Jurisdictional Groups 5 and 6 (Cities of Redondo Beach, Hermosa Beach, Manhattan Beach, Torrance, El Segundo, County of Los Angeles, and Caltrans)

Santa Monica Bay Beaches Bacteria Total Maximum Daily Load Implementation Plan Jurisdictional Groups 5 and 6

July 14, 2005

Implementation Plan

Executive Summary
Santa Monica Bay Beaches Bacteria TMDL Jurisdictional Groups 5 and 6 Implementation Plan

The Santa Monica Bay beaches are listed on the State's 303(d) List of impaired water bodies due to excessive amounts of coliform bacteria which from time-to-time prevent the beaches from attaining their designated use for human body contact recreation, also known as REC-1 beneficial use. As required under the Federal Clean Water Act, the State has taken action to eliminate these impairments by establishing watershed-based, pollutant-specific total maximum daily loads (TMDLs) that effectively set limits on the bacterial indicator concentrations at the shoreline. The California Regional Water Quality Control Board for the Los Angeles Region (Regional Board) issued Wet- and Dry-Weather TMDLs for bacteria at Santa Monica Bay Beaches that became effective on July 15, 2003. The regulated agencies under the TMDLs must now prepare and implement plans to reduce their discharges to comply with the load allocations.

This Implementation Plan has been developed to address the requirements of both the Santa Monica Bay Beaches Bacteria Wet-Weather and Dry-Weather Total Maximum Daily Loads (TMDLs) within Jurisdictional Groups 5 and 6 that include summer dry weather, winter dry-weather, and 30-day rolling geometric mean targets for indicator bacteria. The Implementation Plan utilizes an integrated approach and describes a systematic strategy for progressively improving compliance with Santa Monica Bay Beaches Bacteria (SMBBB) Wet- and Dry-Weather TMDL objectives while at the same time providing opportunities for achieving broader water quality benefits and public goals. The strategy for reducing exceedances relies on a combination of measures designed to reduce migration and transport of bacteria and other pollutants by reducing the amount of dry-weather and wet-weather runoff while at the same time pursuing opportunities for beneficial reuse of runoff.

The Wet-Weather SMBBB TMDL grouped the responsible agencies under the TMDL into Jurisdictional Groups, divided roughly along watershed boundaries. A primary jurisdiction was identified for each Jurisdictional Group and is responsible for submitting an Implementation Plan for the group in a draft report to the Regional Board by March 15, 2005. The final Implementation Plan is due to the Regional Board by July 15, 2005. Jurisdictional Group 5 is comprised of five responsible agencies: City of Manhattan Beach (primary jurisdiction), City of El Segundo, City of Hermosa Beach, County of Los Angeles and Caltrans. The limits of this area extend from the north boundary of the City of Manhattan Beach to just south of the Hermosa Beach Pier. Jurisdictional Group 6 is comprised of six responsible agencies: Cities of Hermosa Beach, Manhattan Beach, Redondo Beach (primary jurisdiction) and Torrance, along with the County of Los Angeles and Caltrans. The limits of Jurisdictional Group 6 extend from the southern boundary of Jurisdictional Group 5 to the southern city limit of Torrance at the coast. The overlap of responsibility and similarity of land use among Jurisdictional Groups 5 and 6 have prompted the agencies to submit a joint implementation plan on behalf of both jurisdictional groups.

This Implementation Plan is the product of a joint planning effort among the agencies comprising Jurisdictional Groups 5 and 6, as well as interested stakeholders and Regional Board staff. Monthly meetings were held among the responsible agencies to direct the course of implementation plan development and coordinate information needs for the plan. A series of workshops were held for interested stakeholders to provide briefings on progress of Implementation Plan development and to receive feedback from stakeholders.

The Regional Board recognizes two general approaches to implementing TMDLs. The first is an integrated water resources approach that takes a holistic view of regional water resources management. The alternative to an integrated approach would be a plan focused on a single pollutant that does not take into consideration these other goals. This Implementation Plan employs an integrated approach designed to provide the Jurisdictional Group 5 and 6 responsible agencies with a systematic process for progressively improving compliance with SMBBB TMDL objectives while at the same time achieving broader water quality benefits and public goals. Although the requirement for developing this implementation plan arises from the Wet-Weather SMBBB TMDL, an integrated approach by definition should consider all TMDLs that apply to the watershed. Therefore, planning for compliance with the summer dry-weather, winter dry-weather and 30-day rolling geometric mean targets for indicator bacteria is included in this Implementation Plan. This Implementation Plan provides the responsible agencies of Jurisdictional Groups 5 and 6 with an iterative, adaptive framework that is designed to identify and advance those management practices that are found to be most effective in achieving the TMDL objectives. This plan calls for three categories of management approaches: Programmatic Solutions, Structural BMPs, and Source Identification & Control. Each of these categories will be implemented in three phases, with each phase incorporating information gained from the prior phases across the three categories.

Programmatic solutions will be initiated and developed where applicable across Jurisdictional Groups 5 and 6. Agencies in Jurisdictional Groups 5 and 6 have already adopted many programmatic solutions as part of management plans under the municipal storm water and Caltrans statewide stormwater permits, so programmatic solutions under this implementation plan will build on these existing programs, focusing on enhancements and improvements that specifically target indicator bacteria control. These measures will focus on improving education, awareness and compliance with good housekeeping practices and ordinances that minimize release of bacteria sources among targeted populations. Programmatic non-structural source control options are generally those that do not require new infrastructure, but rather use techniques such as: education and outreach, positive reinforcement of good housekeeping behavior and land use, and enforcement of existing codes and ordinances. Programmatic options also include improvements in public agency activities and standard operating procedures.

Site-specific structural BMPs will be piloted in specific drainage areas and evaluated for effectiveness. Jurisdictional Group 5 and 6 agencies have already implemented or are in the process of implementing dry weather structural diversions at six major storm drain outfalls and additional sand filtration BMPs to address the upcoming summer dry weather compliance deadlines. The site-specific structural BMP pilot studies will evaluate the effectiveness of addressing wet-weather, and to a lesser degree, dry-weather bacteria control using on-site structural BMPs. It is widely accepted within the scientific community that there is insufficient data and understanding regarding the effectiveness of wet weather structural BMPs for reducing indicator bacteria in receiving waters. Jurisdictional Groups 5 and 6 agencies have selected two study areas as the initial focus for piloting site-specific structural BMPs—the drainage areas associated with monitoring locations SMB 5-5 (Hermosa Pier) and SMB 6-2 (Redondo Pier).

The agencies have selected SMB 6-1 (Herondo) as the focus for initiating source identification and control since it is large, exhibits a wide variety of land use and is a high priority drainage area due to frequent wet and dry weather exceedances. Near-shore source identification activities described in Section 4.1.3.1 and 4.1.3.3 will also be conducted in SMB 6-2 (Redondo Pier and King Harbor areas) to identify potential source control or land use-specific structural BMPs that may be particularly effective in near-shore areas. The objective of source identification is to identify conditions or factors that produce significantly higher indicator bacteria concentrations in the receiving waters associated with these drainage areas than occur in lower priority areas. As significant factors and/or sources are identified, appropriate source controls will be developed and implemented at applicable sources within the high priority drainage areas.

Both structural BMPs and source controls will require carefully designed and implemented monitoring plans to measure effectiveness of these measures in controlling bacteria. It is critical that early phases of this implementation plan develop the necessary evaluations of effectiveness in order to leverage the agencies' expenditures of resources to the maximum extent possible while enhancing other public goals, e.g., water conservation, beneficial reuse, shoreline native habitat restoration. Based on these evaluations of effectiveness, the responsible agencies can make adaptive decisions to pursue the most promising combination of management approaches to achieve TMDL objectives. Source controls and structural BMPs that are identified as being most cost effective will be expanded and implemented in later phases at relevant and applicable sites in Jurisdictional Groups 5 and 6. This implementation strategy is summarized in Table ES-1 and described in detail in Section 4 of this implementation plan.

Table ES-1

Implementation Plan: Three-Pronged, Phased Strategy

	Programmatic Solutions	**Structural BMPs**	**Source Identification & Control**
PHASE 1	Enhance existing programmatic solutions targeting: ▪ Homeowners/residents ▪ Schools ▪ Business ▪ Public agency activities	Site-specific structural BMPs combined into alternatives for study areas ▪ Select drainage areas for study ▪ Siting, data collection and BMP selection process ▪ Conceptual design and selection of alternatives ▪ Design, installation and monitoring of site-specific BMPs.	Identify significant sources in high-priority drainage areas ▪ Eliminate sanitary sewage infrastructure as potential source ▪ Enhance comparative land use mapping to focus source identification ▪ Field reconnaissance of high priority drainage areas. Prioritize source controls
PHASE 2	Assess/Expand/Develop programmatic solutions	Evaluate performance of individual site-specific BMPs and alternatives as a whole	Implement source controls in high priority areas
PHASE 3	Implement additional programmatic solutions	Implement applicable BMPs, research new BMPs	Evaluate high priority source controls and Institutionalize Effective Controls

A schedule is proposed for implementing this plan. The first compliance deadline (summer dry-weather) occurs in July 2006. Jurisdictional Group 5 and 6 agencies have already implemented or are in the process of implementing dry weather structural diversions at six major storm drain outfalls as well as additional sand filtration BMPs to address the upcoming summer dry weather compliance deadline.

Phase I of the three management approaches will begin simultaneously and by the time the TMDL is re-opened in July 2007, Phase I of the three management approaches will be well underway. As the second compliance deadline arrives in July 2009 (winter dry-weather and 10% wet-weather reduction), Phase I of programmatic solutions will have been implemented and Phase I source identification investigations will be complete. Additionally, Phase II of these two management approaches will also be underway and five years of Coordinated Shoreline Monitoring data will be available. It is not clear whether shoreline monitoring data will be of sufficient precision and accuracy to measure a 10% wet weather reduction in the four wet-weather exceedance days (effectively 0.4 of an exceedance day). However, the responsible agencies believe it is reasonable to expect that implementation of Phase I programmatic solutions throughout Jurisdictional Groups 5 and 6 could provide such a reduction, whether or not it can actually be measured at the shoreline.

Assuming the original schedule continues, by the 25% wet weather reduction deadline in July 2013 one entire cycle of the three phases of programmatic solutions and source control measures will be complete. Additionally the final assessment of the site-specific structural BMP pilot study alternative will be complete (Phase II). The combined effect of source controls implemented in high priority drainage areas with appropriate expansion into other drainage areas, and the three phases of programmatic solutions implemented throughout of Jurisdictional Groups 5 & 6, should be expected to provide sufficient controls on bacteria loads "stored" within the watershed to achieve the 25% wet weather objective. This will also be the major decision point regarding distribution of future resources and effort among the three approaches.

Depending on how well compliance targets have been met or exceeded through implementation of one complete cycle of source control and programmatic solutions, and on the demonstrated effectiveness of the pilot study in reducing wet-weather runoff within the pilot areas, a number of potential options may be pursued. The following if/then scenarios illustrate how these decisions may be made.

- If source control measures combined with programmatic solutions appear to demonstrate promise, that is, winter dry weather allocations are not being surpassed, and wet weather exceedance allocations are still being surpassed, but are demonstrating an improving trend, then consider conducting additional source identification in high priority areas using newer source-tracking technologies and/or pilot emerging source control technologies.

- If source control measures and programmatic solutions are demonstrating an improving trend in compliance for dry weather but wet weather exceedances are not significantly improving in high priority areas, and site-specific structural BMPs appear to show promise in reducing wet-weather exceedances in the study areas, then expand these site-specific BMPs into high priority areas in as many sites as are applicable and feasible from a funding standpoint.

- If the previous scenario holds true except that piloted site-specific structural BMPs are not demonstrating measurable improvements in wet weather compliance, revisit regional BMPs and consider researching and piloting medium-sized site-specific BMPs within high-priority areas that may provide more significant storage capacity for wet-weather flows.

When these major decisions regarding course of action are made, there will still be more than five years until the 50% wet weather reduction compliance date and eight years until the final compliance date. This should be sufficient time to complete a second iteration of the management approaches selected for further exploration at the major decision point.

The responsible agencies will provide an implementation progress report to Regional Board staff at each of the interim wet weather milestones. These progress reports will document accomplishments, information and findings, and planned course of action going forward. The agencies reserve the right to come before the Regional Board at any point during implementation to discuss new information or findings of significance and/or to request that the Board reconsider the TMDL in light of the information and findings.

The Implementation Plan is organized into four sections. Section 1 describes the history of the TMDL development, the organization of Jurisdictional Groups 5 and 6, and the objectives of this Implementation Plan. Section 2 provides background information on the compliance requirements of the TMDL. Section 3 of the Implementation Plan summarizes the technical analyses that were prepared to lay the foundation for developing the TMDL compliance strategy. Section 4 describes in detail the Jurisdictional Groups 5 and 6 Implementation Plan that has been outlined above. Section 4 also describes the schedule for implementation.

Section 1
Introduction

This Implementation Plan has been prepared in response to Resolution No. 2002-022 of the California Regional Water Quality Control Board—Los Angeles Region (Regional Board). Resolution No. 2002-022 amends the Water Quality Control Plan for the Los Angeles Region to incorporate implementation provisions for water quality objectives and to incorporate a Wet-Weather Total Maximum Daily Load for Bacteria at Santa Monica Bay Beaches. This Implementation Plan employs an integrated approach to provide the Jurisdictional Groups 5 and 6 responsible agencies with a systematic process for progressively improving compliance with SMBBB TMDL allocations while at the same time achieving broader water quality benefits and public goals.

1.1 TMDL Development History

The federal Clean Water Act of 1972 (CWA) requires states to develop a list of impaired waters and identify the pollutants for which they are impaired, also known as the 303 (d) List. For each impairment, states must establish a watershed-based, pollutant-specific Total Maximum Daily Load (TMDL) that will bring impaired water bodies into compliance with the water quality standards necessary for achieving designated beneficial uses of the water body. The Santa Monica Bay beaches are designated for human body contact recreation, also known as REC-1 beneficial use, and are included on California's 1998 303(d) List due to excessive amounts of coliform bacteria. Nearshore and offshore zones of Santa Monica Bay are also listed as impaired for historical deposits of DDT, Chlordane and PCBs in sediment and fish tissue, however TMDLs for these pollutants have not yet been issued.

The Regional Board released a first draft of the Santa Monica Bay Beaches Bacterial TMDL (SMBBB TMDL) on November 9, 2001. As development of the TMDL progressed, the Regional Board staff decided to bifurcate the SMBBB TMDL into two TMDLs, one for dry weather and one for wet weather, to allow more time to consider the extensive public comments on the wet weather elements of the TMDL. Both the SMBBB Dry- and Wet-weather TMDLs were approved by US EPA in June 2003 and became effective on July 15, 2003.

1.2 Jurisdictional Groups 5 and 6

The Wet-Weather TMDL groups responsible agencies into jurisdictional groups for purposes of implementation. A primary jurisdiction is designated for each jurisdictional group. Primary jurisdictions comprise greater than fifty percent of the land area in the group. The primary jurisdiction is responsible for submitting an implementation plan describing the TMDL implementation approach and schedule to be used by the jurisdictional group in complying with the TMDL—all jurisdictions are jointly responsible for compliance.

Jurisdictional Group 5 is comprised of five responsible agencies: City of Manhattan Beach (primary jurisdiction), City of El Segundo, City of Hermosa Beach, County of Los Angeles and California Department of Transportation (Caltrans). The jurisdictional group covers the Hermosa Subwatershed as defined by the Regional Board. The limits of Jurisdictional Group 5 extend from the northern boundary of the City of Manhattan Beach to just south of the Hermosa Beach Pier, an area encompassing approximately 2,700 acres.

Jurisdictional Group 6 is comprised of six responsible agencies: Cities of Hermosa Beach, Manhattan Beach, Redondo Beach (primary jurisdiction) and Torrance, along with the County of Los Angeles and Caltrans. The jurisdictional group covers the Redondo Subwatershed as defined by the Regional Board. The limits of this area range from the boundary of Jurisdictional Group 5 just south of the Hermosa Beach Pier and just south of Artesia Boulevard in Redondo Beach, to the southern city limit of Torrance at the coast. The combined size of Jurisdictional Group 6 is approximately 4,360 acres.

In Jurisdictional Groups 5 and 6, Caltrans is responsible for State Route LA-1, Sepulveda Boulevard/Pacific Coast Highway. State Route LA-1 enters Jurisdictional Group 5 north of Marine Avenue Intersection as Sepulveda Boulevard then it becomes Pacific Coast Highway when passes Artesia Boulevard. LA-1, Pacific Coast Highway, exits Jurisdictional Group 6 near Massena Avenue Intersection.

