creek. All sources are considered to be nonpoint. Estimated loads from all sources are summarized in Table 4.13-ICR-2.

Loading Capacity. Assuming a uniform phosphorus concentration throughout the water column and a reservoir volume of 1515 acre feet (at the minimum staff gage level maintained under an agreement between STPUD and Alpine County), the maximum amount of phosphorus that can be present in the water column if a concentration of 0.02 mg/L total phosphorus is to be maintained is 82 lb/yr.

Load Allocations. There are no point sources of phosphorus loading to Indian Creek Reservoir; thus, the wasteload allocation is zero. Load allocations for external and internal nonpoint sources of phosphorus are summarized in Table 4.13-ICR-3. The load allocations for external sources assume no reduction in phosphorus loading from precipitation, a 75% reduction in loading from surface runoff and tributary inflow, and an 87 % reduction in internal loading. No load allocations are being established for indicators other than total phosphorus.

Loading capacity linkage analysis. The loading capacity and the associated numeric target for phosphorus are based on a strong quantitative framework, developed through a large set of empirical scientific data, which allows for the prediction of algal biomass and other associated water quality parameters from nutrient loading and water column nutrient concentrations (USEPA, 1999). The proposed phosphorus concentration target corresponds to a literature threshold between mesotrophic and eutrophic conditions.

The literature review summarized in the staff report indicates that the proposed numeric target and the associated loading capacity, if attained, will be adequate to protect designated aquatic life and recreational uses of Indian Creek Reservoir, the beneficial uses most likely to be impaired by eutrophication, and to ensure compliance with applicable narrative water quality objectives.

Margin of safety. The Indian Creek Reservoir TMDL provides an implicit margin of safety by:

1. Interpreting compliance with standards (including beneficial use support and progress from eutrophic to mesotrophic conditions) through multiple targets and indicators.

2. Incorporating conservative assumptions in the source analysis and development of load allocations. Assumptions that provide a margin of safety include:

    - Development of the TMDL for total phosphorus rather than for orthophosphate or "soluble reactive phosphorus," which are the forms of phosphorus most readily available to plants. The analysis assumes that all P in the system, including sediment P, will eventually be recycled and made biologically available.

    - The "worst case" assumption that all phosphorus released from the sediment during summer stratification is made available for algal growth in the hypolimnion during the summer.

Seasonal and interannual factors and critical conditions. The TMDL for Indian Creek Reservoir accounts for seasonal and annual variations in external and internal phosphorus loading and associated impacts on beneficial uses in several ways:

- The load allocations for surface runoff and tributary inflow are set as a 10 year rolling averages to account for seasonal and annual variations in runoff, tributary flows, and phosphorus concentrations.

- The most critical conditions for attainment of aquatic life and recreational uses in Indian Creek Reservoir occur during summer stratification, when the greatest release of phosphorus from the sediment occurs and warm temperatures promote algal blooms and depletion of oxygen in the hypolimnion.

Attainment of the loading capacity will require significant reduction of internal phosphorus loading through methods such as removal of phosphorus rich sediment or chemical treatment to lower phosphorus release from the sediment, or else a significant increase in the level of dilution and flushing with fresh water. Summer stratification of the reservoir may continue to occur, but reduced phosphorus loading will reduce the risk of oxygen depletion in the hypolimnion.

Implementation Plan. Implementation of the TMDL is the responsibility of the STPUD (for control of internal phosphorus loading) and of the U.S. Bureau of Land Management, Alpine County, STPUD, and other land owners and land managers in the watershed (for control of external sources). The implementation program does not specify the means of compliance with the TMDL, but rather establishes a process for identification and implementation of controls for external and internal sources of phosphorus loading to Indian Creek Reservoir. (The Regional Board is prohibited by Section 13360 of the California Water Code from specifying the manner of compliance with its orders.) The implementation program will involve an adaptive management approach.

Implementation will be done in coordination with the Regional Board's ongoing watershed management planning and nonpoint source control efforts. The California State Water Resources Control Board's 2000 *Plan for California's Nonpoint Source Pollution Control Program* (California Nonpoint Source Plan) and the 1995 *California Rangeland Water Quality Management Plan* will be used as appropriate in the implementation process.

The implementation process will include the following:

1. **For control of all sources:**

   Within 4 months after final approval of the TMDL, Regional Board staff will convene a stakeholder group for ongoing communication about TMDL issues. The group should include, but will not be limited to, representatives of STPUD, the USBLM, the U.S. Forest Service and Alpine County, and other public and private landowners in the subwatershed affected by the TMDL (Figure 4.13-ICR-1). Participation should also be invited from the U.S. Natural Resource Conservation Service, the Alpine Resource Conservation District, the Alpine County Watershed Group, and downstream stakeholders in California and Nevada, including the Nevada Division of Environmental Protection, the Upper Carson River Coordinated Resource Management Plan group and the Carson Water Subconservancy District.

2. **For control of internal loading:**

   - Immediately after final approval of the TMDL, Regional Board staff will request a report from the STPUD on the method(s) it intends to use to reduce internal loading of phosphorus to Indian Creek Reservoir from the sediment and to optimize reservoir management for protection and enhancement of aquatic life and recreational uses.

   - By 15 months after final approval of the TMDL, STPUD will investigate the feasibility of controls for internal phosphorus loading to Indian Creek Reservoir and the feasibility of other management measures to protect and enhance beneficial uses and will submit a plan for approval by the Regional Board. Depending upon the nature of the proposed action, the Regional Board may provide direction to staff for implementation, issue waste discharge requirements and/or a formal monitoring program for activities to control internal phosphorus loading, or take other appropriate action.

   - By 2013, STPUD will fully implement controls for internal phosphorus loading.

3. **For control of external loading:**

   - By 1 year after final approval of the TMDL, Regional Board staff and stakeholders will identify specific sites within the watershed contributing direct surface runoff to Indian Creek Reservoir that need Best Management Practices (BMPs) for phosphorus control.

   - By 1 year after final approval of the TMDL, Regional Board staff and stakeholders will identify specific sites needing BMPs for phosphorus control on public and private lands within the watershed tributary to the irrigation ditch that provides inflow to Indian Creek Reservoir from Indian Creek and the West Fork Carson River. Problem assessment and planning for BMP implementation on non-federal rangelands will follow the implementation procedures in the *California Rangeland Water Quality*

Management Plan.