The overlap of responsible agencies among Jurisdictional Groups 5 and 6 and the similarity of land use and development in these areas prompted the responsible agencies of Groups 5 and 6 to determine that they should pool resources to submit a joint implementation plan on behalf of both jurisdictional groups.

1.3 Stakeholder Process

This TMDL Implementation Plan is the product of coordination between the agencies comprising Jurisdictional Groups 5 and 6, as well as interested stakeholders and Regional Board staff. Monthly meetings were held among the responsible agencies to direct the course of Implementation Plan development, to coordinate exchange of information, and to facilitate joint decision-making. Stakeholder Workshops were also held to provide a forum for discussion and exchange of ideas as the Implementation Plan was developed.

The first stakeholder workshop introduced the TMDL requirements and the integrated, iterative approach that is the basis of this plan. This session was attended by staff from all responsible agencies in Jurisdictional Groups 5 and 6, some city council members, as well as interested citizens. Attendees were briefed about types of BMPs being considered for the plan, including programmatic solutions, local site-specific structural controls and regional solutions. Hydrologic findings were also discussed, specifically the pattern of bacteria exceedances characteristic of Jurisdictional Groups 5 and 6 wherein exceedances occur more frequently in dry weather than in wet weather.

The second stakeholder workshop focused on the conceptual approach of the Implementation Plan—three categories of management approaches to be implemented in three phases. Feedback from the stakeholders has been incorporated into this final plan.

Several of the responsible agencies are also considering presenting the Implementation Plan at a scheduled City Council meeting. This will be in addition to internal briefings by city staff for individual council members.

The following table summarizes the workshop schedule and highlights key topics of each workshop.

Table 1-1

Stakeholder Workshops

Workshop Number	Workshop Date	Highlights of Workshop Agenda
1	October 19, 2004	▪ Introduction of TMDL ▪ Implementation Approach ▪ Initial Findings ▪ Stakeholder feedback
2	January 18, 2005	▪ Update of Findings ▪ Draft Implementation Plan

1.4 Scope of Work

The CDM and CH2M HILL team was retained by Jurisdictional Groups 5 and 6 to develop an Implementation Plan that addresses the requirements of both Wet- and Dry-Weather SMBBB TMDLs. The team was charged with preparing an Implementation Plan that utilizes an integrated water resources management approach, addresses multiple pollutants, identifies beneficial use opportunities, and integrates multiple responsible agencies into an overall solution in accordance with the SMBBB TMDLs.

The Scope of Work was comprised of a series of seven (7) tasks:

- Task 1: Staff and Management Support for Development of the Integrated Implementation Plan
- Task 2 : Best Management Practice (BMP) Evaluation
- Task 3: Hydrologic Analysis
- Task 4: Beneficial Use Evaluation

- Task 5: Research Potential Sites for Localized BMPs, Beneficial Use and Diversion Facilities
- Task 6: Prepare TMDL Implementation Plan
- Task 7: Project Management and QA/QC

Technical memoranda were prepared to summarize the results of Tasks 2 through 5 and are provided as attachments to this document. This Implementation Plan is the final work product of Task 6 and is the culmination of work from the preceding tasks.

1.5 Implementation Plan Objectives

The Regional Board recognizes two general approaches to implementing TMDLs. The first is an integrated water resources approach that takes a holistic view of regional water resources management. The objectives of this approach are to integrate planning for future wastewater, storm water, recycled water, and potable water needs and systems; focus on beneficial re-use of storm water, including groundwater infiltration, at multiple points throughout a watershed; and address multiple pollutants. The Regional Board recognizes in the Wet-Weather TMDL that an integrated water resources approach not only provides water quality benefits, but also that responsible agencies implementing the TMDL can serve a variety of public purposes by adopting an integrated water resources approach. Such an integrated approach allows for the incorporation and enhancement of other public goals such as water supply, recycling and storage, environmental justice, parks, greenways and open space, and active and passive recreational and environmental education opportunities. The alternative to an integrated approach would be a plan focused on a single pollutant that does not take into consideration these other goals.

This plan employs an iterative, adaptive management process by providing a framework to assist the Jurisdictional Groups 5 and 6 responsible agencies in identifying and implementing an integrated program of effective and practical solutions for progressively achieving compliance. Although an implementation plan is not explicitly required for the Dry-Weather SMBBB TMDL, an integrated approach by definition should consider all TMDLs that apply to the watershed, accordingly planning for compliance with the Dry-Weather SMBBB.

Section 2
Background

The requirements, compliance targets and deadlines of the SMBBB Wet-Weather and Dry-Weather TMDLs that drive the schedule for this implementation plan are described in this section.

2.1 TMDL Summary

The requirements of SMBBB Dry- and Wet-Weather TMDLs are contained in two Regional Board Resolutions. Resolution No. 02-004 incorporates a Dry Weather TMDL into the LA Basin Plan. Resolution No. 2002-022 incorporates a Wet-Weather TMDL into the Basin Plan but also modifies the compliance schedule of the Dry-Weather TMDL in order to coordinate the schedule for reconsideration of certain provisions of both TMDLs and to assure efficiency and consistency in implementing the Wet-Weather and Dry-Weather TMDLs.[1] The requirements of the Wet-Weather and Dry-Weather TMDLs overlap and can be summarized as follows:

- Both TMDLs require the responsible agencies to submit a coordinated shoreline monitoring plan (CSMP) within 120 days of the effective date of the TMDLs to be used for compliance monitoring of the TMDLs.

- The Dry Weather TMDL requires that responsible agencies provide documentation on 342 potential discharges to Santa Monica Bay beaches.

- The TMDLs require responsible agencies to achieve compliance with the TMDLs according to specified schedules, with a longer schedule allowed for achieving the Wet Weather TMDL allocations.

- The Wet Weather TMDL requires the responsible agencies to develop an implementation plan for achieving compliance. After considering the implementation plan, the Regional Board will amend the TMDL and adopt an individual implementation schedule for each jurisdictional group taking into account the implementation approach being undertaken.

This Implementation Plan is being submitted to fulfill the last of these requirements.

2.2 Compliance Targets and Allocations

The TMDLs are based on numeric targets for bacteriological water quality objectives for Water Contact Recreation (REC-1) revised by Regional Board Resolution 2001-018 amending its Basin Plan on October 25, 2001. This Basin Plan amendment received final approval from USEPA on September 25, 2002.[2] These water quality objectives are based on four bacterial indicators and include both geometric mean limits and single sample limits:

1 Resolution No. 2002-022, Finding 26.
2 Resolution No. 2002-022, Finding 18.

1. Rolling 30-day Geometric Mean Limits

a. Total coliform density shall not exceed 1,000/100 ml

b. Fecal coliform density shall not exceed 200/100 ml

c. Enterococcus density shall not exceed 35/100 ml.

2. Single Sample Limits

a. Total coliform density shall not exceed 10,000/100 ml

b. Fecal coliform density shall not exceed 400/100 ml

c. Enterococcus density shall not exceed 104/100 ml

d. Total coliform density shall not exceed 1,000/100 ml if the ratio of fecal-to-total coliform exceeds 0.1

The SMBBB TMDLs divide the storm year, which runs from November 1st to October 31st, into three separate periods for compliance purposes, the three periods are:

- Winter dry-weather (November 1st to March 31st)
- Summer dry-weather (April 1st to October 31st)
- Year-round wet-weather [3]

The SMBBB TMDLs set allocations based on the number of days within a storm year that sample results under the Coordinated Shoreline Monitoring Plan (CSMP) exceed the water quality objectives (targets). The exceedance allocations for Rolling Geometric Mean and Summer Dry-Weather are set at zero exceedances for all monitoring sites. Allocations for Winter Dry-Weather and year-round Wet-Weather are specific to each monitoring site and have been established based on historical monitoring data and/or comparison with historical monitoring data at the Reference Beach. These site-specific allocations are listed in Table 2-1.

3 Wet weather days are those days with precipitation of ≥0.1 inches and the three days (72 hours) following the end of the rain event.

Table 2-1

Waste Load Allocations

Site ID	Hist. ID	Location description	Type of Site	Single Sample Allowable Exceedance Days			
				Winter Dry Daily Sampling	Winter Dry Weekly Sampling	Wet Weather Daily Sampling	Wet Weather Weekly Sampling (daily/7)
Leo Carillo Beach			**reference beach**	3	1	17	3
SMB-5-1	S13	Manhattan State Beach at 40th Street	existing open beach	1	1	4	1
SMB-5-2	DHS 113	27/28th St. extended in Manhattan Beach	moved to point zero	*3*	*1*	*17*	*3*
SMB-5-3	S14	Manhattan Beach Pier--50 yds south	moved to point zero	1	1	5	1
SMB-5-4	DHS 114	26th Street extended in Hermosa Beach	existing open beach	0	0	12	2
SMB-5-5	S15	Hermosa Beach Pier--50 yds south	existing open beach	2	1	8	2
SMB-6-1	DHS 115	Herondo Street extended (at Herondo drain)	moved to point zero	3	1	17	3
SMB-6-2	S16	Redondo Beach Pier--50 yds south	existing open beach	3	1	14	2
SMB-6-3	N/A	Projection of Sapphire Street drain	new site at point zero	*3*	*1*	*17*	*3*
SMB-6-4	DHS 116	Topaz Street extended (north of groin/jetty)	existing open beach	3	1	17	3
SMB-6-5	S17	Redondo State Beach at Avenue I	moved to point zero	3	1	6	1
SMB-6-6	S18	Malaga Cove	existing open beach	1	1	3	1
J5/6 Total				23	10	120	22

Note:	The Reference Beach is used in setting maximum waste load allocations to ensure that water quality is at least as good as that of the reference system. A reference system is an area and associated monitoring site that is not impacted by human activities that could potentially affect bacteria densities in the receiving water body.
(shaded)	Signifies that the value was not explicitly provided in the TMDL Weekly allocations for wet weather were obtained by dividing the daily allocations in the TMDL by "7" and rounding up.
Italic	No allocations for SMB-5-2 and SMB-6-3 were provided in the TMDL so values equal to the reference beach were assumed.
	Note that the Regional Board staff derived both wet and winter dry weather allocations by calculating a five-year average exceedance rate for each site and multiplying the site-specific exceedance rate by the number of wet or dry days in the 90th percentile storm year (1993), the baseline year. If exceedance rate is proportional to the number of wet or dry days, then only 1 in 10 years will be wetter than the baseline year and likely to have a wet weather exceedance. In contrast, 9 out of 10 years are dryer than the baseline year, most of the time there are likely to be more dry weather exceedances than in the baseline year. Single-Sample Exceedance: Total coliform >10,000, fecal coliform >400, Enterococcus >104, or if Total coliform >1,000 when fecal-to-total coliform ratio exceeds 0.1 Rolling 30-day Geometric Mean Exceedance: Total coliform >1,000, fecal coliform >200, Enterococcus >35

2.3 Compliance Schedule

Based on the SMBBB TMDLs as currently written, schedules for TMDL compliance are shown in Table 2-2.

Table 2-2

Compliance Schedules

Wet Weather Integrated Implementation Plan	Compliance Deadline
10% cumulative percentage exceedance-day reduction	2009-July 15
25% cumulative percentage exceedance-day reduction	2013-July 15
50% cumulative percentage exceedance-day reduction	2018-July 15
Final Compliance	2021-July 15
Dry Weather Implementation	**Compliance Deadline**
Summer single-sample targets	2006-July 15
Summer geometric mean targets	2006-July 15
Winter single-sample exceedance allocations	2009-July 15
Winter geometric mean targets	2009-July 15

Table 2-3 summarizes the required exceedance day reductions based on the information provided in Table 7-4.5 of the SMBBB Wet Weather TMDL. The required reductions were calculated by subtracting the final allowable number of wet weather exceedance days from the estimated number of wet weather exceedance days in the critical year (90th percentile)*.

Table 2-3

Required Exceedance Day Reductions[4]

Compliance Monitoring Point	Total Exceedance Day Reductions*
Jurisdictional Group 5	
SMB-5-1	0
SMB-5-2**	---
SMB-5-3	0
SMB-5-4	0
SMB-5-5	0
Subtotal	0
Jurisdictional Group 6	
SMB-6-1	2
SMB-6-2	0
SMB-6-3**	---
SMB-6-4	2
SMB-6-5	0
SMB-6-6	0
Subtotal	4
Total for Jurisdictional Groups 5 and 6	**4**

Notes: * The compliance targets are based on existing shoreline monitoring data and assume daily sampling. If systematic weekly sampling is conducted, the compliance targets will be scaled accordingly. These are the compliance targets until additional shoreline monitoring data are collected prior to revision of the TMDL. Once additional shoreline monitoring data are available, the following will be re-evaluated when the TMDL is revised:
1) estimated number of wet-weather exceedance days in the critical year at all beach locations, including the reference system(s) and 2) final allowable wet-weather exceedance days for each beach location. **Compliance monitoring points SMB-5-2 and SMB-6-3 are not included in this analysis.

4 Santa Monica Bay Beaches Bacteria TMDL, Attachment A.

Four years after the effective date, based in part on new data collected under the CSMP, the Regional Board will re-consider various provisions of the TMDLs, including:

- Allowable winter dry-weather exceedance days
- Allowable wet weather exceedance days
- Reevaluation of the reference system
- Reevaluation of the reference year
- Clarification or revision of the geometric mean implementation provision

2.4 Coordinated Shoreline Monitoring Plan

Compliance monitoring is being conducted in accordance with the Coordinated Shoreline Monitoring Plan (CSMP) which was submitted jointly by all jurisdictional groups and subsequently approved by the Regional Board. Monitoring under this plan began in November 2004.

The Coordinated Shoreline Monitoring Plan was developed by a Technical Steering Committee consisting of representatives from each of the primary jurisdictions as well as additional responsible agencies. The plan was designed to comply with the monitoring requirements of both the dry- and wet-weather TMDLs and will also provide data to support the re-evaluations that will be made when specific provisions of the TMDLs are re-considered. CSMP monitoring sites located within Jurisdictional Groups 5 and 6 are listed in Table 2-3.

Table 2-4

Compliance Monitoring Sites

Site ID	Historical ID	Location Description
SMB-5-1	S13	40th St., Manhattan Beach
SMB-5-2	DHS 113	27/28th St. extended, Manhattan Beach
SMB-5-3	S14	50 yards south of Manhattan Beach Pier
SMB-5-4	DHS 114	26th St. extended, Hermosa Beach
SMB-5-5	S15	50 yards south of Hermosa Beach Pier
SMB-6-1	DHS 115	Herondo St. extended (at Herondo drain)
SMB-6-2	S16	50 yards south of Redondo Beach Pier
SMB-6-3	N/A	Project of Sapphire St. drain
SMB-6-4	DHS 116	Topaz St. extended (north of groin/jetty)
SMB-6-5	S17	Avenue I, Redondo Beach
SMB-6-6	S18	Malaga Cove

Compliance Monitoring requirements of the Wet-Weather SMBBB TMDL call for source investigations in subwatersheds contributing to chronic exceedances (three weeks out of four or 75% of testing days) of the bacteria water quality objectives at monitoring sites that demonstrate such non-compliance based on results of the coordinated shoreline monitoring. Standardized guidelines for conducting source investigations will be developed by a Source Tracking Subcommittee comprised of representatives from a variety of agencies and led by staff from the City of Los Angeles Environmental Monitoring Division. Development of these guidelines will consider similar guidelines being developed by USEPA staff as well as related work and advice to be provided by staff from Southern California Coastal Water Research Project. These will include guidelines for conducting a sanitary survey as well as recommended methods for differentiating indicator bacteria from human and non-human sources.

Section 3
Summary of Technical Analyses

A number of analytical tasks were conducted to provide a foundation for development of the Implementation Plan. These tasks resulted in a series of technical memoranda that: (a) identify and evaluate current Best Management Practices (BMPs) and their applicability to the requirements of Jurisdictional Groups 5 and 6, (b) analyze that area's hydrology and land use characteristics, (c) define opportunities for beneficial reuse, and (d) synthesize that information and research potential sites for localized BMPs, beneficial use and diversion facilities. The technical memoranda are provided as appendices to this Implementation Plan. Summaries and findings of the analyses are described in this section.

3.1 Best Management Practices (BMP) Evaluation

The Best Management Practices (BMP) Evaluation identified a variety of potential runoff management options of three general types: programmatic solutions, site-specific structural (BMPs), and regional structural BMPs. The entire technical memorandum discussing and evaluating these BMPs is provided in Appendix A. Programmatic solutions include education and outreach, positive reinforcement of good housekeeping practices and desirable land use practices, and enforcement of codes and ordinances. On-site structural BMPs are those that can be installed on an individual parcel to help manage runoff before it reaches the storm drain system. Smaller local or regional facilities typically collect and treat and/or beneficially reuse runoff from multiple parcels before it has entered major storm drain lines. Regional facilities manage runoff after the runoff has entered the storm drain system.

3.1.1 Existing Programmatic Solutions

Agencies in Jurisdictional Groups 5 and 6 have already adopted many programmatic solutions as part of management plans under the municipal storm water permit [1] and the Caltrans Statewide NPDES Permit (Caltrans Permit), so programmatic solutions under this implementation plan will build on these existing programs, focusing on enhancements and improvements that specifically target indicator bacteria control within Jurisdictional Groups 5 and 6. Under the municipal storm water permit the cities are responsible for implementing those aspects of the permit requirements that are applicable within each city's jurisdiction. The Los Angeles County Flood Control District's (County's) role as the Principal Permittee under the municipal permit is to coordinate and facilitate activities among all the co-permittees (agencies) by providing overall program coordination and also by acting as the agency to carry out required activities within unincorporated areas of the County, but the County is not responsible for ensuring compliance by individual cities within their jurisdictions.

[1] California Regional Water Quality Control Board, Los Angeles Region, December 13, 2001. Order No. 01-182, NPDES Permit No. CAS004001, Waste Discharge Requirements for Municipal Storm Water and Urban Runoff Discharges within the County of Los Angeles, and the Incorporated Cities Therein, Except the City of Long Beach.

Likewise, Caltrans is responsible for carrying out Caltrans Permit requirements only for the State Highways and rights-of-way where Caltrans has jurisdiction. Caltrans is responsible for State Route LA-1, Sepulveda Boulevard/Pacific Coast Highway. State Route LA-1 enters Jurisdictional Group 5 north of Marine Avenue Intersection as Sepulveda Boulevard then it becomes Pacific Coast Highway when it passes Artesia Boulevard. LA-1, Pacific Coast Highway, exits Jurisdictional Group 6 near the Massena Avenue Intersection.

The following discussion provides an overview of the programmatic aspects of these storm water permits in order to provide a basis from which to consider potential enhancements to these existing programs or additional program elements that may be appropriate for this implementation plan. The intention of this discussion is not to provide detailed information regarding specific responsibilities among the Jurisdictional Group 5 and 6 agencies, but to describe in general the nature of existing programs. Specific existing programs for which additional enhancements are being considered in this implementation plan will be discussed in more detail in Section 4 as needed.

Programmatic solutions are generally those that do not require new infrastructure, but rather use techniques such as education and outreach, positive reinforcement of ocean-safe behavior and land use, and, if necessary, ordinances prohibiting undesirable activity. Programmatic solutions also include improvements in public agency activities and standard operating procedures and policies to minimize impacts on water quality. These programs are intended to prevent or reduce bacteria from being introduced into runoff at the source.

Existing and ongoing programs under the municipal stormwater permit are grouped into six programs: Public Information and Participation, Industrial/Commercial Facilities Control, Development Planning, Development Construction, Public Agency Activities, and Illicit Connection/Illicit Discharge Elimination. Not all of these programs are included in the programs under the Caltrans Permit since they are not all applicable, however where they are applicable, the programs are similar.

3.1.1.1 Public Information and Participation Program

The Jurisdictional Group 5 and 6 agencies coordinate their Public Information and Participation Programs through joint countywide quarterly public education meetings as well as watershed meetings. The agencies work together to implement countywide advertising campaigns, media relations and public service announcements; develop print materials and conduct events targeting specific activities, pollutants and populations; and to carry out numerous specific goals and commitments for educating the public regarding pollution prevention. These programs and materials target a variety of pollutants, including bacteria. Table 3-1 lists the various existing public information and participation programmatic solutions on which this implementation plan will build.

Table 3-1 **Existing Public Information and Participation Programs**
Implement public information and participation program
Mark all storm drain inlets with a "no dumping" message
Maintain the (888) CLEAN-LA hotline
Provide a list of reporting contacts to public through www.888CleanLA.com website
Countywide media campaign for Storm Water Pollution Prevention (SPP)
Strategy to educate ethnic communities about SPP
Enhance outreach for proper disposal of cigarette butts
Conduct educational activities within jurisdictional group and participate in county-wide events
Public Outreach Strategy meetings quarterly
Countywide media outreach to 35 million impressions per year
Distribute SPP information to K-12 schools
Coordinate and provide contact information for public education activities
Strategy to measure effectiveness of in-school programs
Behavioral change assessment strategy
Coordinate watershed-specific pollution prevention outreach programs
Corporate Outreach Program to target retail gas outlets and restaurant chains
“Don’t Trash California” Public Outreach Campaign (Caltrans)
Adopt-A-Highway program (Caltrans)

The Jurisdictional Group 5 and 6 agencies have also initiated and participated in a number of joint public education activities through watershed management committee work. The annual joint calendar project distributes a full color, one-page, poster-type calendar to residents featuring a storm water pollution prevention message using a compelling photograph to promote the message. For several years the agencies through a joint ad campaign have placed quarterly display ads in a variety of local newspapers--the most recent series of ads focused specifically on pet waste.

Caltrans has an independent public education program under its statewide Storm Water Permit. The program consists of a variety of written materials (e.g. “Pathogens in Storm Drain Discharges” brochure), monthly and quarterly bulletins, a website, workshops, storm drain stenciling, anti-litter signs, a statewide Adopt-a-Highway Program, along with many local municipal partnerships. Jurisdictional Groups 5 and 6 are in District 7 of Caltrans. In addition to the statewide campaign, District 7 implements “No Dumping” and “Litter Free” signs at selected locations on highways and freeways, and stenciled warnings at drain inlets to prohibit discharges at park-and-ride lots, rest areas, vista points, and other areas with pedestrian traffic.

3.1.1.2 Industrial/Commercial Facilities Control

Each agency maintains a list of industrial and commercial facilities within its jurisdiction known as Critical Sources Categories. This list includes industrial facilities listed under the federal regulations for industrial storm water permitting[2], as well as additional categories of commercial facilities such as restaurants, automotive service, and laundries. Each agency conducts storm water inspections at these facilities at least twice in each five-year period and where necessary requires corrective action to ensure that best management practices for preventing pollution of runoff are being implemented at these facilities.

3.1.1.3 Development Planning

As part of the planning review process for priority development and redevelopment projects, each agency implements a Development Planning Program that:

- Minimizes impacts from storm water and urban runoff on the biological integrity of natural drainage systems and water bodies
- Maximizes the percentage of pervious surfaces to allow percolation of storm water
- Minimizes the quantity of storm water directed to impervious surfaces and the storm drain system
- Minimizes pollution emanating from parking lots through the use of appropriate BMPs
- Properly designs and maintains structural BMPs in a manner that does not promote breeding of vectors, and
- Provides for appropriate permanent measures to reduce storm water pollutant loads from the developed site.

3.1.1.4 Development Construction

Each agency implements a Development Construction Program to minimize the adverse impacts of construction activity on urban runoff. Building and safety inspectors include inspections for implementation of construction best management practices as part of their routine inspections, with additional inspections for projects that involve grading during the wet season. Other key elements of this program include tracking of building and grading permits, requiring proof of coverage under the General Construction Activities Stormwater Permit prior to issuing a grading permit, and annual training of building & safety inspectors.

3.1.1.5 Public Agency Activities

Each agency implements a program to minimize storm water pollution impacts from its own activities. This program touches virtually every aspect of public works activities. Table 3-2 lists the major elements of these programs where applicable.

---
[2] 40 CFR 122.26

Table 3-2 **Existing Public Agency Activity Programs**
Implement a sewer overflow prevention and response program for agency owned/operated sewers
Implement Development Planning Program at Permittee-owned construction projects
Implement Development Construction Program at Permittee-owned construction projects
Develop, if needed, and implement SWPPPs for field facilities
Equip wash areas with a clarifier, pre-treatment device, or be connected to sewer
Store pesticides/herbicides/fertilizers indoors and apply only in accordance
Designate Catch Basins as priority A, B, or C
Ensure that Catch Basins (CBs) are cleaned appropriately
Place temporary screens on CBs prior to special events or cleanout immediately afterwards
Place and maintain trash receptacles at all transit stops with shelters
Inspect the legibility of CB stencils and re-label within 180 days if necessary
Visually monitor and clean all open channels annually for debris
Designate curbed streets as priority A, B, or C based on liter accumulation
Recover saw cutting waste and dispose it offsite
Train targeted employees in permit requirements for Public Agency Activities
Inspect and, if needed, clean Permittee owned parking lots twice per month, but at least once

3.1.1.6 Illicit Connection/Illicit Discharge Elimination

Illicit Connection/Illicit Discharge Elimination Programs implemented by the agencies seek to eliminate improper discharges to the storm drain system by screening the storm drain system for evidence of illicit discharges and connections. Whenever illicit connections or discharges are identified, the agencies require prompt mitigation and termination through code enforcement authority. Key elements of the IC/ID Elimination Programs are outlined in Table 3-3.

Table 3-3 **Existing Illicit Connections/Illicit Discharges Elimination**
Develop an Implementation Program which specifies the IC/ID program will be implemented
Create a database for permitted storm drain connections and map IC/ID
Perform IC/ID Trend Analysis
Train targeted employees in the permit requirements for IC/ID
Field screen the storm drain system for illicit connections in open channels
Field screen the storm drain system for illicit connections in underground storm drains in priority areas
Field screen the storm drain system for illicit connections in underground s/d larger than 36 inch diameter
Review all permitted connections to the storm drain system for compliance
Investigate illicit connections 21 days after discovery
Terminate illicit connections 180 days after confirmation
Respond to illicit discharges within one business day of discovery
Investigate illicit discharges as soon as practicable

3.1.1.7 Caltrans Statewide Stormwater Permit

Caltrans operates under a statewide NPDES permit that governs management of its storm water activities. As part of its storm water activities, Caltrans has developed an approved Storm Water Management Plan (SWMP) which addresses storm water pollution control related to planning, design, construction, maintenance and operation of all transportation facilities as an ongoing part of Caltrans normal business practices.

An important component of the SWMP is the Project Planning and Design Guide (PPDG), which provides specific guidance for incorporating BMPs into projects during the planning and design phases of a project. These include Treatment BMPs, Design Pollution Prevention BMPs, and critical Construction Site BMPs. Other components of the SWMP include research and development of BMPs, monitoring of storm water activity through regional work plans and annual reporting, and continual funding of storm water research and public education.

3.1.2 On-Site Structural Best Management Practices (BMPs)

The BMP Evaluation considered a comprehensive list of potentially applicable on-site structural BMPs that are detailed in the accompanying technical memorandum provided in Appendix A-1. A fact sheet was developed for each BMP that describes the BMP in terms of:

- Pollutant Removal Effectiveness
- Primary benefits

- Applications
- Design Considerations
- Construction Considerations
- Maintenance Considerations
- Implementation Challenges
- Cost

Subsequent analysis in later tasks, as detailed in the technical memoranda, consider hydrologic characteristics of Jurisdictional Groups 5 and 6, specific land use, beneficial reuse, and siting issues to narrow the list of applicable BMPs. Those on-site structural BMPs retained for potential piloting in the implementation plan are described briefly in the following subsections along with preliminary unit cost information. The full evaluation of these BMPs is found in Appendix A-1 from the technical memorandum.

3.1.2.1 Pervious Paving

Pervious paving describes a system comprising a load-bearing, durable surface together with an underlying layered structure that temporarily stores water prior to infiltration or drainage to a controlled outlet. The surface can itself be porous such that water infiltrates across the entire surface of the material (e.g., grass and gravel surfaces, porous concrete and porous asphalt), or can be built up of impermeable blocks separated by spaces and joints typically filled with sand or soil, through which water can drain. Typical pervious pavements include:

- Porous Asphalt
- Poured Porous Concrete
- Modular Concrete Block
- Structural Soil

Unit costs for pervious paving are on the order of $10 to $15 per square foot (s.f.). Based on these rates, a pilot project involving 6,000 square feet of surface to be replaced with pervious paving may cost approximately $60,000-90,000 for installation. Estimated costs for an average annual maintenance program of a porous pavement parking lot are approximately $3,500 per acre per year or $500 for a 6,000 s.f. parking area.

3.1.2.2 Bioretention Cells

Bioretention cells are landscaping features adapted to treat stormwater runoff on-site. They can be installed in parking lot islands of commercial areas or pocket parks in residential land areas. Surface runoff is directed into shallow, landscaped depressions. These depressions are designed to incorporate many of the pollutant removal mechanisms that operate in natural ecosystems. During storms, runoff may be allowed to pond above the mulch and soil in the system.

Unit costs for bioretention cells range from $3-4/s.f. for residential operations to $10-$40/s.f. for commercial applications, with the upper end reflecting the additional costs associated with retrofitting an existing developed site. A pilot project that retrofits six parking lots islands with bioretention, 200 square feet each, at a commercial facility may cost approximately $48,000.00 for design and installation. This is based on the estimate of $40 per square foot. The operation and maintenance costs for a bioretention facility will be comparable to that of typical maintenance required for landscaped areas.

3.1.2.3 Infiltration Trench/Basin

An infiltration trench is a rock-filled trench with no outlet that receives stormwater runoff. Stormwater runoff passes through some combination of pretreatment measures, such as a swale or sediment basin, before entering the trench. Runoff is then stored in the voids of the stones, slowly infiltrated through the bottom and into the soil matrix over a few days. The primary pollutant removal mechanism of this practice is filtration through the soil. Unit costs for infiltration trenches are approximately $4/cf.

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater. By using plastic storage media or pre-cast concrete boxes, infiltration basins can also be installed underground. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Unit costs for an above ground infiltration basin are approximately $1.30/cf and $7-$10/cf for a below ground infiltration basin.

3.1.2.4 Vegetated Buffer Strips

Vegetated buffer strips are constructed or natural strips of vegetation for removing sediment, organic matter and other pollutants from runoff. These strips are typically broad surfaces with a vegetated cover, preferably of native or xeric plant communities, that intercept and remove a variety of pollutants (sediment, organic matter and other pollutants). These vegetated areas can be sited to receive sheet flow directly from paved or other drainage areas, acting as a buffer for sensitive receiving waters. Native or xeric vegetation is preferable to turf for bacteria removal because the reduced irrigation and fertilizer requirements of native planting minimizes the culture of bacteria in the soil. Native or xeric plantings will also obviate concerns regarding irrigation over-spray and dry weather runoff from irrigation.

Costs in the literature for buffer strips are often based on use of turf as the buffer. A pilot project to install a 1-acre vegetated buffer strip may cost approximately $30,000 for turf, but costs could be higher for native or xeric landscaping due to the additional cost of plants and mulch to hold the soil and deter non-native weeds while the plants fill in. Initial cost for xeric or native planting will depend on the size and density of initial planting and the type of mulch applied. Conversely, long term maintenance costs of native plantings will be far less than a turf buffer because there is no mowing or fertilizing required and very little irrigation once the plants are established (after 2 years). The only long-term maintenance for native plantings is occasional dry weather irrigation and periodic pruning or replacement of plants for aesthetics.

3.1.2.5 Biofiltration Swales

Biofiltration swales are constructed or natural vegetated conveyance channels. Runoff flows through what is effectively a pervious channel for removing sediment, organic matter, and other pollutants from the runoff. Runoff may be captured in drain inlets and routed to the swales or may flow into the swales through sheet flow. As the runoff flows through the vegetated swale, the vegetation and underlying soil act to remove sediment and other pollutants from runoff by one or more of the following mechanisms: filtration, infiltration, absorption, adsorption, decomposition, and volatilization. Installation costs for biofiltration swales will be somewhat higher than for buffer strips due to additional costs associated with design and installation of the drainage-way. Many examples of biofiltration swales in the literature employ turf swales that may or may not be mowed, however for bacteria removal, turf is not a desirable choice due to the need for irrigation and fertilizer. If native or xeric plants are used for a swale, there may be a need for stonework or riprap as well as additional physical geotextile materials along the swale to create a natural drainage course and prevent erosion while the plants are becoming established.

3.1.2.6 Cisterns

A cistern is a tank for storing rainwater, which has been collected from a roof or other catchment area. Cisterns can be used for a single residential home, for a housing development, and for commercial and public buildings. The captured water can be use for irrigation of landscaped or natural pervious areas. Normally a sump pump is included in the installation for irrigation usage. Typical design, permitting and installation costs for a cistern are estimated at $2 - $2.50 per gallon of cistern volume.

3.1.2.7 Rain Barrels

Rain barrels are small gravity flow aboveground devices for capturing runoff from roof drains applicable for use at residential single-family homes. A typical rain barrel would cost on the order of $200-300.

3.1.3 Regional BMPs

The BMP Evaluation considered a list of potentially applicable regional BMPs; complete summaries of these are provided in Appendix A-1. Subsequent analyses in later tasks that considered the hydrologic characteristics of Jurisdictional Groups 5 and 6, as well as specific land use, beneficial reuse, and siting issues, narrowed the list of regional BMPs. The regional BMPs most applicable for piloting in Jurisdictional Groups 5 and 6 are described briefly below.