- By 3 years after final approval of the TMDL, depending on progress toward BMP implementation under the 1995 *California Rangeland Water Quality Management Plan* and the 2000 California Nonpoint Source Plan, staff will consider the need for regulatory action to ensure implementation of BMPs to control external sources of phosphorus loading to Indian Creek Reservoir.

- By 2013, BMPs will be fully implemented for nonpoint sources of phosphorus loading to Indian Creek Reservoir within the subwatershed affected by the TMDL. The California Nonpoint Source Plan requires implementation of management measures for all nonpoint source problems statewide by 2013.

Attainment of the interim total phosphorus and dissolved oxygen targets is projected to occur by 2013. Attainment of the long term total phosphorus and dissolved oxygen targets, other TMDL targets and the narrative water quality objectives related to protection of beneficial uses is projected to occur by 2024.

Potential implementation measures include BMPs to control external sources of phosphorus loading and in-lake measures to increase flushing of phosphorus from the reservoir, remove phosphorus-rich sediment or inactivate the internal phosphorus release process. Agricultural BMPs potentially relevant to control of external phosphorus loading to Indian Creek Reservoir include: range and pasture management, proper livestock to land ratios, irrigation management, livestock waste management, fences (livestock exclusion), retention/detention ponds, constructed wetlands, streambank stabilization, sediment ponds; and riparian buffers (USEPA, 1999). The STPUD (2002)_has proposed conversion of the irrigation ditch tributary to Indian Creek Reservoir to an underground pipeline; this could eliminate some or all of the need for agricultural BMPs in that area. Additional potentially relevant nonpoint source management measures include: education outreach; runoff control for existing development; road, highway and bridge runoff systems; marina and recreational boating management measures (including shoreline stabilization); instream habitat restoration; and vegetated treatment systems.

Further study will be necessary to identify the best and most cost effective in-lake phosphorus control method(s) for Indian Creek Reservoir. The STPUD is considering the acquisition of additional water for flushing phosphorus from the reservoir through purchase and changes in the place and time of use of water rights. Based on the literature review summarized in the staff report, both phosphorus inactivation (by one of several chemical methods) and phosphorus removal (by dredging or bulldozing) appear to have the potential for rapid attainment of the numeric target. Other potential control methods include hypolimnetic withdrawal, hypolimnetic oxygenation, biomanipulation, and treatment systems involving harvest of periphyton to remove nutrients.

The BMPs and lake restoration measures summarized in the staff report and supplement are technically feasible and have been shown to be effective in reducing phosphorus loading and/or abating eutrophic conditions. The Regional Board recommends that, in addition to any in-lake treatment measure(s), STPUD should use the full amount of its existing water rights, under the constraints imposed by the Alpine Decree, in a manner that will maximize fresh water inflow into Indian Creek Reservoir.

Monitoring. The proposed TMDL monitoring plan involves continuation of current monitoring by the STPUD of Indian Creek Reservoir and its tributary inflow. (Not all of the parameters sampled are necessary for determining compliance with TMDL load allocations.) Regional Board staff recognize that sampling parameters, stations and frequencies may need to be changed over time as a result of an adaptive management approach to implementation. Consequently, the Basin Plan does not specify sampling parameters, locations and frequencies or sampling and analytical protocols. The Regional Board's Executive Officer may adopt a formal monitoring program for Indian Creek Reservoir and its tributary inflow pursuant to the California Water Code, and changes in this program may be made over time without the necessity for further Basin Plan amendments.

The TMDL monitoring program is expected to involve:

- monitoring of tributary inflow and water quality (including P concentration)

- monitoring of Indian Creek Reservoir including gage height, water quality, and algal cell/colony counts

- monthly depth-profile measurements in Indian

Creek Reservoir including dissolved oxygen and temperature

- monthly measurements of total phosphorus concentrations at several depths including the hypolimnion
- monthly measurement of chlorophyll a at the near-surface depth
- monthly measurements of Secchi depth in Indian Creek Reservoir during the stratification period, and
- periodic inspections of BMPs, once they have been installed.

The phosphorus concentration and inflow amounts of precipitation and surface runoff to the reservoir will not be measured directly. The success of BMPs to reduce phosphorus runoff to Indian Creek Reservoir will be assessed through measurements of reservoir quality. If implementation results in increased outflow from the reservoir, monitoring of the outflow channel and Indian Creek may be necessary to document impacts on downstream water quality and beneficial uses.

Schedule for review and revision of the TMDL. Regional Board staff will continue to review monitoring reports on an ongoing basis and will periodically discuss them with STPUD and other stakeholders. The review process will use all indicators and targets to evaluate progress from eutrophic to mesotrophic conditions. Comprehensive reviews of monitoring data and progress toward implementation and attainment of targets will be conducted at five year intervals following final approval of the TMDL. Because some of the targets and load allocations are expressed as ten year rolling averages to account for seasonal and annual variability, the first decision point on the need for revision of the TMDL will not occur until after the comprehensive review held in the tenth year.

Table 4.13-ICR-1
Numeric Targets and Indicators for Indian Creek Reservoir TMDL

Indicator[1]	Target Value	Reference
Total P concentration	(Interim[2]) No greater than 0.04 mg/L, annual mean	Current water quality objective (mean of monthly means); see Basin Plan Table 3-14
Total P concentration	(Long term[2]) No greater than 0.02 mg/L, annual mean	USEPA, 1988, 1999.
Dissolved oxygen concentration	(Interim[2]) 30 Day Mean 6.5 mg/L; 7 Day Mean Minimum 5.0 mg/L; 1 Day Minimum 4.0 mg/L	Regionwide water quality objective for waters designated for COLD use; see Basin Plan Table 3-6
Dissolved oxygen concentration	(Long term[2]) Shall not be depressed by more than 10 percent, below 80 percent saturation, or below 7.0 mg/L at any time, whichever is more restrictive.	Water quality objective for surface waters of Indian Creek watershed; see Basin Plan Chapter 3
Secchi depth	Summer mean no less than 2 meters	USEPA, 1988. 1999
Chlorophyll a	Summer mean no greater than 10 ug/L	USEPA, 1988,1999
Carlson Trophic Status Index	Composite index no greater than 45 units	USEPA 1988, 1999

[1] These indicators will be measured for at least one depth profile sampling station in Indian Creek Reservoir. The Carlson Trophic Status Index will be computed from other parameters as explained in the technical staff report.