3.1.3.1 Constructed Wetlands

Constructed wetlands typically manage runoff from a number of parcels or a small residential or commercial development. Constructed wetlands use a biological treatment technology designed to mimic processes found in natural wetland ecosystems. These wetland systems utilize wetland plants, soil and the associated microorganisms to remove contaminants found in runoff. The root mass of the wetlands plants provides treatment by filtration. The roots also offer attachment surfaces for microbes that facilitate the process of breaking down pollutants. These systems also provide opportunities to create or restore wetland habitat for wildlife and environmental improvement.

Reported costs for design and installation of constructed wetlands have been in the range of $200,000 to $500,000 per acre. Literature indicates that annual maintenance and operational costs typically range between 3 to 5 percent of construction costs, but this assumes that there will be regular harvesting of vegetation that is typically done for nutrient and control of pollutants that accumulate in the plant material, itself. If the wetland is intended primarily for bacteria and sediment removal, harvesting of plants may not be necessary and then maintenance costs will be substantially less.

3.1.3.2 Wet Ponds

Wet ponds (also known as retention ponds or wet extended detention ponds) are constructed basins that maintain a permanent pool of water throughout the year (or at least throughout the wet season). They are similar to constructed wetlands in that they manage runoff from a number of parcels or a small residential or commercial development. Wet ponds treat runoff through sedimentation and biological uptake. Wetland-type planting may be used in shallow edges of these ponds to create a combined wet pond/wetland system. Costs for wet pond installation and maintenance are on the same order as for constructed wetlands.

3.1.3.3 Leach Fields

A leach field is a technology for infiltrating runoff that introduces the runoff into sub-grade gravel beds via a perforated pipe or box culvert. The entire facility is underground. Equipment designed for septic systems may be utilized for these applications. In Jurisdictional Groups 5 and 6, leach fields are best suited for placement near storm drain outlets and may be considered a diversion mechanism for dry weather flows. The use of leach fields may be precluded at locations where depth to water table is less than five feet below the leach field. More detailed discussion of leach field applications is provided in the siting technical memorandum (Appendix D).

3.2 Hydrologic Analysis

The hydrologic analysis consisted of several essential and interrelated elements:

- Grouping of sub-watersheds into drainage areas,
- Land use analysis
- Analysis of historic water quality data associated with drainage areas
- Wet and dry weather runoff estimation

The hydrologic analysis conducted in this study is a conceptual level estimate of runoff values. More detailed hydrologic studies should be conducted for the design of structural BMPs. Following is a summary of the methodology and findings of this analysis. The entire technical memorandum describing the hydrologic analysis is provided in Appendix B.

3.2.1 Grouping of Sub-Watersheds into Drainage Areas

Over 70 sub-watershed drainage areas were identified within Jurisdictional Groups 5 and 6. Using a watershed and beach outlet GIS map developed by the four major agencies (Manhattan Beach, Hermosa Beach, Redondo Beach and Torrance), the sub-watersheds were grouped together to form ten larger drainage areas shown in Figure 3-1.

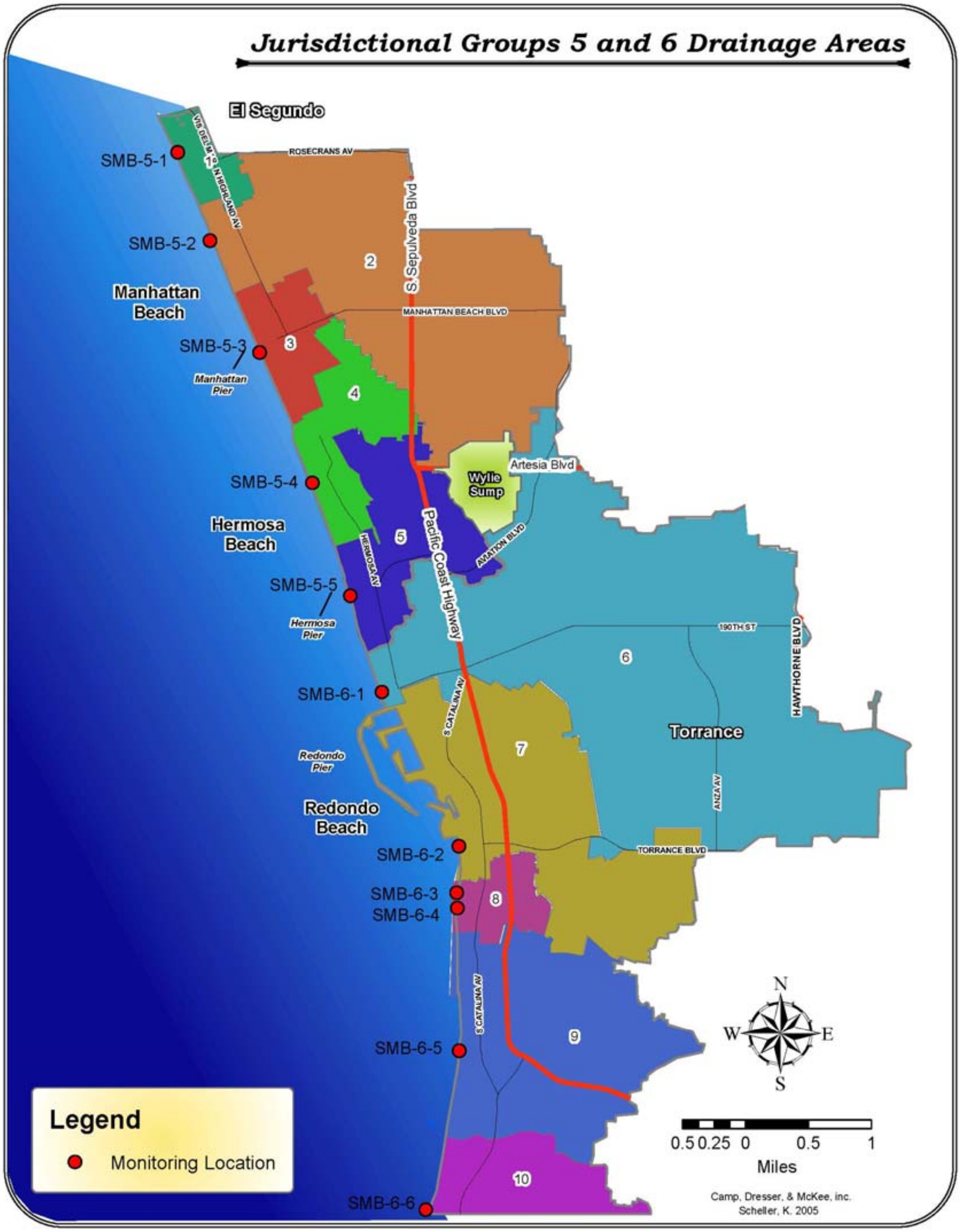


Figure 3-1
Drainage Areas Map

Each of the ten drainage areas is associated with one or two monitoring site(s) under the Coordinated Shoreline Monitoring Plan. The drainage areas are named according to the monitoring site(s) they represent in Table 3-4.

Table 3-4
Jurisdictional Groups 5 & 6 Drainage Areas

Map ID	Monitoring Site ID	Historical ID	Location Description
1	SMB-5-1	S13	40th St., Manhattan Beach
2	SMB-5-2	DHS 113	27/28th St. extended, Manhattan Beach
3	SMB-5-3	S14	50 yards south of Manhattan Beach Pier
4	SMB-5-4	DHS 114	26th St. extended, Hermosa Beach
5	SMB-5-5	S15	50 yards south of Hermosa Beach Pier
6	SMB-6-1	DHS 115	Herondo St. extended (at Herondo drain)
7	SMB-6-2	S16	50 yards south of Redondo Beach Pier
8	SMB-6-3 SMB-6-4	 DHS 116	Project of Sapphire St. drain, Topaz St. extended (north of groin/jetty)
9	SMB-6-5	S17	Avenue I, Redondo Beach
10	SMB-6-6	S18	Malaga Cove

3.2.2 Land Use Analysis

Land use was divided into six general categories: commercial, manufacturing/industrial, mixed use, open space, public facility and residential. Parcel data from each agency was incorporated into the drainage area GIS map to create a land use map for Jurisdictional Groups 5 and 6. This enabled an analysis of each drainage area to determine total acreage and individual land use category acreage. Analysis of this data revealed that approximately 75% of the total area within Jurisdictional Groups 5 and 6 is residential land use. The sub-watersheds and land use map is shown in Figure 3-2.

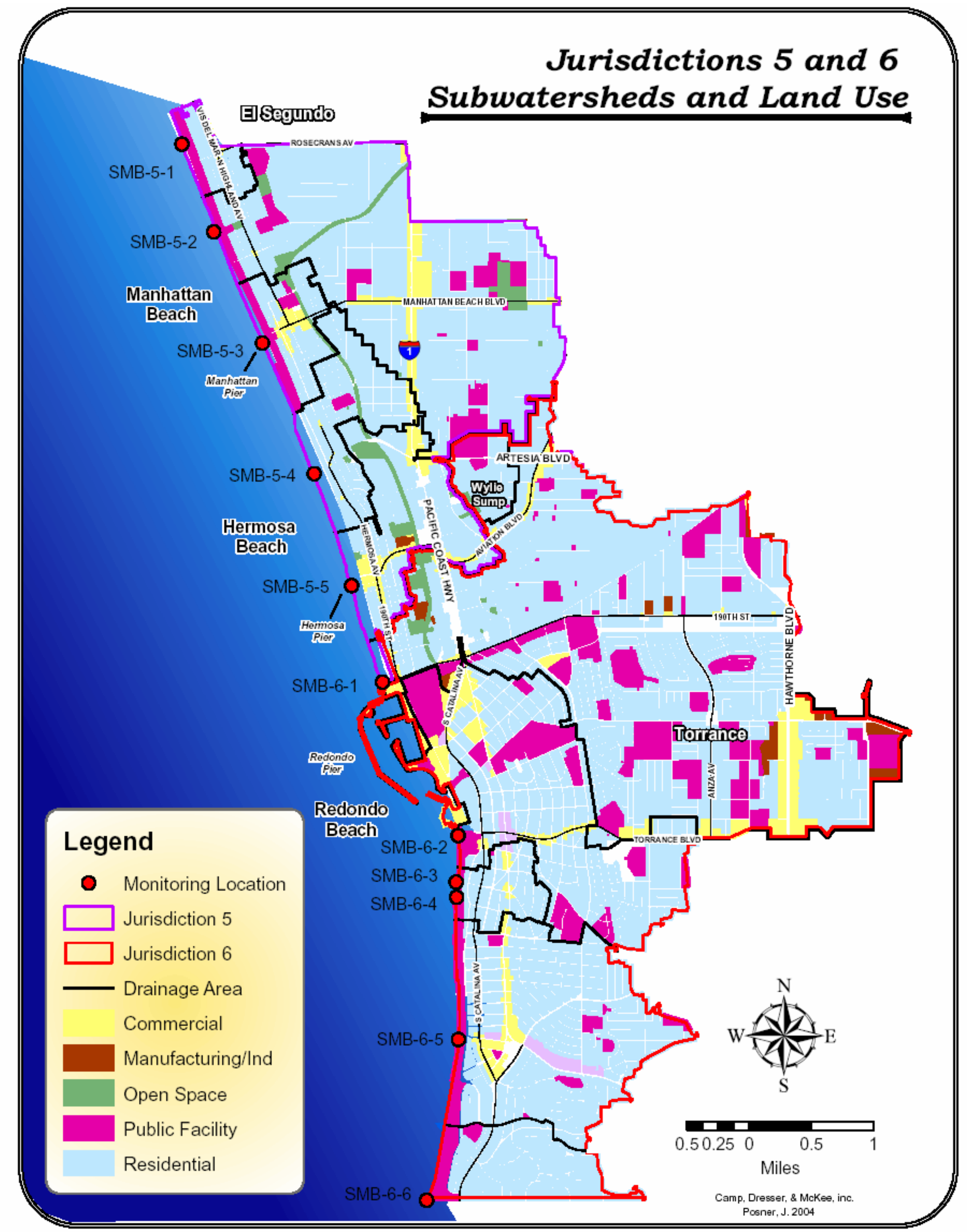


Figure 3-2
Sub-watershed and Land Use Map

3.2.3 Analysis of Historic Water Quality Data Associated with Drainage Areas

Analysis of historical data at each monitoring site was conducted to identify drainage areas and/or hydrologic conditions that should be prioritized when developing the implementation plan.

Historical shoreline monitoring data was available for all but one of the monitoring sites in Jurisdictional Groups 5 and 6. Two different agencies have collected this data for different sites so that some of the sites have been monitored on a daily basis while others have been monitored on a weekly basis. For each site, four to five storm-years of historical data were compared with the TMDL targets for the four single-sample bacterial indicators (total coliform, fecal coliform, enterococcus, and fecal-to-total coliform ratio) and for the monthly geometric mean values of the first three indicators. The frequency of target exceedances was compared to exceedance allocations for each site and these results were tabulated by monitoring site and by storm year and are provided in the technical memorandum in Appendix B.

Based on historical performance, the SMB 6-1 (Herondo) monitoring site was the only clearly problematic site from a wet weather compliance perspective. SMB 6-1 is also associated with the largest drainage area, projected to generate nearly 40 percent of the total runoff from Jurisdictional Groups 5 and 6 drainage areas, combined. This monitoring site has also historically exhibited chronic dry weather compliance exceedances. Accordingly, the SMB 6-1 drainage area is identified as a high priority drainage area for both wet- and dry-weather.

In general, dry weather exceedances have been more problematic in Jurisdictional Groups 5 and 6 than wet weather exceedances. Dry weather exceedances have been historically problematic at SMB 6-1 and 6-2, and to a lesser degree at SMB 5-5 and 6-5. Almost all sites have occasionally surpassed the summer dry weather allocation of zero exceedances. Two sites, SMB 5-1 and SMB 6-6, consistently exhibited the lowest frequency of exceedances year-round, wet or dry.

Also of note were historic problems with geometric mean exceedances for enterococcus at virtually all sites except SMB 5-1. This was not the case for fecal coliform or total coliform geomean historical data.

3.2.4 Wet and Dry Weather Runoff Estimation

Wet weather runoff estimates for each drainage area were calculated using runoff coefficients derived from land use distribution. In a separate analysis[3] conducted for Jurisdictional Groups 2 and 3, fifty years of precipitation data recorded at Los Angeles International Airport (LAX) was sorted by daily precipitation volume. The daily volume of the 18th largest rain day for each year of the 50-year period was tabulated

[3] City of Los Angeles 2003. City of Los Angeles Integrated Resources Plan Facilities Plan Interim Deliverable. Volume 3 Runoff Management, August 2003. Prepared by CH:CDM and City of Los Angeles Department of Public Works, Bureau of Sanitation

and analyzed statistically to identify the 90th percentile 18th largest daily volume over the 50 years of data—this was associated with a 0.45 inch/day rainfall. Since the TMDL allows for up to 17 wet-weather exceedance days per year, the implication is that managing all rainfall events of volume equal to the 18th largest will hold exceedances to no more than 17 days in nine out of ten years. Estimated wet weather runoff volumes in million gallons per day were calculated for a 0.45-inch rainfall event using the runoff coefficients derived from land use distribution in Jurisdictional Groups 5 and 6 to show the estimated runoff volume for each drainage area. Using this approach the calculations demonstrated that the estimated wet weather runoff volume for a 0.45-inch rain event over the entire Jurisdictional Group 5 and 6 areas is approximately 47 million gallons. The SMB-6-1 (Herondo) drainage area was estimated to have the greatest amount of runoff at roughly 18 million gallons per day, nearly 40 percent of the total runoff of all the Jurisdictional Group 5 and 6 drainage areas, combined.

Volumetric dry weather runoff rates were estimated for each of the drainage areas using a dry weather runoff rate of 230 gallons per day per acre derived for Jurisdictional Groups 2 and 3 which had similar land use distributions as Jurisdictional Groups 5 and 6. Dry weather runoff estimates expressed in million gallons per day were tabulated for each of the drainage areas as the product of the runoff rate and the drainage area.

Details of these calculations are provided in Appendix B.

3.2.5 Results of Hydrologic Analysis

GIS analysis of sub-watersheds grouped into drainage areas indicates a positive correlation between total acreage within a drainage area and frequency of exceedances, i.e., the larger the drainage area the higher the frequency of historical exceedances. The most problematic drainage area within Jurisdictional Groups 5 and 6 is SMB-6-1 (Herondo) and it is also the largest drainage area by a factor of two when compared with the next largest drainage area. Furthermore, the SMB-6-1 drainage area is almost 30 times larger than the smallest drainage area. The best performing drainage area with respect to exceedances is also the smallest. The only site for which this correlation is not yet clear is SMB-5-2 which is the second largest drainage area, but it is a relatively new monitoring site and there was insufficient historical data to evaluate this correlation. While drainage area is not the only factor contributing to frequency of exceedances, it does appear to be the strongest factor based on historical evidence.

The macro-scale land use analysis did not reveal evidence for land use as a primary cause of exceedances in problematic drainage areas. Land use is fairly evenly distributed throughout Jurisdictional Groups 5 and 6, and areas with higher frequency of exceedances appear, at least at the macro scale, to have similar land uses as drainage areas with lower exceedances. There appeared to be no clear correlation between land use distribution and frequency of exceedances. However, land use distribution may be a secondary influence on exceedances—the second-best performing drainage area with respect to exceedances was fifth largest out of ten, but it was the only drainage area with no commercial development.

3.3 Beneficial Reuse Evaluation

The beneficial reuse evaluation explored opportunities to beneficially reuse dry and wet weather runoff within Jurisdictional Groups 5 and 6. On-site/local as well as regional reuse opportunities were evaluated considering land use information gathered as part of the hydrologic analysis. A complete discussion of this evaluation is provided in the technical memorandum for this task in Appendix C. A summary of the rationale for narrowing the list of beneficial reuse options within Jurisdictional Groups 5 and 6 is provided below.

3.3.1 Infiltration

Infiltration is among the simplest and least expensive approaches to beneficial reuse of runoff. Infiltration projects do not store runoff, so no treatment is required for bacteria/pathogens since water is infiltrated, applied with subsurface irrigation, or otherwise locally managed. Infiltration requires that soils be sufficiently permeable to allow percolation into the unconfined water table perched above the confining layers that protect the drinking water aquifer. The porosity of the soils must be sufficient to allow percolation within an acceptable period of time and without excessive mounding or ponding. Review of soil maps for the Jurisdictional Groups 5 and 6 areas indicates that soils with relatively high infiltration rates are located along the coast extending approximately 2 miles inland. Site-specific soils data will be needed to assess the feasibility of infiltration for specific projects.

Additional factors to be considered prior to selecting an infiltration BMP are depth to the water table (unconfined groundwater), land use and space availability. A shallow water table reduces the capacity for infiltration without surface ponding. The availability of sufficient open space with appropriate land use also affects the selection of site-specific BMPs. A number of infiltration BMPs were identified in the beneficial use evaluation (Appendix C) and siting evaluation (Appendix D) as potentially suitable for land uses within Jurisdictional Groups 5 and 6, including:

- Permeable paving
- Vegetated buffer strips
- Infiltration Trenches/Basins
- Bioretention cells
- Wet Ponds
- Constructed wetlands
- Leach Fields

3.3.2 On-Site Beneficial Reuse

Rain barrels and cisterns are water conservation devices that can be used to reduce runoff volume and peak flow rates for small storm events in areas where wet-weather exceedances are problematic. The limited storage capacity of rain barrels makes their effectiveness minimal for large or extended storm events. Cisterns are larger than rain barrels and the roof runoff stored in these devices can provide a source of natural 'soft water' for gardens and landscaping. Because residential irrigation accounts for up to 40 percent of domestic water consumption, these water conservation devices can reduce demand on the municipal water system. Cisterns are available in a range of sizes applicable for public or commercial buildings and for multi-family developments and single-family homes.

3.3.3 Groundwater Recharge

Jurisdictional Groups 5 and 6 are located in the West Coast groundwater basin. The West Coast Basin drinking water aquifers are generally confined or semi-confined alluvial aquifers and the presence of these confining or semi-confining geological formations above the aquifers limits the applicability of beneficial recharge of the drinking water aquifer via infiltration projects. Injection wells with accompanying pretreatment systems are required in order to beneficially recharge the drinking water aquifers within the Jurisdictional Groups 5 and 6 areas.

The West Coast Basin Barrier Project is an existing project of the Los Angeles County Department of Public Works created to halt seawater intrusion into the groundwater basin. The West Coast Basin Barrier Project currently injects 17.5 million gallons per day of water—50% is imported water, and 50% is reclaimed water). The reclaimed water is advanced-treatment effluent from the West Basin Water Recycling Plant that is owned and operated by the West Basin Municipal Water District in the City of El Segundo. This plant provides advanced treatment of secondary effluent from the Hyperion Wastewater Treatment Plant, producing 7.5 million gallons per day of recycled water that is blended with imported water for injection. An expansion of the West Basin Water Recycling Plant is planned to provide additional treatment of reclaimed water to reduce dependence on imported water, ultimately providing 100% reclaimed water to the barrier project (17.5 million gallons per day) in the near future. The new treatment processes at the plant will include micro-filtration, reverse osmosis, and combined disinfection using hydrogen peroxide addition and ultraviolet (UV) irradiation.

It may be feasible to beneficially reuse storm water runoff by blending with the Hyperion effluent to improve the characteristics of the injected water. Storm water generally has low concentrations of total dissolved solids (TDS), whereas wastewater treatment plant effluent typically has high levels of dissolved solids. Blending of storm water runoff with the effluent can be used to reduce the overall TDS of the reclaimed water. The feasibility of such a project will depend on a wide variety of issues, including: infrastructure requirements and cost, water quality issues and governing regulations, as well as contractual agreements among the various parties.

3.3.4 Dry Weather Diversions

Dry weather diversion systems divert dry weather urban runoff from the storm drain system to a sanitary sewer main for treatment at the wastewater treatment plant. During wet weather the diversions are shut off or bypassed to avoid overloading the sewer main and causing a sewer overflow.

The County Sanitation Districts of Los Angeles County (Districts) conducted a dry weather characterization study during the period from May 2002 to October 2002. The study assessed 125 storm drains and provided a baseline for setting priorities for dry weather urban runoff diversions in the coastal area from Manhattan Beach to Long Beach.

In Jurisdictional Groups 5 and 6 there are seven storm drains with dry weather diversion facilities or plans for such installations. These dry weather diversions are located at storm drains associated with the following monitoring sites/drainage areas:

- SMB-5-2 (28th Street, Manhattan Beach) planned diversion
- SMB-5-3 (Manhattan Beach Pier) diverted in 1990
- SMB-6-1 (Herondo Drain) diversion under construction
- SMB-6-2 (Redondo Beach Pier) two drains diverted in February 2005
- SMB-6-3 (Sapphire St., Redondo Beach) planned diversion
- SMB-6-5 (Avenue I, Redondo Beach) diversion under construction

The Districts' Dry Weather Characterization Study did not recommend diversions for any other locations within Jurisdictional Groups 5 and 6 at this time. Accordingly, this implementation plan will defer consideration of additional diversions until the effectiveness of the current and planned diversion can be evaluated. A more detailed discussion of the Dry Weather Characterization Study is provided in the siting technical memorandum (Appendix D).

3.4 Facilities Siting

The fifth task evaluated potential sites within Jurisdictional Groups 5 and 6 for implementing onsite and small regional BMPs, beneficial reuse, and regional options for controlling runoff. A complete discussion of this analysis is provided in the technical memorandum for this task in Appendix D. Potential sites for the narrowed list of structural runoff management measures are shown in Table 3-5.

Table 3-5

Potential sites for Structural Runoff Management Measures

Localized BMPs	**Potential Sites**
Porous Pavement	Municipal facilities, public walkways Single-family and multi-family residences Parks
Bioretention	Parking lot islands Street medians Residential communities
Wet pond	Medium, large parks (> 5 acres)
Constructed wetland	Parks
Vegetated buffer strip	Parks Beachfront
Beneficial Reuse	**Potential Sites**
Cistern	Parks Community centers Schools
Rain barrel	Residences
Regional Options	**Potential Sites**
Diversion Facilities	Current diversion facilities are located, or will soon be located at: SMB-5-2, SMB-5-3, SMB-6-1, SMB-6-2, SMB-6-3 and SMB-6-5
Leach fields	Near storm drain outlets

Numerous public parks, government facilities, schools, and residences were identified as possible sites for implementation. Site-specific studies should be conducted during preliminary design of these BMPs. Infiltration BMPs should be designed not only to facilitate their primary function of infiltrating wet-weather runoff, but also to minimize the generation of dry weather runoff through appropriate design and selection of plant material. In addition, pilot tests are recommended before full-scale implementation throughout Jurisdictional Groups 5 and 6 to ensure that the technology performs as anticipated for controlling bacteria.

Section 4
Implementation Plan for Jurisdictional Groups 5 and 6

The Implementation Plan utilizes an adaptive, iterative management approach which will address multiple pollutants, identify beneficial reuse opportunities, and integrate multiple agencies in its overall solution. This Implementation Plan is designed to provide the responsible agencies (jurisdictions) of Jurisdictional Groups 5 and 6 with a systematic strategy for progressively improving compliance with Total Maximum Daily Loads (TMDLs), integrating both Wet- and Dry-weather Santa Monica Bay Beaches Bacteria (SMBBB) TMDLs and other water quality goals. The strategy for reducing exceedances relies on a combination of measures designed to reduce bacteria and other pollutant loads from sources by reducing the amount of dry-weather and wet-weather runoff while at the same time pursuing opportunities for beneficial reuse of runoff. This plan calls for three categories of management approaches: Programmatic Solutions, Structural BMPs, and Source Identification & Control. Each of these management approaches will be implemented in three phases, with each phase incorporating information gained from the prior phases across the three categories. This feedback across phases and management approaches provides the iterative adaptive framework that is critical to effective implementation of bacteria TMDLs for which there is great uncertainty regarding significant sources and effective means of control.

Phase I

Programmatic Solutions: Enhance Existing Programmatic Solutions
Structural BMPs: Pilot Site-Specific Structural BMPs
Source Identification & Control: Identify Significant Sources and Prioritize Source Controls

Phase II

Programmatic Solutions: Assess and Expand Effective Solutions and Develop Additional Programmatic Solutions
Structural BMPs: Evaluate Performance of Site-Specific Structural BMPs
Source Identification & Control: Implement Source Controls in High Priority Areas

Phase III

Programmatic Solutions: Implement Additional Programmatic Solutions
Structural BMPs: Implement Applicable BMPs/Research New BMPs
Source Identification & Control: Evaluate High Priority Source Controls and Institutionalize Effective Source Controls

Programmatic solutions are the core of an effective implementation plan because it is through programmatic solutions that long-term solutions of many types will be institutionalized. Programmatic solutions will be developed jointly by the agencies and implemented within Jurisdictional Groups 5 and 6. These measures will focus initially on: increasing public understanding of the connection between residential/commercial land use activities and beach closures, encouraging good housekeeping practices, and improving compliance with existing ordinances among targeted populations. The development of additional programmatic solutions in later phases will be built on progressive feedback from the other two management approaches. Effective public education and outreach should also improve public acceptance and understanding of structural BMPs and source controls, creating a synergy among the three implementation approaches.

For Jurisdictional Groups 5 and 6 which are largely built-out communities, the development planning program under the municipal storm water permit will achieve gradual reductions in adverse land-use impacts on runoff from private property as redevelopment occurs. This implementation plan considers what additional benefits can be achieved by accelerating such action on public property by the responsible agencies. Piloting of structural BMPs will be initiated in specific drainage areas and evaluated for effectiveness. Structural BMPs that are identified as being most cost effective during the initial phases will be expanded and implemented in later phases at relevant and applicable sites across Jurisdictional Groups 5 and 6.

Identification of significant sources and development of controls for these identified significant sources is the third management approach in this adaptive, iterative plan. The objective of source identification in high priority drainage areas is to seek to identify conditions or factors that produce significantly higher indicator bacteria concentrations at some locations in comparison with other locations. This information will provide critical feedback so that fiscal and technical resources can be focused on controlling sources that have the most significant impact on shoreline water quality. Source control techniques will be developed and piloted as part of this management approach, and those that are found to be effective will be incorporated into long-term programmatic solutions.

At the completion of each phase of the three management approaches, comparative assessments will be made of the performance and cost for these approaches. Based on these assessments as well as new information that becomes available from local and regional studies and research, the Jurisdictional Group 5 and 6 agencies will adapt and adjust the course of implementation. Upon completion of Phase 3 of each approach, the agencies will revisit earlier phases as appropriate in keeping with the iterative nature of the plan.

This implementation strategy is summarized in Table 4-1 and described in detail in the body of this section. The plan describes activities that will be accomplished by the Jurisdictional Group 5 and 6 agencies collectively, however not every agency will carry out every activity because not all activities are applicable to all agencies. More detail is provided for early phases while later phases are described more generally. The details of later phases will be developed at key decision points and be based on information gained in prior phases.

Table 4-1
Implementation Plan: Three-Pronged, Phased Strategy

	Programmatic Solutions	Structural BMPs	Source Identification & Control
PHASE 1	Enhance existing programmatic solutions targeting: ▪ Homeowners/residents ▪ Schools ▪ Business ▪ Public agency activities	Site-specific structural BMPs combined into alternatives for pilot study areas ▪ Select drainage areas for study ▪ Siting, data collection and BMP selection process ▪ Conceptual design and selection of alternatives ▪ Design, installation and monitoring of site-specific BMPs.	Identify significant sources in high-priority drainage areas ▪ Confirm sanitary sewage infrastructure is not significant source ▪ Enhance comparative land use mapping to focus source identification ▪ Field reconnaissance of high priority drainage areas Prioritize source controls
PHASE 2	Assess/Expand/Develop programmatic solutions	Evaluate performance of individual site-specific BMPs and alternatives as a whole	Implement source controls in high priority areas
PHASE 3	Implement additional programmatic solutions	Implement applicable BMPs, research new BMPs	Evaluate high priority source controls and Institutionalize Effective Controls

4.1 Phase I- Enhance Existing Programmatic Solutions, Pilot Site-Specific Structural BMPs, Identify Significant Sources of Bacteria And Prioritize Source Controls

Structural BMPs and source controls will be initiated in separate areas in order to facilitate identification of cost effective solutions for achieving compliance with the SMBBB TMDLs. A combination of site-specific infiltration/treatment and beneficial reuse structural BMPs will be tested in one or two drainage areas to evaluate the effectiveness of these types of BMPs in controlling bacteria exceedances. On a parallel track, source identification and control will be initiated in one or two high priority drainage areas. Monitoring plans will be developed to allow for comparative assessment of the effectiveness of these management approaches in achieving long-term improvements in shoreline compliance with TMDLs.

Small drainage areas or sub-drainage areas will be more useful than large drainage areas for testing site-specific BMPs because relatively fewer pilot projects should be required in order to demonstrate measurable reductions in wet weather runoff or a significant increase in permeability of the drainage area overall. Availability of public land is an additional factor to consider. Since it is recommended that BMPs be implemented in parks, schools, and other public facilities, selected areas should have adequate public land available. Soils information obtained from site-specific soil studies will also be critical in determining where to implement infiltration BMPs.

Source identification done during dry weather is simpler, less costly and can proceed more quickly because chronic discharges are more easily identified and field activities are not confined exclusively to wet weather periods. Areas for source identification should have a wide range of land use so that a variety of potentially significant bacteria sources are represented. Larger drainage areas typically have a wider variety of land uses. Initial source identification efforts will be conducted during dry weather in high priority areas. Following identification, significant sources will be controlled during both wet- and dry-weather. SMB 6-1 (Herondo) is an example of an appropriate high priority drainage area for initiating source identification and control. This drainage area exhibits frequent wet and dry weather exceedances. Selection of a second drainage area for initiating source identification and control will also be useful. SMB-5-2, SMB 6-2 and 6-5 could also be effective choices for source identification activities as they are the next largest drainage areas after 6-1 and each have a mix of commercial, residential and public facility/open space.

In summary, during Phase I, programmatic enhancements will be implemented throughout Jurisdictional Groups 5 and 6. Structural BMPs will be piloted in two small drainage areas with highly infiltrating soils and adequate public space. Source identification will be conducted in two high priority drainage areas.

4.1.1 Phase I - Enhance Existing Programmatic Solutions

Programmatic solutions are generally those that do not require new infrastructure, but rather use techniques such as: education and outreach, positive reinforcement of good housekeeping behavior and land use, enforcement of existing codes and ordinances, and, if necessary, development of new policies and procedures.

Agencies in Jurisdictional Groups 5 and 6 have already adopted many programmatic solutions as described in Section 3.1.1, so Phase 1 will focus on enhancements to existing programs that specifically target activities of concern with respect to indicator bacteria control. In order to expedite the enhancement of programmatic solutions under Phase I, recommended actions rely as much as possible on existing materials, procedures and programs but increase the focus on known sources of bacteria. The following subsections describe how existing programmatic solutions will be enhanced to increase their effectiveness in targeting pollution prevention with respect to known sources of bacteria.

4.1.1.1 Homeowners and Residents

Current public outreach/education of homeowners and residents will be enhanced by the following elements.