[2] Interim targets are expected to be attained by 2013. Long term targets are expected to be attained by 2024. See the Implementation Plan below.

Table 4.13-ICR-2
Estimated Existing Phosphorus Loads to Indian Creek Reservoir from External and Internal Sources (rounded to the nearest pound)

Source	Load (pounds per year) and % of total
EXTERNAL SOURCES	
Precipitation	3
Direct surface runoff	68
Tributary inflow	43
Minor sources[1]	0
A. Total External Load (lb/yr)	114 [24%]
INTERNAL SOURCES	
Total anoxic load (by literature formula from Welch and Cooke, 1999, for 120 day stratification period)	204
Total oxic load (by subtraction)	150
B. Total Internal Load (lb/yr)	354 [76%]
C. Loss in Reservoir outflow (lb/yr)	137
TOTAL LOAD (A + B)	468
NET WATER COLUMN LOAD (A + B – C)	331

[1]Loading and losses from the minor sources and sinks discussed in the staff report are considered *de minimis.*

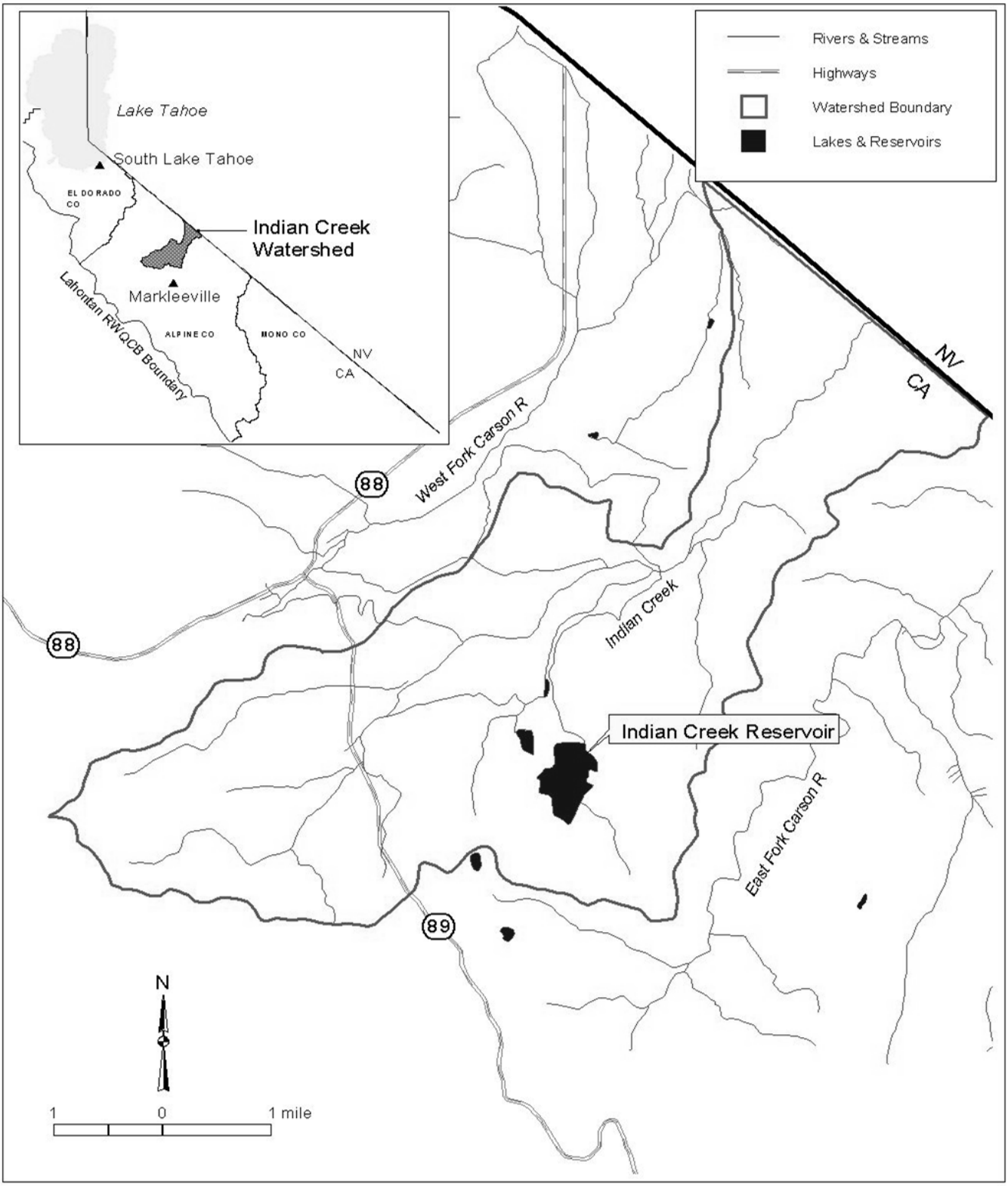
Table 4.13-ICR-3
Load Allocations for Indian Creek Reservoir

Source	Load Allocation (lb/yr)
EXTERNAL	
Precipitation	3
Direct Surface Runoff[1]	17
Tributary Inflow[1]	32
Total external allocation	52
INTERNAL	
Total internal allocation	46
OUTFLOW	18
Total Load Allocation	98
Net Load Allocation[2]	80

[1]Allocations for these parameters are interpreted as 10 year rolling averages to account for seasonal and annual variability.

[2]This allocation is to the water column, with the assumption that an additional 18 lb/yr of internally derived phosphorus will leave the reservoir in the outflow.

FIGURE 4.13-ICR-1. INDIAN CREEK WATERSHED



Squaw Creek (sediment), Placer County

Introduction: Squaw Creek is located in an 8.2 square mile alpine watershed about six miles northwest of Lake Tahoe in Placer County, between Tahoe City and Truckee. The creek is impaired due to sedimentation/siltation from historic and current watershed disturbance associated with land development. Land uses in the watershed are primarily for ski facilities, commercial and residential developments, and related infrastructure.