- ***Distribute County Tip Cards*:** Agencies will distribute County-produced tip cards regarding pet waste to appropriate businesses within Jurisdictional Groups 5 and 6:

pet stores, veterinarians, pet grooming facilities, mobile pet groomers, and pet boarding facilities.

- ***Watershed Direct Mail Piece:*** The Ballona Watershed Management Committee with assistance from the County of Los Angeles is preparing a direct mail piece for distribution to homeowners. This piece includes best management practices that address bacteria sources associated with residential development. Jurisdictional Groups 5 and 6 agencies assigned to the Ballona Watershed Management Committee will distribute this piece via direct mail or as an insert in newsletters, but also will make the piece available at public counters and home improvement centers.

- ***Landscape BMP Webpage:*** Existing literature is available from several agencies regarding the use of xeric and native plants for water conservation. Other existing literature discusses how to reduce the use of fertilizers, pesticides, herbicides and irrigation runoff. This information will be integrated and placed on a web page hosted on one of the responsible agency's websites or on the County website and each agency will place a link to the web page on their web site.

- ***Landscape Awards:*** The agencies will institute a quarterly landscape award based on jointly developed criteria. Each responsible agency will identify a qualifying residence, multi-family complex, and/or office building that meet the award criteria. An award sign could be displayed on the winner's demonstration landscape as a symbol of recognition. The sign would include a link to the landscape BMP web page. The award could also include a gift certificate donated by a home improvement or garden center and coordinated through the County. Awards could be issued on a quarterly basis. For additional publicity, announcement of awards and issuance of gift certificates could take place at regular City Council meetings. For office complexes, awards could also be announced at the local Chamber of Commerce meeting. In the event a qualifying recipient could not be identified in a particular month, the sign could be posted at the responsible agency's demonstration landscape.

- ***Speakers:*** Agencies will outreach to garden clubs, homeowners associations and other community groups and organizations by offering speakers to discuss landscaping, good housekeeping and pet care BMPs.

4.1.1.2 Schools

Public schools are not within the jurisdiction of municipalities, thus the Jurisdictional Group 5 and 6 agencies do not have code enforcement authority over public school sites. Consequently, storm water pollution prevention activities by Jurisdictional Group 5 and 6 agencies are limited to outreach and education activities. A list of schools located within Jurisdictional Groups 5 and 6 draining to the Santa Monica Bay is provided in Table 4-2. Once public school districts are identified by the Regional Board as being subject to small MS4 Permit requirements, presumably local public school sites within Jurisdictional Groups 5 and 6 will become responsible agencies under the TMDLs.

Table 4-2
Schools Located Within Jurisdictional Groups 5 and 6

	Elementary Schools	Middle Schools	High Schools
Manhattan Beach	▪ Grand View ▪ Pacific ▪ Robinson ▪ Meadows ▪ Pennekamp	▪ Manhattan Beach	▪ Mira Costa
Hermosa Beach	▪ Hermosa Valley ▪ Hermosa View		
Redondo Beach	▪ Alta Vista ▪ Beryl Heights ▪ Birney Jefferson ▪ Tulita ▪ Washington	▪ Adams ▪ Parras	▪ Redondo Union
Torrance	▪ Towers ▪ Victor ▪ Anza	▪ Lynn	▪ West

Encourage Environmental Defenders Program for Elementary Schools: The agencies will encourage local schools to host the County-wide Environmental Defenders education assemblies in order to increase the level of participation among schools within Jurisdictional Groups 5 and 6. This will be done by obtaining participation lists from the County of Los Angeles and mailing annual letters from agency staff to both public and private elementary school principals thanking them for participating or encouraging them to participate if they have not done so.

Distribute Storm Water Videos: USEPA/Weather Channel's *After the Storm* educational videos and other videos are available at no charge from USEPA. These videos will be distributed to public and private middle schools and high schools in Jurisdictional Groups 5 and 6, and directed to interested environmental science teachers.

Graphic Arts Contest: Jurisdictional Groups 5 and 6 will sponsor a contest for high school art students to compete in creating graphic art to be used in public outreach materials throughout Jurisdictional Groups 5 and 6. The agencies with advice from the County will select the winning artwork for use in programmatic initiatives. This will serve the dual purpose of creating public awareness among high school students, staff and administration, as well as creating art for educational programs.

4.1.1.3 Business

Restaurant BMP Workshops: The County of Los Angeles has developed an effective training workshop targeting corporate (chain) restaurant managers. The workshop encourages active participation and includes a PowerPoint® presentation, discussions, skits that demonstrated problematic versus best management practices, and demonstrations with volunteers from the audience. Each participant receives a folder with relevant materials, as well as promotional items to take away. At the conclusion feedback is obtained via a short survey. These workshops will be held in the Jurisdictional Group 5 and 6 areas on an annual basis, with minor adjustments to increase emphasis on bacteria sources. Repeating the workshops on a regular basis will allow the agencies to provide updated information to restaurant operators and outreach to new restaurant operators as they begin business within the area. The challenge will be to obtain participation from restaurant owners and operators. A number of approaches can be used to publicize and encourage participation in these workshops including: direct mail from agencies, announcement at local Chamber of Commerce meetings and newsletters, and requiring participation as a condition of the restaurant certification. It will be important to offer the workshops at a convenient time and location for restaurant managers. Onsite workshops will be considered to provide incentive for participation.

Develop Restaurant Certification program: Jurisdictional Group 5 and 6 agencies will work cooperatively to share ideas in developing a model restaurant certification program, building on existing County materials. Restaurants that successfully complete the certification program would be eligible to post the certificate and possibly place a decal in the window. Criteria for the certification should include: participation in the Restaurant BMP workshop, prompt correction of identified deficiencies arising from restaurant storm water inspections, a wash sink available for kitchen floor mats and mop buckets, proper maintenance of grease traps/interceptors, use of techniques that minimize runoff from cleaning of outside eating areas and proper training of employees upon hiring. Additional criteria could also include: recycling of cans and bottles, and other materials, and use of cloth or recycled paper napkins, etc.

4.1.1.4 Public Agency Activities

The Jurisdictional Groups 5 and 6 agencies are involved in a variety of activities that minimize impacts on runoff as summarized in Table 3-2. Certain activities will be modified or enhanced to target bacteria sources.

Parks and Recreation Activities: Agencies will verify that maintenance departments conduct routine inspections of parks and recreation facilities to eliminate broken sprinkler heads, over watering and to reduce overspray. Agencies will incorporate protective landscaping principles into annual maintenance staff training and when planning re-landscaping projects.

Roundtable: The agencies will coordinate joint meetings among field staff responsible for industrial/commercial inspections and if appropriate, code enforcement. These sessions will provide an opportunity for round-table discussions of field experiences, observations and inspection techniques—such opportunities will be helpful for small agencies by effectively leveraging the knowledge base of each agency's field staff. These meetings will also provide an opportunity for managerial staff to obtain feedback from field personnel regarding their observations, concerns and challenges. Both industrial/commercial inspectors and code enforcement officers may be involved because industrial/commercial inspections may occur twice every five years, whereas code enforcement officers may be out in the community on a weekly or even daily basis. If code enforcement officers are aware of the concerns and techniques used by industrial/commercial inspectors, they are better prepared to act on potential violations (for some agencies code enforcement officers also conduct industrial/commercial inspections). An example of how this round-table sharing could be helpful is illustrated by the following:

> Recently one of the agencies identified a mobile pet washing service that has been repeatedly discharging wash water onto the agency's streets and/or into catch basins. The Agency's storm water coordinator pursued the matter with the owner of the business who claimed to believe that catch basins are connected to the sanitary sewer system. This information was shared with other neighboring storm water coordinators via email to alert them to the potential for violations by the same or similar operators.

This type of information will be shared among code enforcement staff at periodic round table meetings.

4.1.2 Phase I - Pilot Site-Specific Structural BMPs

Site-specific structural BMPs are intended to deal with small rain events, the first flush of larger rain events, and sometimes with dry weather flows by infiltrating or treating these flows. It is widely accepted within the scientific community that there are currently insufficient data and understanding regarding the effectiveness of using site-specific structural BMPs for reducing indicator bacteria concentrations in receiving waters during wet weather. This management approach will investigate the effectiveness of site-specific BMPs by selecting one or two drainage areas as study areas for piloting a variety of site-specific structural BMPs. Phase I includes the design, construction and monitoring of the selected pilot program.

4.1.2.1 Select Drainage Area(s) for Study

A number of considerations are important in selecting drainage areas for piloting site-specific structural BMPs:

- Small drainage areas are more advantageous than larger areas for this study because fewer projects will be required in order to demonstrate measurable reductions in wet weather runoff, increases in drainage area permeability, and ultimately corresponding decreases in wet-weather exceedances. A number of smaller drainage areas (other than the two best-performing drainage areas) may be appropriate for piloting site-specific infiltration and beneficial reuse BMPs. Even though some of the drainage areas have not demonstrated historical problems with surpassing allocated exceedances for wet weather, they may still have sufficient numbers of wet weather exceedances within allocations to evaluate a long-term trend relative to implementation of BMPs.

- Availability of public land is important in selecting drainage areas. Drainage areas with parks, schools, and other public facilities provide more placement opportunities for BMPs and pose fewer implementation challenges. For instance, drainage area SMB-6-3/6-4 does not appear to have much parkland or other public facility land use except for the beach area, and this may limit the number of site-specific BMPs that can be implemented in this area.

- BMP selection at school sites should place high consideration on safety issues and may therefore limit the types of BMPs that may be appropriate. Examples of BMPs that could be implemented at school sites are: replacing asphalt play surfaces with grass, installing porous pavements in parking lots, using an underground cistern to capture rainwater for reuse in onsite irrigation, groundwater recharge system, and storm water collection system to reduce flooding. However, the Jurisdictional Group 5 and 6 agencies have no authority to install structural BMPs within a school site.

- An additional factor to consider is the placement of compliance monitoring points. Since exceedances may increase if the monitoring point is moved to point zero, it may be useful to select one drainage area where the compliance monitoring point will be relocated, and one drainage area where the compliance monitoring point will not be relocated.

- The drainage area selected should ideally have a compliance monitoring point with enough historical monitoring data to perform comparative analyses. Drainage areas with new compliance monitoring points such as SMB-6-3 may not have enough data to perform a statistically valid comparative analysis.

- Those drainage areas that have highly infiltrating soils are preferred. Site-specific soil studies should be conducted in potential drainage areas prior to selecting locations for implementation.

Based on these considerations, Jurisdictional Groups 5 and 6 agencies have selected two study areas as the initial focus for piloting site-specific structural BMPs—the drainage areas associated with monitoring locations SMB 5-5 (Hermosa Pier) and SMB 6-2 (Redondo Pier).

4.1.2.2 Siting Data Collection and BMP Selection Process

Siting of BMPs for the study will begin by assembling relevant information. A review of aerial photographs available for the drainage areas combined with a visual survey of the study drainage areas will be used to identify potential locations for site-specific BMPs on publicly owned land. Information on privately owned land will be collected as part of the Phase II assessment. For each agency-owned property within the drainage area, a site visit will be conducted and a checklist of site characteristics and parameters will be completed and photographs taken to provide data sufficient to prepare a preliminary list of BMPs applicable to each property. The topography and portion of the property devoted to landscaping, building and paving, and undeveloped/natural areas will be estimated based on information collected during site visits and from aerial photographs. The total area of each property will be estimated based on GIS data for each parcel. Based on the assembled information, a list of applicable site-specific BMPs will be prepared for public parcels within the study area.

Aerial photographs of the drainage area and information gathered as part of the visual survey will be used to refine estimates of permeable and impermeable areas within the drainage area. This information will be incorporated into the existing GIS information for the drainage area in order to develop a baseline permeability of the drainage area against which effectiveness assessments can be made with respect to increases in permeability achieved by the BMPs.

4.1.2.3 Study Area Conceptual Design Alternative Selection

One or more conceptual design alternatives will be assembled for the study drainage area. An alternative will consist of a number of site-specific BMPs to be implemented at each study parcel within the study drainage area. The Siting Technical Memorandum (Appendix D) identifies several siting tools that can be used in assembling alternative combinations of site-specific BMPs in the study drainage area. Feasibility and permitting considerations as well as additional data needs for preliminary design will be identified. Estimates of capital and O&M costs will be prepared for each of the alternatives. Estimates of the effective increase in permeability or volume of rainfall diverted/treated will also be prepared for each alternative.

Based on a comparative analysis of the alternatives, Jurisdictional Groups 5 and 6 agencies will select a preferred alternative for piloting within the study area(s). The selected alternative will include, to the extent possible, a variety of site-specific BMPs on as many sites as feasible within the study area(s). To illustrate this process of constructing and evaluating alternatives for pilot testing, a hypothetical study area and set of alternatives are described in the next subsection.

Hypothetical Study Drainage Area and Alternatives Analysis
Assume a typical small drainage area of 150 acres with predominantly residential development and a baseline permeability of 40% (equivalent to a 0.60 runoff coefficient). Also assume the study area includes a recreation center with 10,000 s.f. of roof catchment area. Finally, assume the drainage area contains another one-acre plot of public land that is topographically suitable for creating a wetland or wet pond

hydraulically down gradient of a 10-acre residential development. Based on this hypothetical drainage area, consider the following hypothetical alternatives:

Alternative A: Construct a one-acre wetland treating a 10 acre runoff area, install a cistern at the recreation center for drip irrigation of native plant gardens and ornamental landscaping, replace a total of 6,000 s.f. of impervious walkway along the bluff top with permeable paving.

Alternative B: Construct a one-acre wet pond treating a 10-acre runoff area, install a 1-acre vegetated buffer strip along the beach bluff top using native plants, and replace 3,000 s.f. of bluff top pavement with permeable paving. Replace a 1,000 s.f. impervious playground at the recreation center with porous asphalt paving.

Alternative C: Construct a 1200 s.f. bioretention cell to divert runoff from one acre of roadways, replace 40,000 s.f. of parking lots and lightly used roadways with permeable paving.

A comparative hypothetical analysis of these alternatives is shown in Table 4-3 to demonstrate the kind of information that can be useful in selecting the most cost-effective alternative. Alternatives A and B achieve comparable increases in permeability for the drainage area on the order of a 7% increase in permeability for comparable capital expenditures. However, the annual maintenance costs of Alternative B are substantially higher than A due to the increased maintenance associated with a wet pond in comparison with a wetland.

Alternative C demonstrates the difficulty of relying mainly on pervious paving for increasing the permeability of a drainage area. When pervious paving is used solely to infiltrate storm water falling directly onto the paving, the cost per area infiltrated is an order of magnitude higher than other infiltration BMPs. The cost effectiveness of porous paving can be improved if it can also be used to infiltrate runoff from adjacent areas, e.g., if a pervious parking area can be used to infiltrate runoff from nearby roof drains. Strategic placement of pervious paving to increase the effective area infiltrated may also improve local problems with flooding due to undersized storm drains thereby providing added public benefits. The effective cost of pervious paving can also be reduced if it is incorporated as part of scheduled repaving projects wherein capital costs have already been budgeted for replacement of paving.

Table 4-3

Comparative Hypothetical Alternatives Analysis

Hypothetical Alternatives	Structural BMPs included in alternative	Approximate infiltration area (sf)	Percent of drainage area infiltrated/treated based on a 150 acre drainage area (6,534,000 sf)	Revised drainage area permeability assuming a baseline of permeability of 40%	Estimated design, permitting & construction costs ($)	Estimated annual maintenance costs	Capital costs per area infiltrated or treated ($/acre)	Annual O&M Costs per area infiltrated or treated ($/acre/yr)
A	Constructed wetland	435,600			400,000	4,000	40,000	400
	Large cistern	10000			50,000	500	217,800	2,178
	Pervious paving	6,000			90,000	500	653,400	3,630
	Total	**451,600**	**6.912%**	**46.912%**	**540,000**	**5,000**	**52,087**	**482**
B	Pervious paving	4,000			60,000	300	653,400	3,267
	Wet pond	435,600			500,000	15,000	50,000	1,500
	Vegetated buffer strip	43,560			40,000	400	40,000	400
	Total	**483,160**	**7.395%**	**47.395%**	**600,000**	**15,700**	**54,094**	**1,415**
C	Bioretention cells	43,560			50,000	500	50,000	500
	Pervious paving	40,000			400,000	2,000	435,600	2,178
	Total	**83560**	**1.279%**	**41.279%**	**450,000**	**2,500**	**234,586**	**1,303**

4.1.2.4 Site-Specific BMP Design, Installation and Monitoring

The selected alternative for each study area will be designed and installed within the Capital Improvement Program of the affected agency pending availability of funding. Design may require additional site-specific data collection, including soils information, depth to groundwater, location of utilities, easements, etc. A monitoring and evaluation plan for each BMP will be included as part of the design. Monitoring and evaluation plans will be configured to feed into the International Stormwater BMP database[1] in accordance with associated guidance manuals.

4.1.3 Phase I - Identify Significant Sources of Bacteria and Prioritize Source Controls

The objective of source identification in high priority drainage areas is to seek to identify conditions or factors that produce significantly higher indicator bacteria concentrations in the receiving waters associated with these drainage areas than occur in lower priority areas. This is a challenging proposition because indicator bacteria are ubiquitous in natural as well as developed environments.

Fecal coliform and enterococcus bacteria are simply indicators of the presence of material originating in the gut of warm-blooded animals. Total coliform is an even broader indicator not limited exclusively to warm-blooded creatures. These indicators are merely screening tools and do not differentiate between material from human, animal (mammal) and bird sources. Clearly there are a myriad of sources of such indicator bacteria in both the developed and undeveloped environment.

Natural undeveloped areas in southern California are typically arid and do not provide transport for fecal bacteria except during wet weather. Wildlife in the natural environment is also typically less dense so bacteria loading is less than in developed areas where high densities of a particular species may be supported, such as pigeons in parks or seagulls at popular beaches. When moisture does exist in the natural environment such as in wetland areas or lakes, and the hydraulic detention time is sufficient, natural treatment processes in these aquatic systems often achieve significant removal of fecal bacteria. In developed areas many of these loading and environmental factors are reversed. These unfavorable conditions are further compounded by evidence that indicator bacteria may actually multiply in dark, wet storm drains, including tidally-influenced storm drains[2].

Yet despite these challenges, many of Jurisdictional Groups 5 and 6 monitoring sites are historically compliant most of the time. So the goal of source identification in high priority drainage areas is to identify the significant sources and environmental loading factors that are pushing the indicator bacteria loading above the REC-1

[1] USEPA 2004 [2002]. American Society of Civil Engineers/Water Environment Federation. *International Stormwater BMP Database*.

[2] City of San Diego 2004. Mission Bay Clean Beaches Initiative Bacterial Source Identification Study, Final Report, City of San Diego Metropolitan Wastewater Department, September 15, 2004.

standards in the receiving waters. Most likely it is a combination of factors that create problem drainage areas including:

- A high percentage of paved surfaces within a drainage area provide quick and easy transport to the storm drain and ultimately to the beach in wet weather.
- Turf areas require fertilizer and frequent watering, both factors that provide a beneficial environment and nutrients for fecal bacteria to survive and multiply—if turf areas are located adjacent to paved areas or in close proximity to storm drain inlets, then irrigation over-watering and over-spray may also provide the transport.
- Congregation of pets or wildlife in small areas increases localized loading of indicator bacteria.
- Excessive runoff of soil from construction sites or landscaping activities have been associated with elevated indicator bacteria concentrations in storm drains—either because the soil itself carries a load of bacteria, or because deposition of soil in the storm drain system provides support for the growth of bacteria.
- Kitchen grease and other kitchen waste may contain high concentrations of indicator bacteria.
- Inadequately composted manure and other natural fertilizers are sources of indicator bacteria.

Bacteria source identification is a rapidly evolving field and there are a number of local and regional studies in progress that may provide findings that will require modifying/adapting techniques suggested in this implementation plan. Recent findings from the Mission Bay study[2] have raised controversial issues regarding tidally influenced drains—these findings may be of relevance for tidally influenced drains in Jurisdictional Groups 5 and 6, particularly the high priority drain SMB 6-1 (Herondo). New techniques are being researched to develop less expensive indicators to identify/exclude the presence of human sources of fecal bacteria. Local hydrologic studies may be conducted in the next five to ten years that may shed light on additional issues specific to particular monitoring sites. Relevant findings from these and other studies may require revisiting source identification/control approaches presented in this implementation plan in accordance with the iterative/adaptive process.

Sources of bacteria in dry and wet weather are often the same, although wet weather sources may be more widely distributed and therefore more difficult to pinpoint. Source identification done during dry weather is simpler, less costly and can proceed more quickly because chronic discharges are more easily identified and field activities are not confined exclusively to wet weather periods. Initial source identification efforts will be conducted during dry weather in high priority areas; however significant sources once identified will be addressed in both wet- and dry-weather.

SMB 6-1 (Herondo) has been selected as the focus for initiating source identification and control since it is a large drainage area, exhibits a wide variety of land use, and is a high priority due to frequent wet and dry weather exceedances. Near-shore source identification activities described in Section 4.1.3.1 and 4.1.3.3 will also be conducted in SMB 6-2 (Redondo Pier and King Harbor areas) to identify potential source control or land use-specific structural BMPs that may be particularly effective in near-shore areas.

In order to better distinguish between significant and *de minimus* sources and factors, selective parallel source identification activities will be conducted in "high performing" drainage areas (those that historically have had a record of significantly lower indicator bacteria concentrations at shoreline monitoring sites associated with these areas than is typical of other drainage areas in Jurisdictional Groups 5 and 6). Drainage areas associated with SMB-5-1 and SMB-6-6 were historically the best performing locations year-round, during wet- and dry-weather and accordingly would be most appropriate for selective parallel comparative source identification activities.

A number of techniques and avenues of investigation will be pursued for source identification. The following discussion highlights key techniques for Phase I.

4.1.3.1 Confirm Sanitary Sewage Infrastructure is Not Significant Source

In high priority areas it is important for the protection of human health to establish that the sanitary sewage infrastructure is not a significant cause of elevated indicator bacteria concentrations at shoreline monitoring sites. There are two routes to be considered for potential transport of sanitary sewer sources to the shoreline. Where sanitary sewer system infrastructure is located in close proximity to the shoreline, migration paths for sanitary sewage may be associated with surface or subsurface migration directly from the source, i.e., not via the storm drains. The second possibility is that the storm drain system may be providing conveyance for sanitary sewage migration, and in such cases sources may be located anywhere within the drainage area.

A variety of techniques may be employed to ascertain or eliminate sanitary sewage as a potential source in close proximity to the shoreline:

- **Identify potential shoreline sources of sanitary sewage**. These may include: buried shoreline sewer lines and pump stations, under-pier sewage lines, marina facilities for pumping out of marine sanitary devices, beachside rest rooms and associated sewer lines, and heavy watercraft traffic in near-shore areas.

- **Evaluate buried shoreline sewer lines and pump stations**. Confirm that there is adequate sewage system maintenance and overflow prevention. Identify sewer exfiltration issues. Develop and implement protocols for periodic monitoring of the condition of buried shoreline sewer lines and pump stations. The techniques used will depend on the specifics of the location being evaluated.

- **Restaurant Grease Interceptors or other below-grade sewer connections.** Restaurant kitchen drains are usually equipped with grease traps or grease interceptors to remove oil and grease and reduce the incidence of sanitary sewer overflows due to grease clogs. Grease interceptors are often installed in the ground outside buildings, are connected to the sanitary sewer system, and if not properly maintained may overflow and seep onto the parking lot or street. An inventory of building permit databases will be conducted to ascertain the number and distribution of in-ground grease interceptors to assess whether the number and location of such devices warrants further source control measures.

There are already procedures in place to prevent the storm drain system from conveying sanitary sewage to the shoreline, these include:

- **Screening for illicit connections/illicit discharges**. Responsible agencies subject to the municipal storm water permit are required to undertake a systematic screening of the storm drain system for illicit connections. This screening has already been completed for the open channel conveyances and is to be completed by December 2006 for underground storm drains. Findings of these screenings will identify the presence of illicit sanitary sewer connections within the storm drain system. Caltrans also has a systematic Illicit Connection/Illegal Discharge Program under its statewide storm water permit—Caltrans notifies local municipalities of illicit connections and illegal discharges when they are discovered.

- **Sanitary Sewer Overflows**. Agencies that own/operate sanitary sewers already have spill prevention and response plans in place. Records of sanitary sewer overflows within high priority drainage areas could be reviewed, noting chronic issues related to sanitary sewer overflows or sewer maintenance. Planned or needed sewer infrastructure maintenance or improvement projects within high priority areas should be reviewed to consider whether these projects should be expedited.

4.1.3.2 Enhance Comparative Land Use Mapping for Source Identification

Refinement of comparative land use mapping may assist the agencies in source identification by identifying land use distribution patterns associated with higher rates of indicator bacteria exceedances at the shoreline. While size of drainage area appears to be the strongest macro-scale factor contributing to high-priority area exceedances, there may be other secondary macro-scale factors of importance that can be discerned from further refinement of land use mapping. For example, the second best performing drainage area (SMB 6-6 Malaga Cove) with respect to historical exceedances is fifth largest in size, but is also the only drainage area in Jurisdictional Groups 5 and 6 with no commercial land use designation. Based on this observation one could conclude that initial field reconnaissance to identify problematic land use activities should be directed at commercial areas within high priority drainage areas.

The GIS map of drainage areas developed for Jurisdictional Groups 5 and 6 will be enhanced as additional information becomes available to provide additional direction for source identification. A number of potential refinements and additional data imports may be useful:

- **Refine Land Use Designation**. Comparative land use mapping among the drainage areas may assist in directing field reconnaissance to identify particular land use activities that may be contributing significantly to high priority area exceedances. Current land use mapping based on zoning will be refined to sub-classify land uses and provide additional direction regarding the importance of land use as a causative factor for exceedances. For example, distinguishing among: landscaped open space such as parks, beaches, other types of public facilities, and undeveloped open space may provide such direction.

- **Incorporate IC/ID Data.** The County of Los Angeles gathers illicit connection and illicit discharge data in GIS format from the MS4 NPDES Permittees for an annual trend analysis. This IC/ID data will be layered onto the drainage area map to assist in identifying problematic land uses that may be generating a higher rate of illicit discharges and illegal connections. Caltrans maintains an independent database for its IC/ID program.

4.1.3.3 Field Reconnaissance of Selected High Priority Areas

A combination of field reconnaissance techniques will be applied to systematically close in on significant sources in high priority areas. Broader, macro scale techniques will be applied to larger areas, and more focused, detailed approaches applied to selected areas such as near-shore commercial areas and other high-priority areas of concern identified by one of the macro-scale screening techniques. These techniques will include:

- **Drainage Area Survey.** In large high-priority areas conduct a systematic visual screening survey along major arteries to identify land use areas of concern. Delineate the boundaries of land use areas of concern by noting cross-streets. Make note of unusual land use activities or areas of high-density activities of concern.

- **Focused reconnaissance of identified land use areas.** Conduct systematic, detailed, visual site reconnaissance of selected areas on foot making detailed field notes with accompanying photographs of publicly accessible areas to identify potential sources of bacteria. Particular attention should be paid to outdoor areas of commercial establishments such as restaurants, veterinarians and animal boarding facilities, home and garden centers, and other establishments with outdoor activities and outdoor material and waste storage areas. Make note of staining on pavement and algae in gutters that may be indicative of chronic dry weather discharges. Visit commercial areas during early morning hours just prior to opening or visit late in the evening for restaurants to note maintenance activities—look for wet areas that may be indicative of outdoor hosing of impervious surfaces.

- **Follow-up Interviews.** Conduct follow-up telephone or in-person interviews with managers, employees, maintenance supervisors, etc. to gather additional information regarding land use activities of concern as needed to clarify maintenance procedures and activities.

- **Flow Tracking of Selected Storm Drains Branches.** For priority storm drains with chronic and significant dry weather flows, it may be possible to trace unusual flow volumes up the system to identify whether these unusual flows are associated with activities that may be contributing to potentially significant bacteria loads. Field personnel would begin at the storm drain outfall and work up the system tracing only the most significant dry-weather flows to their sources. At each branch in the storm drain system, personnel would attempt to visually inspect drains by lifting manhole covers and observing flow rates. These screenings could be conducted at various times of the day since dry weather flows are often intermittent.

- **Confirmatory Sampling and Analysis.** Sampling and analysis can become prohibitively expensive and if applied broadly may not provide useful information for source identification because of the ubiquitous nature of indicator bacteria. However, selective sampling and analysis may be useful to confirm the presence of high concentrations of indicator bacteria in a discharge, especially if needed to require corrective action by a landowner.

4.1.3.4 Develop Prioritized List of Source Controls for Significant Sources

Based on information obtained in the previous tasks, the agencies will compile a prioritized list of significant sources in high priority areas and corresponding source control techniques. Cost estimates for these source control techniques will be assembled. Source controls to be implemented in high priority areas during Phase II will be selected from this prioritized list.

4.2 Phase II –Assess/Expand/Develop Programmatic Solutions, Evaluate Performance of Site-Specific Structural BMPs, and Implement Source Controls in High Priority Drainage Areas

During Phase II the results of activities conducted during Phase I will be evaluated and action taken in response to the findings. Field staff will be apprised of significant sources that are identified. In addition to assessment and expansion of existing programs, new programmatic solutions that emphasize bacteria sources and good housekeeping practices will be developed to improve public outreach and education. Pilot testing of source controls for significant sources will be conducted in high priority areas to establish the effectiveness of these technologies. A detailed evaluation of the effectiveness of structural BMPs deployed in the study drainage areas will be conducted during Phase II.

4.2.1 Phase II - Assess/Expand/Develop Programmatic Solutions

During Phase II, programmatic solutions will be assessed and evaluated for effectiveness. Based on this evaluation and based on priorities identified in Phase I of Source Identification, additional programmatic solutions will be developed and successful Phase I programs will be expanded based on expected performance and relative cost in comparison with other management approaches.

Programmatic solutions are widely regarded within the engineering and scientific communities as essential components of integrated nonpoint source management programs, but there have been few attempts to evaluate the effects of nonstructural BMPs on stormwater quality. USEPA provided guidance in their 1997 document. [3] The Australia-based Cooperative Research Center developed a set of guidelines that include a conceptual framework for assessing the value and life cycle costs of nonstructural BMPs for stormwater quality improvement, a set of monitoring and evaluation protocols, and example monitoring tools.[4] Seven lines of inquiry for evaluation were suggested:

- **Degree of Implementation –** Evaluation of the extent to which a solution has been fully implemented as conceived.
- **Changes in people's awareness and/or knowledge –** Evaluation of whether the solution has increased levels of awareness and/or knowledge of a specific stormwater issue within a segment of the community.
- **Changes in people's attitude (self-reported) –** Evaluation of whether the solution has changed people's attitudes, as indicated through self-reporting.
- **Changes in people's behavior (self-reported) –** Evaluation of whether the solution has changed people's behaviors, as indicated through self-reporting.
- **Changes in people's behavior (actual) –** Evaluation of whether the solution has changed people's behaviors, as indicated through direct measurement (e.g., the "observational approach").
- **Changes in stormwater quality –** Evaluation of whether the solution has improved stormwater quality in terms of loads and/or concentrations of pollutants.
- **Changes in waterway health –** Evaluation of whether the solution has improved the health of receiving waters.

The guidance provides monitoring and evaluation protocols relevant to each selected line of inquiry and these can be used to develop a monitoring and evaluation plan for programmatic solutions, as well as for source control and structural BMPs. Not all of

---

[3] USEPA 1997. Monitoring Guidance for Determining the Effectiveness of Nonpoint Source Controls.

[4] Taylor, Andre, and Tony Wong 2003. Nonstructural Stormwater Quality Best Management Practices: Guidelines for Monitoring and Evaluation. Technical Report, Report 03/14, November.

these lines of inquiry will be applicable in evaluating each solution, so it is important to select those lines of inquiry that are most relevant.

Enhanced Programmatic Solutions (Phase I will be the first of the three measures to be implemented; consequently measurable improvements in shoreline bacteria exceedance trends before structural BMPs or source controls are implemented will be largely attributed to enhanced programmatic solutions. Feedback from the identification of significant sources will be used to implement further enhancements, expansion or development of additional programmatic solutions.

Examples of the types of Phase II programmatic solutions that may result from the experiences in Phase I and from feedback from source identification are described below. Some of these solutions are clearly appropriate but could not be implemented in Phase I because of time required to develop them fully. Some of these examples may not be implemented because other higher priority programmatic solutions may arise as a result of the source identification findings and be implemented instead.

4.2.1.1 Homeowners and Residents

Landscaping BMP Brochure: Web page material compiling landscaping best management practices from various agencies can be combined with additional material and assembled into a print brochure. This information could be channeled to receptive citizens through nurseries, garden clubs, and public counters during spring/fall planting times.

Consider providing garden centers with small signs to place near xeric and native plant displays.

4.2.1.2 Schools

Environmental Defenders: Work with County's public education group to update the Environmental Defenders presentations and materials to incorporate new educational issues specific to bacteria sources. The timing of this solution may depend on contracting issues under the County Education Campaign, i.e., it is possible that this development work can occur during Phase I and then additional development of materials will occur in Phase II based on significant source identification findings.