The purpose of this Total Maximum Daily Load (TMDL) is to ensure attainment of all sediment related water quality standards, including narrative objectives related to protection of in-stream beneficial uses. The TMDL implementation program is based substantially on continuation and improvement of existing erosion control and monitoring programs currently conducted by Squaw Valley Ski Corporation, The Resort at Squaw Creek, and Intrawest Village at Squaw Valley -

Phase I and II. One additional operational permit will be assigned to Placer County to control nonpoint source erosion and sediment delivery to Squaw Creek. Other individual or general Waste Discharge Requirements (WDRs) may be issued as warranted for construction-related or other land-disturbing activities to control sediment discharges to the creek. The Water Board staff report (Lahontan Regional Water Quality Control Board, 2006) provides the technical information supporting the regulatory elements of this TMDL.

Problem Statement: The focus of this TMDL is beneficial uses related to aquatic life and recreational activities (COLD, SPWN, REC-1, REC-2, WILD, MIGR, and COMM; see Chapter 2 of this Basin Plan), and water quality objectives for sediment, settleable materials, suspended sediment, turbidity and nondegradation (see Chapter 3 of Basin Plan). The magnitude and extent of the sedimentation impairment was determined based on regional bioassessment studies, where the abundance and diversity of benthic macroinvertebrates (aquatic organisms at least one-half millimeter in size) and substrate particle size were evaluated as measures of aquatic life health and stream channel conditions, respectively. Bioassessment data were composited into "biologic condition scores" to numerically quantify and compare the integrity of biologic communities at reference streams (physically comparable stream sites exhibiting conditions associated with minimally disturbed landscapes) and Squaw Creek. The biologic condition score is a numeric value based on an index of seven biologic metrics that are sensitive to changes in biological integrity caused by sedimentation.

Biologic condition scores calculated for Squaw Creek's meadow reach indicate degraded macroinvertebrate communities compared with reference streams. Stream channel substrate data collected from the Squaw Creek meadow reach showed smaller median particle size (referred to as D-50 particle size) and larger average percentages of fines and sand (defined as particles less than 3 millimeters in size) when compared to low gradient reference stream sites. Excessive fine particles deposited on the streambed can be detrimental to fish and invertebrates by increasing embeddedness of gravels and decreasing interstitial spaces, leading to changes in species composition and diversity. Accelerated hillslope erosion from land disturbance related to development in naturally erosion-prone areas contribute to excess sediment delivery to the creek. Stream channel erosion, road sanding operations and naturally occurring erosion also contribute to sediment loading to the creek.

Desired Conditions: Indicators and targets (numeric targets) were selected to interpret the water quality standards and track the effectiveness of the TMDL. For the Squaw Creek TMDL, these include indicators of stream substrate quality (D-50 particle size and percentage of fines and sand), and a biological condition score selected to represent abundant and diverse benthic macroinvertebrate communities, based on data collected from regional reference streams. Because the aquatic life beneficial use is the most sensitive to excessive sedimentation, it is reasonable to assume that protection of the aquatic life beneficial use will ensure support of all beneficial uses potentially impacted by sedimentation. The numeric targets are shown in Table 4.13-SC-1 and will be included in future updates of monitoring programs for operational WDRs issued to dischargers in the watershed.

Source Analysis: Sediment delivery from hillslope source categories was estimated based on studies conducted in primarily in 2000 and 2001. The estimated annual sediment load for the watershed during this time period is 37,900 tons per year. The contribution of sediment from hillslope sources is divided among categories as shown in Table 4.13-SC-2. The source analysis indicates that approximately 60 percent of the sedimentation affecting Squaw Creek is related to disturbance brought on by human activities.

Loading Capacity and Linkage Analysis: The sediment loading capacity of Squaw Creek isderived from mathematical comparisons of biologic conditions found in reference streams and Squaw Creek, and is set such that Squaw Creek will meet its water quality objectives and support beneficial uses. It is estimated that that a 25 percent reduction in the overall sediment loading of 37, 900 tons per year is needed to protect beneficial uses. Therefore, the loading capacity is 28,425 tons per year.

Linkage between sediment delivery to the creek and impairment of aquatic life beneficial uses was based on USEPA guidance, best professional judgment, modeled loading estimates, and sediment-related in-stream physical habitat parameters that correlate with biologic conditions found in regional streams.

TMDL and Allocations: The TMDL is the sum of wasteload allocations for point sources, load allocations for nonpoint sources, and a margin of safety. The allowable sediment load (i.e., the load capacity) is distributed among the existing controllable sediment source categories, future growth and a margin of safety.

There are currently no National Pollutant Discharge Elimination System (NPDES)-regulated point sources in the watershed; therefore, the wasteload allocation is zero. The allocations reflect conservative assumptions about the efficiency of Best Management Practices (BMPs) to control sedimentation. No reduction in sediment delivery from undisturbed lands was assigned. A summary of the TMDL, allocations, and required load reductions is presented in Table 4.13-SC- 3.

Because the load allocations are broad estimates, they are not appropriate for use as discharge specifications in WDRs/permits. Water Board staff expect dischargers to follow an iterative approach to implementing storm water pollution controls, including using data from the instream monitoring to guide hillslope activities accordingly.

Margin of Safety, Seasonal Variations and Critical Conditions: An explicit margin of safety is established by reserving (by not allocating) part of the total loading capacity, thereby requiring greater load reductions from existing and/or future source categories. An implicit margin of safety incorporates conservative assumptions in the TMDL analysis. The Squaw Creek TMDL includes both an implicit and explicit margin of safety.

Conservative assumptions were incorporated into data interpretations throughout the TMDL.

The explicit margin of safety was established by reserving four percent of the loading capacity to offset uncertainties in the analysis. The TMDL also incorporates a monitoring and review program which allows for future management revisions if the Water Board finds that water quality objectives are not being met or that beneficial uses are not being protected. The TMDL takes into account seasonal variations and critical conditions to assure that the load allocations will support water quality standards over time. The Squaw Creek TMDL accounts for critical conditions by establishing targets based on net long term effects.

Implementation and Monitoring Plan: The Implementation Plan relies on compliance with the existing pollution controls in place in the watershed, and proposes additional actions to address sediment discharges that are not currently regulated. These controls include permitting authorities outlined in the Porter-Cologne Water Quality Control Act, such as NPDES permits, WDRs, waivers of WDRs and Basin Plan discharge prohibitions.

WDRs issued to existing dischargers in the watershed contain comprehensive requirements to control sediment dischargers. These water quality requirements specify that discharges must identify erosion control problems, propose projects to address the problem, and maintain those projects. Proposed WDRs/NPDES permits will follow the template set by the existing permits.

Implementation monitoring will focus on tracking compliance with existing and proposed regulatory actions, including installation and maintenance of BMPs to control sediment discharges, with a focus on control of fine sediment. Progress toward meeting the TMDL will be determined through monitoring of the in-stream physical and biological parameters identified in the numeric targets section. The monitoring and reporting programs for existing WDRs/permits in the watershed will be updated to require monitoring of these numeric targets, and any new operational permits will incorporate these monitoring parameters as well. Reporting and surveillance requirements provide the mechanism for the Water Board, dischargers, and public to determine if the Implementation Plan is achieving the TMDL, or if other actions are required. The monitoring requirements are presented in Tables 4.13-SC-4 and 4.13-SC-5.

Schedule of TMDL Attainment, Data Review and Revision: The estimated time frame for meeting the numeric targets and achieving the TMDL is 20 years. This estimate takes into consideration time for the significant temporal disparities between

upland erosion control actions, sediment delivery, and the time needed for the target indicators to respond to decreased sediment loading.

Attainment of the biologic health target will be evaluated by the rolling average of biologic condition scores calculated from three consecutive sampling events. For example, if numeric target sampling begins in 2006, biologic condition data will be collected in 2006, 2008 and 2010. These data will be assessed in 2010 by averaging all biologic condition scores for each site collected over this period. Data collected in 2012 will be added to the dataset, and an average value for biologic condition scores collected in 2008, 2010 and 2012 will be calculated, and so on. The biologic condition target will be met when the rolling average for three consecutive 3- sampling event datasets meets or exceeds 25.

Progress toward meeting the physical habitat numeric targets will be evaluated by assessing the data trend for each indicator (decreasing trend for percent fines and sand, and increasing trend for median (D-50) particle size. Data assessment will begin after three sampling events have occurred. For example, if numeric target sampling commences in 2006, data will be collected in 2006, 2008, and 2010; therefore, in 2010, the data trend will be evaluated. Each subsequent sampling event's data will be added to the dataset for purposes of trend evaluation.

Permit compliance status will be assessed quarterly, using the Water Board's permit compliance tracking database currently in place, and through semi-annual field inspections. Permit compliance for the purposes of TMDL attainment refers only to those permit conditions specific to erosion and sedimentation control. Compliance information will be taken into account when assessing the need for any revisions to targets or TMDL implementation. During the 10-year data review (the halfway point estimated for TMDL attainment), staff shall examine all data trends to determine the need for revision of the TMDL, numeric targets, allocations, or implementation plan. Revisions to the WDRs, NPDES permits, or other regulatory actions shall be made as warranted to ensure that applicable water quality objectives and beneficial uses are attained.

Table 4.13-SC-1
Indicators and Targets for Squaw Creek TMDL

Indicator	Target Value	Notes
Biologic Health: Biologic Condition Score, calculated from Index of Biologic Integrity.	Biologic condition score of 25 or more when meadow reach stream flows are continuous. Applies to the meadow reach of Squaw Creek.	Represents desired biologic integrity of stream, protective of aquatic life uses. Target value based on regional reference stream biologic conditions.
Physical Habitat: Median (D-50) Particle Size	Increasing trend in D-50 value approaching 40 millimeters (mm) or greater. Applies to the meadow reach of Squaw Creek.	Represents desired substrate conditions for aquatic life. Target value based on regional reference stream substrate conditions.
Physical Habitat: Percent Fines and Sand	Decreasing trend in percent fines and sand value approaching 25% cover of the stream bottom or less. Applies to the meadow reach of Squaw Creek.	Represents desired substrate conditions for aquatic life. Target value based on regional reference stream substrate conditions.

Table 4.13-SC-2
Sediment Delivery Estimates, Squaw Creek Watershed
(Rounded to nearest 100 tons)

Sediment Source Category	Annual Sediment Delivery (Tons/year)	Percent of Total Annual Sediment Delivery
Dirt Roads	9,300	25%
Dirt Roadcuts	900	2%
Road Traction Sand	300	1%
Residential/Commercial Areas	200	1%
Graded Ski Runs	9,000	24%
Alluvial Channel Erosion	4,300	11%
Undisturbed Areas	14,000	37%
Uncontrollable Sources*	16,100	42%
Controllable Sources	21,800	58%
Total Annual Sediment Delivery**	37,900	100%

*This is considered the best estimate of current naturally occurring sediment delivery. The estimate shown includes 50 percent (rounded to 2,100 tons/year) of the annual channel bank contribution and 100 percent (14,000 tons/year) of sediment delivery from undisturbed areas.

**This estimate adds to 37,900 tons/year because the alluvial channel erosion estimate was distributed equally between the "controllable" and "uncontrollable" sediment source categories. The estimate of one-half of 4,300 tons/year (2,150 tons/year) was rounded down to 2,100 tons/year.

Table 4.13-SC-3
TMDL, Allocations and Percent Reductions Needed by Sediment Source Category

Sediment Source Category	Annual Sediment Delivery (Tons/year)	Percent Reduction Required	Load Allocation* (Tons/year)
Dirt Roads	9,300	60%	3,700
Dirt Road Cuts	900	50%	450
Road Traction Sand	300	25%	200
Residential/Commercial Areas	200	25%	150
Graded Ski Runs	9,000	50%	4,500
Alluvial Channel Erosion (50 percent of the total load from channel bank erosion is assumed to be controllable)	2,100	10%	1,900
Total Controllable Sources	21,800	50%	10,900
Alluvial Channel Erosion (50 percent of the total load from channel bank erosion is assumed to be naturally occurring)	2,100	0%	2,100
Undisturbed Areas	14,000	0%	14,000
Total Uncontrollable Sources	16,100	0%	16,100
Total Existing Sediment Load	37,900	Load Allocation to Existing Sources	27,000
Overall Reduction Needed to Achieve TMDL	25%	Load Allocation to Future Growth	150
TMDL = Load Allocations (existing and future sources) + MOS	28,425	Load Allocation to Margin of Safety (4%)	1,275
		Total Load Allocations	28,425

* Allocations to existing sources rounded to nearest 50 tons.

Table 4.13-SC-4
Numeric Target Monitoring Plan and Compliance Schedule

Indicators and Target Values	Monitoring Specifications	Responsible Monitoring Parties	Schedule
Biologic Health Indicator: Biologic condition score, based on bioassessment data. **Target Value:** Biologic condition score of 25 or greater. **Physical Habitat Indicator:** D-50 Particle Size. **Target Value:** Increasing trend approaching 40 mm or greater. **Physical Habitat Indicator:** Percent fines and sand. **Target Value:** Decreasing trend approaching 25 percent.	1. Establish 3 sampling sites (upper, middle, and lower) on the meadow reach of Squaw Creek 2. Conduct bioassessment sampling and calculate biologic condition score using Herbst (2002) protocol. 3. Analyze D-50 particle size and percent fines and sand using Herbst protocol. 4. All sampling protocols will be specified in WDRs.	• SVSC (existing permit) • Resort at Squaw Creek (existing permit) • Village at Squaw Valley (existing permit) • Placer County (anticipated permit)	1. Water Board to add monitoring requirements to existing WDR Monitoring & reporting programs of permitted dischargers no later than six months after final approval of TMDL. 2. Water Board to issue WDRs/permit for Placer County stormwater discharges no later than six months after final approval of TMDL. 3. Each regulated discharger to conduct sampling individually or as agreed to cooperatively. 4. Numeric target sampling shall be conducted once every two years between the months of July and September when flow in the meadow reach is continuous. 5. Progress toward attainment of the physical habitat targets to be evaluated by trend assessment, beginning after 3 consecutive sampling events have been completed. Trend assessment will be based on all monitoring data for each physical habitat indicator. 6. Attainment of the biologic condition score target will be assessed using 3-(sampling) event rolling average datasets. The biologic condition target will be met when the rolling average for three consecutive 3-event datasets meets or exceeds 25.

Table 4.13-SC-5
Monitoring of Sediment Control Actions(1)

Monitoring Parameter	Responsible Monitoring Party	Monitoring Schedule
Compliance with all sediment-related permit requirements, including discharge specifications, BMP installation and maintenance, general requirements and prohibitions, monitoring, and reporting.	Water Board staff	Assess permit compliance quarterly using Water Board's permit tracking database currently in place. Assessment of numeric target data (collected as specified in permits) will occur according to schedule outlined in Table 4.13-SC-4, above.
Facilities inspections to ensure permit compliance.	Water Board staff	Water Board staff to inspect all facilities twice annually.
TMDL data review and assessment.	Water Board staff	As outlined in Schedule of TMDL Attainment, Data Review and Revision, above.

(1) Requirements may already be satisfied under existing WDRs.

Middle Truckee River Watershed (sediment), Placer, Nevada, and Sierra Counties

Introduction: The middle Truckee River Watershed Total Maximum Daily Load (TMDL) is a plan to attain sediment-related water quality objectives, especially narrative objectives to protect in-stream aquatic life beneficial uses, such as COLD and SPWN.

This TMDL addresses the segment of the Truckee River from the outflow of Lake Tahoe at Tahoe City to the California/Nevada state line. This reach flows through the eastern parts of Placer, Nevada and Sierra counties, and is commonly referred to as the middle Truckee River. The TMDL also addresses Gray and Bronco creeks, which are adjacent drainages located in the eastern portion of the Truckee River basin, near the California-Nevada state line. The watersheds are rugged, mostly undeveloped areas, with few controllable sediment sources. No data are available to support that Gray or Bronco creeks were listed due to beneficial use impairment in the creeks; rather, the listings were based on reports of sediment discharges from the creeks to the Truckee River during thunderstorm events. Therefore, this TMDL establishes watershed-wide sediment load reductions that are protective of beneficial uses in the Truckee River, and sets load allocations for Gray and Bronco creeks to address their 303(d) listings.

Problem Statement: At higher stream flows, suspended sediment concentrations (SSCs) in the middle Truckee River are above those recommended for aquatic life protection, particularly at the Farad gauging station at the downstream end of the TMDL project area. Continuous turbidity monitoring conducted in 2002 and 2003 indicates that flow events resulting from thunderstorms, snow melt and dam releases produce turbidity spikes that exceed the numeric water quality objective of 3 Nephelometric Turbidity Units. Studies of aquatic insect populations in the river indicate that as deposited sediment volumes increase, the diversity and structure of these communities shift toward more sediment-tolerant species. Lastly, the watershed's population has increased significantly over the last decade and major development and population growth is planned over the next 10 years in formerly undeveloped areas. Increased sedimentation to stream channels is linked to urbanization associated with high growth and population density, accompanied by development in erosion-sensitive landscapes.

Desired Conditions: Desired conditions in the Truckee River are expressed by a numeric target for in-stream suspended sediment that is protective of aquatic life, with an emphasis on early life-stage salmonids (e.g., rainbow, cutthroat and brown trout). Based on a review of scientific literature and analysis of 30 years of suspended sediment data in the river, suspended sediment concentrations in the Truckee River should be less than or equal to 25 milligrams per liter, as an annual 90th percentile value.

Desired conditions are also expressed by implementation actions needed to control sediment discharges and improve in-stream conditions in the Truckee River. Implementation actions were identified based on the source assessment, which showed that control of storm water runoff from urban areas, dirt roads, graded ski runs, and legacy sites (past land or in-stream disturbances that have ongoing impacts) is needed to minimize sediment discharges from these sources. Table 4.13-TR-1 summarizes the indicators and target values for this TMDL.

Source Assessment: The annual suspended sediment load estimated for the Truckee River at the Farad gauging station is approximately 50,300 tons, based on an above average water year (1996-1997). This is a broad estimate which will vary significantly depending on the characteristics and magnitude of runoff for any given water year. The primary sources are runoff from urban areas, dirt roads, and legacy erosion sites, and in some subwatersheds, graded ski runs. Continuous turbidity monitoring in the river during 2002 and 2003 shows that sediment loading "pulses" attributed to thunderstorms, snowmelt periods and dam releases may account for up to half the total sediment loading. Table 4.13-TR-2 summarizes the sediment source assessment.

Loading Capacity: The suspended sediment loading capacity is derived from a mathematical comparison of long-term suspended sediment concentrations in the river and those recommended in literature to provide high quality aquatic life habitat. It is estimated that a 20 percent reduction in overall sediment loading is needed to achieve desired in-stream conditions; therefore, the loading capacity is 40,300 tons per year, based on water year 1996-1997. Attainment of the loading capacity and reduction will be evaluated through the targets shown in Table 4.13-TR-1.

TMDL and Allocations: The TMDL is the sum of wasteload allocations (WLAs) for point sources

[National Pollutant Discharge Elimination System (NPDES)-regulated sources] and load allocations (LAs) for nonpoint sources, and includes an implicit margin of safety. The allowable sediment load (i.e., the loading capacity) is allocated to the existing urban and non-urban sources and future development in the watershed. The allocations reflect conservative assumptions about the efficiencies of sediment and erosion control practices that will reduce sediment loading to the river, resulting in TMDL attainment over time. The allocations are summarized in Table 4.13-TR-3.

TMDL attainment will be evaluated through the TMDL targets (Table 4.13-TR-1) that express desired conditions in the watershed, rather than sediment mass reductions. This is appropriate since sediment mass reductions are not a practical indication of beneficial use protection due to the inherent natural variability of sediment delivery and the uncertainties associated with accurately measuring sediment loads and reductions.

Margin of Safety, Seasonal Variation and Critical Conditions: The Truckee River TMDL includes an implicit margin of safety. Conservative assumptions that comprise the implicit margin of safety were incorporated into data interpretations and analysis throughout the TMDL, including the use of a high water year to base loading estimates, and conservative assumptions regarding the ability to reduce sediment loading through management practices. Seasonal variations are accounted for by expression of the SSC target as an annual 90th percentile value, allowing for fluctuations in SSC over the target limit, while providing a high level of protection for sensitive aquatic life stages.

Implementation and Monitoring Plan: Implementation of the TMDL is based on continuation and improvement of existing erosion control and monitoring programs, NPDES storm water permits, and cooperative agreements with other state and federal agencies.

Existing Waste Discharge Requirements (WDRs), including NPDES storm water permits, contain requirements to control sediment discharges from construction projects, highway operations and maintenance, and facilities with long-term operations such as ski resorts or industrial areas. NPDES municipal permits for the Town of Truckee's and Placer County's jurisdictions in the watershed contain similar requirements. Water quality improvement projects undertaken by entities such as the United States Forest Service (USFS)-Tahoe National Forest, the Tahoe Donner Land Trust (TDLT), and the Truckee River Watershed Council (TRWC) will complement the Water Board's regulatory activities to meet the TMDL.

Tracking of implementation indicators and compliance with sediment and erosion control requirements in permits will help Water Board staff and the public assess progress toward meeting the TMDL. Monitoring of suspended sediment concentrations in the middle Truckee River will track the in-stream response to improving upland conditions. Table 4.13-TR-4 summarizes the TMDL target monitoring plan.

Schedule of TMDL Attainment, Data Review and Revision: The estimated time frame for meeting the numeric targets and achieving the TMDL is 20 years. This estimate takes into consideration time needed for dischargers to devise plans to address sediment sources and iteratively apply appropriate sediment controls. There will also be funding constraints that may affect the pace of certain implementation actions needed to address legacy sites. Further, there may be significant temporal disparities between upland erosion control actions and reduced sediment delivery to the river.

Progress toward meeting the targets will be evaluated by Water Board staff on an annual basis. After 10 years (the halfway point estimated for TMDL attainment), staff shall examine target and compliance data to determine the need for revision of the TMDL, numeric targets, or implementation plan.

Examples of issues to consider during review of the TMDL include:

- precipitation rates and types during the water years
- sampling or data collection problems
- overall compliance with permit conditions
- progress on legacy sites restoration
- completeness of dirt road management plans implemented and monitored
- status of road sand management activities
- other potential sources that could be affecting water quality conditions

Potential outcomes of the 10-year review could include recommendations to reassess sediment sources, revise targets, or adjust the implementation plan.

Table 4.13-TR-1
Indicators and Targets for Truckee River TMDL

Indicator	Target Value	Notes
Water Column: Suspended sediment concentration	Annual 90th percentile value of less than or equal to 25 milligrams per liter (mg/L) suspended sediment. Measured at Farad (United States Geological Survey gauge 10346000) Data from other monitoring sites along the mainstem Truckee River will be evaluated as needed to assess SSC variations and potential source areas from upstream tributaries.	Target represents protection of aquatic life beneficial uses (COLD and SPWN), based on literature review.
Implementation Measure: Road sand application best management practices (BMPs), and recovery tracking	Road sand is applied using BMPs and recovered to the maximum extent practicable (MEP).	Road traction sand is needed for public safety; therefore amounts used cannot be specified by TMDL. However, application BMPs and increased road sand recovery can lessen sediment impacts to watercourses.
Implementation Measure: Ski area BMP implementation and maintenance	Ski areas identify and prioritize areas within their facilities where BMP implementation and maintenance is needed to control erosion and sedimentation to stream channels.	Candidate sites to be identified and prioritized in annual worklists submitted to fulfill WDR permit requirements.
Implementation Measure: Dirt roads maintained or decommissioned	Identified dirt roads with inadequate erosion control structures are rehabilitated and maintained, or decommissioned. Focus on dirt roads with high potential for sediment delivery to surface waters (e.g., within 200 feet of watercourse).	Candidate roads to be identified and prioritized through watershed assessments or Water Board inspections.
Implementation Measure: Legacy sites restoration/BMP implementation	Identified legacy sites are restored or storm water BMPs are implemented to prevent erosion and sedimentation to surface waters.	Candidate sites to be identified and prioritized through watershed assessments, or Water Board inspections. Storm water NPDES/WDR holders should identify and prioritize legacy sites in annual worklists.

Table 4.13-TR-2
Summary of Suspended Sediment Sources in the Truckee River Watershed

Summary of Suspended Sediment Sources (Water Year 1996-1997[a] in Tons)			
Subwatershed	**Total Watershed Loading (tons/year)**	**Urban Areas (tons/year)**	**Non-Urban Areas[b] (tons/year)**
Squaw Creek	2,971	430	2,541
Donner/Cold Creeks	2,253	168	2,085
Gray Creek	1,453	0	1,453
Prosser Creek	1,276	108	1,168
Little Truckee River	1,026	0	1,026
Martis Creek	490	20	470
Bear Creek	432	56	376
Bronco Creek	210	0	210
Juniper Creek	173	0	173
Trout Creek	61	46	15
Subwatershed Totals	10,345	828	9,517
Intervening Zones/Unmeasured Inputs[c]	15,973	1832	14,141
Load Measured at Farad	26,318		
Event-Based Loading[d]	24,064	2,406	21,658
Total Suspended Sediment Load	50,382	5,066	45,316
Percent of Total		10%	90%

a. Except for the estimate for event-based loading, which relies on the Desert Research Institute's (DRI) 2004 study, conducted from May 2002 to June 2003 (see table note "d", below).

b. Calculated as the difference between the sum of load estimates for each subwatershed's urban areas and each subwatershed's total load.

c. Calculated as the difference between the total suspended sediment load from subwatersheds and the total suspended sediment load measured at Farad (26,318 tons minus 10,345 tons).

d. Calculated by multiplying 256 (tons of sediment) by 94 (events). 256 tons is the upper limit of the most frequently occurring suspended sediment event load range. This range also corresponds to most frequent event load occurring at Farad, where the watershed sediment load is calculated. Ninety four represents the most conservative (worst-case) number of events recorded during the DRI 2002-2003 study (at Bridge 8). This conservative estimate is appropriate given that the study occurred over a lower than average water year.

Table 4.13-TR-3
Allocations for the Truckee River Watershed Sediment TMDL

	Allocations (All Estimates in Tons/Year)			
Subwatershed	**Urban Areas (Wasteload Allocation)[a]**	**Non-Urban Areas (Load Allocation)[b]**	**Total Allocated Load**	**Notes**
Squaw Creek	350	1,878	2,228	Allocations are per Squaw TMDL: Total load = 25% reduction from total watershed load shown in Table 4.13-TR-2; WLA = road sand/urban allocation from Squaw TMDL.
Donner/Cold Creeks	84	1,626	1,710	Controllable non-urban load = 40%
Gray Creek	0	1,293	1,293	Controllable non-urban load = 20%
Prosser Creek	54	911	965	Controllable non-urban load = 40%
Little Truckee River	0	800	800	Controllable non-urban load = 40%
Martis Creek	10	315	325	Controllable non-urban load = 60%
Bear Creek	28	293	321	Controllable non-urban load = 40%
Bronco Creek	0	187	187	Controllable non-urban load = 20%
Juniper Creek	0	154	154	Controllable non-urban load = 20%
Trout Creek	23	12	35	Controllable non-urban load = 40%
Total Suspended Sediment Loads Allocated to Subwatersheds	549	7,469	8,018	
Intervening Zones/ Unmeasured Inputs	916	11,030	11,946	Controllable non-urban load = 40%
Event Based Loading	1,203	16,893	18,096	10% to WLA based on existing wasteload/load ratio; Controllable non-urban load =40%
Future Development	2,268		2,268	85% of WLA to existing urban areas.
Totals	4,936	35,392	40,328	
Allocations Summary				
Total WLA			4,936	(549 + 916 + 1,203 + 2,268)
Total LA			35,392	(7,469 + 11,030 + 16,893)
Total Allocated Loads (WLA +LA) *Must not exceed TMDL*			40,300	(4,936 + 35,392), rounded to nearest 100 tons
TMDL (Loading Capacity)			40,300	(50,382 x 80%; 20% overall load reduction**) rounded to nearest 100 tons**

a. All WLAs based on 50% load reduction (BMP efficiency of 50%).

b. All LAs based on 55% BMP efficiency applied to percent controllable load

Table 4.13-TR-4
Summary of TMDL Target Monitoring Requirements

Target	Monitoring and Reporting	Responsible Entities
Water Column: Suspended sediment concentration Annual 90th percentile value of less than or equal to 25 milligrams per liter (mg/L) suspended sediment.	SSC grab samples measured at least once per month at Farad (USGS gauge 10346000). Upstream SSC data can be assessed for potential variations and source areas if target exceedances are identified at Farad. SSC sampling is conducted on the Truckee River at Tahoe City, and at confluences with Donner, Martis and Juniper Creeks. Additionally, a municipal monitoring program is being developed that covers the jurisdictions of the Town of Truckee, Placer County, and the California Department of Transportation (Caltrans). Data generated by this program will be reported annually to further assist the evaluation of potential source areas or variations across the watershed.	SSC data are collected from the Truckee River locations by DRI, for Nevada Department of Environmental Protection's (NDEP) Water Quality Planning Branch and stored in the United States Environmental Protection Agency's Storage and Retrieval (STORET) system. The Town of Truckee and Placer County are responsible for developing the municipal monitoring program, and Caltrans is required to coordinate with this effort. The program will be coordinated with NDEP's sampling on the Truckee River. The Water Board may require dischargers to contribute to the SSC monitoring on the Truckee River.
Implementation Measure: Road sand application and recovery managed to the maximum extent practicable (MEP).	Road sand use and recovery should be tracked and reported annually. Additionally, road sand characteristics such as durability, abrasion loss, sieve analysis, and phosphorous content should be reported annually.	Placer County, Town of Truckee, and Caltrans, as required under municipal storm water permits.
Implementation Measure: Ski area BMP implementation and maintenance to control erosion and sediment.	Ski runs and other related facilities are inspected at a minimum of once per year for erosion features once snow cover has dissipated. Annual reports are submitted describing inspection results, projects proposed to correct deficiencies, and effectiveness of erosion control projects previously implemented.	Squaw Valley Ski Corporation, Northstar-at-Tahoe, Alpine Meadows, Tahoe-Donner Ski Area.

Target	Monitoring and Reporting	Responsible Entities
Implementation Measure: Dirt roads maintained or decommissioned to control erosion to the extent feasible.	Monitoring should focus on dirt roads with high potential for sediment delivery to surface waters (e.g., within 200 feet of watercourse). Prioritized dirt roads should be monitored annually to evaluate erosion features and potential corrective actions. The number of miles of roads inspected, proposed corrective actions, and effectiveness of previous implementation measures should be reported annually.	Placer County, Town of Truckee, USFS, State Parks, and dischargers regulated by the Water Board. Water Board will respond to complaint-driven issues and oversee grant funded road assessments and improvement projects.
Implementation Measure: Legacy site restoration and BMP implementation.	Candidate sites should be identified and prioritized through watershed assessments and Water Board regulatory oversight. A list of legacy sites should be maintained and updated as sites are restored and new information is generated. Legacy site information should be reported annually under the municipal storm water programs.	Placer County, Town of Truckee, and Caltrans are required to evaluate and report annually. USFS should report progress on its Off Highway Vehicle road management program. Other information should be collected from entities such as State Parks, TRWC, TDLT, etc. Water Board will respond to complaint driven issues and oversee grant funded road assessments and improvement projects.