Material for Teachers: Assemble informational material (non-curricular) regarding Implementation Plan activities and findings to be used as a reference for classroom or outdoor educational activities. This information could be posted on a website and a memo faxed to each school briefly describing the material and providing the web link. This will include some technical information on the bacteria TMDL and also discussion of best management practices for preventing ocean pollution. Agencies will also work with the California Regional Environmental Education Community (CREEC) to identify existing environmental curricula that are relevant and promote these to local school districts and teachers.

4.2.1.3 Business

Restaurant Training Kits: Based on feedback and experience in conducting restaurant training workshops, provide kits for restaurant managers to use in training their employees in best management practices consistent with Countywide programs for restaurant chains/franchises. Consideration will be given to providing these kits in multiple languages, especially posters and promotional items that may be included.

Pilot Restaurant Certification program: Implement the restaurant certification program in high priority areas. During implementation obtain feedback from participating restaurants. Publicize and explain certification to local Chamber of Commerce either with article in newsletter or at a meeting.

Target Additional Land Use Activities: Develop additional targeted outreach/education strategies for land use activities of concern based on prioritized findings of Phase I identification of significant sources. Consider developing and piloting business certification for additional targeted categories. Depending on the results of significant source identification, potential targets for education/outreach may include:

- Property management companies responsible for exterior maintenance and common trash storage areas, in commercial shopping centers.
- Pet boarding facilities and veterinarians
- Garden and home improvement centers

4.2.1.4 Public Agency Activities

Roundtable: Incorporate findings from significant source identification into round-table discussions to update field personnel regarding newly identified significant land use activities and potential discharges of concern. Consider approaches field personnel may use for dealing with these sources.

Frequency and format of inspectors' roundtable meetings will be adjusted to meet the needs of participants and the workload. It may be that less frequent general meetings with separate subcommittee meetings are most effective.

4.2.2 Phase II - Evaluate Performance of Site-Specific Structural BMPs

Evaluation of the performance of piloted site-specific BMPs can be accomplished at two levels. At the micro-scale, the BMPs can be evaluated based on a number of factors that rely on experience during design, installation and maintenance. An evaluation as simple as constructing a list of pros and cons for each piloted BMP that includes factors encountered during the pilot study such as: design and siting constraints, difficulty and/or length of time required for installation, impacts on related infrastructure, operational effectiveness, ease and frequency of maintenance required. A second assessment for each piloted BMP should consider the actual cost of design, installation and short- and long-term operation and maintenance per unit volume of water infiltrated/treated or area of permeability enhanced.

At the macro-scale, the effective permeability of the drainage area (or the increase in permeable acreage) and/or the amount of area treated should be assessed for each of the small drainage areas where these BMPs are to be piloted. Additionally, flow monitoring at the outfall or at appropriate downstream location in the storm drain system may demonstrate measurable reductions in flow. The ultimate macro-scale assessment of effectiveness will consider whether there is a demonstrable decreasing trend in the number of exceedance days at the compliance point; it may be necessary to normalize this assessment based on the number of wet-weather and dry-weather days in a given storm year and it will require a number of years of data to demonstrate these trends statistically. The shoreline monitoring performance of the study drainage area(s) can also be compared with performance trends of drainage areas where site-specific BMPs have not been piloted to give additional insight.

An expanded component of the piloted alternative will be to identify a suite of site-specific BMPs that could be incorporated on privately owned land in the same drainage study area if funds and willingness of the owners could be obtained. This is conceived as a potential Phase III implementation that would be evaluated in terms of the potential or theoretical infiltration or reuse that could be achieved by private projects in combination with the public land projects already piloted within the study area. This would allow the agencies to assess what the best performance that could be achieved in the study drainage area might be. For purposes of estimation it would be prudent to assume a percent participation on the part of private landowners that is substantially less than 100%. Several scenarios could be created with participation rates of 10%, 20% and 50% participation to assess the potential effect on drainage area performance of the scenarios.

Based on the above assessments, the Jurisdictional Groups 5 and 6 agencies will assess the overall effectiveness of these site-specific BMPs when applied as extensively as possible throughout a drainage area. This will provide an upper bound on the potential for site-specific BMPs, when implemented in a systematic manner, to reduce the number of wet-weather exceedances. Based on these findings the Jurisdictional Groups 5 and 6 agencies will decide whether to move forward with this approach in the high priority drainage areas and possibly throughout Jurisdictional Groups 5 and 6, whether to pilot additional structural BMPs, or whether programmatic solutions and/or source control BMPs are sufficiently effective means for achieving necessary reductions in exceedances.

4.2.3 Phase II - Implement Source Controls in High Priority Drainage Areas

Once significant factors and/or sources of indicator bacteria loads to the storm drain system are identified, appropriate source controls will be implemented at applicable sources within the high priority drainage areas. A monitoring and evaluation plan will be developed for each source control selected for implementation.

Examples of potential source control techniques that may be effective for significant sources in high priority drainage areas include:

- Institute a schedule or increase the frequency of routine monitoring and maintenance of buried shoreline sewer lines and pump stations.

- Institute a quarterly self-inspection/cleanout program for in-ground grease interceptors and require that maintenance records be submitted to the permitting authority on an annual basis.

- Require new commercial construction and redevelopment of existing commercial facilities to construct a covered trash enclosure with drainage connected to the sanitary sewer.

- Marinas can require that the Harbor Master place dye tablets in marine sanitary devices of watercraft berthed at the harbor in order to detect and prevent unlawful discharges within the harbor and near-shore areas.

- Require use of low-flow cleaning devices for outdoor eating areas.

- Cover outside storage areas at garden and home improvement centers, curtail discharges to street/storm drain of irrigation or other runoff from garden centers.

- In high priority areas, especially at beaches and outdoor public eating areas, replace open trash receptacles with bird-proof receptacles to reduce the congregation of seagulls, pigeons and/or crows.

- Monofilament wire strung overhead in areas associated with food consumption such as beaches and outdoor eating areas has been demonstrated to be effective at significantly reducing the number of birds that land in these areas. The monofilament wires are nearly transparent and can be strung on poles spaced at an appropriate distance, or from the eves of roofs. The wires themselves are not very noticeable, however the poles will be. These bird exclusion devices can be installed on a temporary basis to evaluate performance and public acceptance before expanding to additional areas.

- Remove turf strips adjacent to street gutters or storm drain inlets from publicly-owned landscaped areas and replace with xeric planting or decorative gravel, providing sufficient irrigation and fertilizer to maintain street trees that are present.

- Increase frequency of irrigation system maintenance in public parks and facilities to eliminate broken sprinkler heads, over watering and reduce overspray.

- In redevelopment areas encourage developers to avoid designs with narrow strips of turf adjacent to sidewalks and streets.

4.3 Phase III- Implement additional programmatic solutions, implement applicable BMPs/research new BMPs, evaluate and institutionalize effective source controls

By Phase III of the implementation all three measures will have undergone evaluation so a comparative assessment can be made regarding the relative cost-effectiveness of these approaches. Also, monitoring data from the Coordinated Shoreline Monitoring Plan may provide an indication of trends toward reductions in exceedance days under Phase I and II implementation. Based on this assessment, the Jurisdictional Group 5 and 6 agencies will decide which options to pursue during Phase III. Although it is not possible to project what all possible options might be in advance, some of these potential options are discussed in the following subsections.

4.3.1 Phase III - Implement additional programmatic solutions

Based on effectiveness of programmatic solutions implemented in Phases I and II, and based on additional information gathered from significant source identification, evaluate the need for additional programmatic solutions.

4.3.1.1 Homeowners and Residents

Homeowners Associations**:** Provide speakers for homeowners associations regarding TMDL issues and findings as they apply to residential areas.

4.3.1.2 Schools

School District Administration**:** Outreach to local school district administration to share experience and provide information on programmatic solutions for Phases I and II that may be applicable to school sites, for example, bird-proof trash receptacles and bird exclusion devices in outdoor eating areas or xeric landscaping techniques that reduce runoff but also conserve water use.

4.3.1.3 Business

Revise/Expand Restaurant Certification program: Based on experience in piloting restaurant certification program and feedback from participants, make revisions in the program. Decide whether to expand program to other drainage areas in Jurisdictional Groups 5 and 6. If so, publicize and explain certification rollout to local Chamber of Commerce.

4.3.1.4 Public Agency Activities

Roundtable: Based on experience during Phases I and II and feedback from identification of significant sources, consider whether additional policies and procedures are needed. Evaluate other public agency storm water-related programs to identify whether additional roundtables could be helpful in exchanging information and experience among agencies' staffs.

4.3.2 Phase III – Implement Applicable BMPs and Research New BMPs

Based on the effectiveness of each of the structural BMPs assessed during Phase II, the Jurisdictional Group 5 and 6 agencies may take one or more of the following courses of action:

- Expand implementation of effective structural BMPs to applicable and appropriate sites in high priority drainage areas within Jurisdictional Groups 5 and 6
- Research emerging structural BMP technologies for applicability in Jurisdictional Groups 5 and 6
- Identify additional site-specific BMP technologies for piloting within Jurisdictional Groups 5 and 6
- Investigate potential improvements/modifications to existing infiltration and detention basins to achieve additional load reductions of pollutants of concern to Santa Monica Bay
- Pursue larger, regional options such as leach fields for dry weather diversion, or diversion of wet weather runoff to the West Coast Basin project as supplemental water for blending.

4.3.3 Phase III - Evaluate High Priority Source Controls and Institutionalize Effective Source Controls

During Phase III source control measures will be assessed for effectiveness and those that are found to be effective in high priority areas will be expanded where applicable in other areas of Jurisdictional Groups 5 and 6. For example:

***Expand Bird-proof Trash Receptacles**:* If bird-proof receptacles are found to be effective in high priority areas in reducing the congregation of seagulls, pigeons and/or crows, consider deploying these receptacles in as many public areas in high priority drainage areas as possible. Consider also expanding to selected locations in other drainage areas, e.g., beaches.

Expand Bird Exclusion Devices. Based on performance and public acceptance of piloted bird exclusion devices, consider whether to expand to additional areas where appropriate.

A key aspect of the expansion of effective source control measures is to incorporate them into programmatic solutions. The end point of effective source controls is when they are institutionalized into the agencies' programmatic solutions. For example, if bird-proof trash receptacles are to be instituted throughout public areas in a jurisdiction, then specifications for these trash receptacles must be communicated to the maintenance and purchasing departments to specify that future replacement or new placement of receptacles are of this type. Other effective source controls applicable to the private sector, such as a requirement that cleaning of outside eating areas must be accomplished so as to minimize runoff, will be incorporated into programmatic solutions through changes in policy and procedures.

4.4 Summary of Integrated Strategy

In summary, the Implementation Plan consists of three management approaches: 1) programmatic solutions; 2) structural BMPs; and 3) source identification and control. In deciding how to focus and prioritize the various management approaches into an integrated plan, the responsible agencies carefully considered the analysis of historic water quality data associated with each drainage area under wet- and dry-weather conditions. The annual frequency of exceedances was compared to target exceedance allocations for each monitoring site. A detailed discussion of this analysis is provided in the technical memorandum in Appendix B, however what is important to note is that the results of this analysis provide a more complex compliance picture than the wet-weather exceedance day reduction projections in the TMDL as listed in Table 2-3.

Based on the analysis of historical performance, the SMB 6-1 (Herondo) drainage area was clearly problematic both during wet-weather and dry-weather, and this drainage area is by far the largest, covering nearly 40 percent of the area of Jurisdictional Groups 5 and 6, some 2300 acres. Identifying and controlling significant bacteria sources in such a large drainage area will require significant resources. By contrast, at SMB 6-4 the analysis did not find a need for wet-weather exceedance reductions during the years evaluated as called for in the TMDL, however a couple of other monitoring locations did surpass wet-weather exceedance allocations in isolated years.

Dry weather exceedances in Jurisdictional Groups 5 and 6 have historically been more problematic and wide-spread than wet weather exceedances. Besides SMB 6-1 (Herondo), the drainage area from SMB 6-2 (Redondo Pier) has historically also been problematic during dry weather, and to a lesser degree so have SMB 5-5 and 6-5. Additionally, there have been problems with rolling 30-day geometric mean exceedances for enterococcus at many monitoring locations, yet geometric mean data for fecal coliform and total coliform have not shown similar problems.

An additional uncertainty arises for four of the historically monitored sites that have been relocated to the zero point, i.e., to the wave wash directly in front of the storm drain outfall instead of the historical monitoring location 50 yards away from the storm drain outfall. This relocation of historical monitoring sites to the zero point is likely to have an adverse effect on the frequency of exceedance days because the dilution and dispersion of indicator bacteria from storm drain discharges has been eliminated at these locations. This situation may result in the re-evaluation of assigned exceedance allocations for these locations once several years of monitoring data under the Coordinated Shoreline Monitoring Plan become available.

This plan is an iterative, adaptive implementation plan designed to address wet- and dry-weather TMDL issues while at the same time addressing additional pollutants, integrating water conservation methods, and identifying beneficial reuse opportunities. Although the requirement for developing this implementation plan arises from the Wet-Weather SMBBB TMDL, the Jurisdictional Group 5 and 6 agencies must devote public resources to achieving summer dry weather, winter dry weather and 30-day rolling geometric mean targets for indicator bacteria in shoreline waters. This plan provides three management approaches within an iterative framework that is designed to identify and advance those management practices that are found to be most effective in achieving the water quality objectives.

4.4.1 Implementation Plan for Multiple TMDLs/Pollutants

The Jurisdictional Group 5 and 6 agencies are implementing dry weather structural diversions at six major storm drain outfalls to address summer dry weather bacteria targets. These dry weather diversions are operational only during summer dry weather due to limitations in the capacity of sanitary sewer infrastructure and/or treatment facilities.

Programmatic solutions during Phase I will address both summer and winter dry weather nuisance flows while also encouraging water conservation and working to modify land use activities that are known to contribute to bacteria loads. These known sources include: pet waste, heavily irrigated turf and landscaping areas, and various nuisance flows from restaurants. Joint meetings or "roundtables" among field personnel from the Jurisdictional Group 5 & 6 agencies will work toward improving compliance with existing ordinances through sharing of field observations, techniques and findings, effectively leveraging the knowledge base of each agency's field staff. These Phase I programmatic solutions are being implemented across Jurisdictional Groups 5 and 6 to achieve a general improvement in overall "background" indicator bacteria levels during dry weather. And to the extent that these activities can reduce the overall load of bacteria "stored" in the watershed, these measures should provide a concomitant reduction in wet weather bacteria loads. It is not clear whether shoreline monitoring data will be of sufficient precision and accuracy to measure a 10% reduction in four wet-weather exceedance days (effectively 0.4 of an exceedance day). However, the responsible agencies believe it is reasonable to expect that implementation of Phase I programmatic solutions throughout Jurisdictional Groups 5 and 6 could provide such a reduction, whether or not it can actually be measured at the shoreline.

The agencies are proposing to pilot a suite of site-specific structural BMPs, primarily infiltration BMPs and localized beneficial reuse projects, to assess how they perform in managing low-flow wet-weather, the first flush of larger rain events, and possibly some sources of dry weather runoff such as irrigation runoff. Information at this time is insufficient to project the effectiveness of site-specific BMPs for reducing concentrations of indicator bacteria at the shoreline. Each of these structural BMPs will require detailed design and implementation of a monitoring plan to measure effectiveness. Jurisdictional Groups 5 and 6 agencies have selected two study areas as the initial focus for piloting site-specific structural BMPs—the drainage areas associated with monitoring locations SMB 5-5 (Hermosa Pier) and SMB 6-2 (Redondo Pier).

Identification of significant sources of bacteria during Phase I is directed at finding "hot spots" or nuisance flows of indicator bacteria in order to identify conditions that contribute to unusually high levels of indicator bacteria at shoreline monitoring locations from high priority drainage areas. The responsible agencies believe that it is a priority to investigate whether sanitary sewage infrastructure is a significant source of elevated shoreline bacteria. Therefore, activities described in sections 4.1.3.1 and 4.1.3.2 that focus on near-shore portions of high priority drainage areas will be expedited. To the extent that significant sources associated with sanitary sewage infrastructure are identified, the responsible agencies commit to prompt control of these sources. Other significant sources will be prioritized for source control piloting in high priority areas during Phase II. Each type of source control will require a carefully designed monitoring plan to measure effectiveness with respect to bacteria. SMB 6-1 (Herondo) has been selected as the focus for initiating source identification and control since it is large, exhibits a wide variety of land use and is a high priority drainage area due to frequent wet and dry weather exceedances. Near-shore source identification activities described in Section 4.1.3.1 and 4.1.3.3 will also be conducted in SMB 6-2 (Redondo Pier and King Harbor areas) to identify potential source control or land use-specific structural BMPs that may be particularly effective in near-shore areas.

This implementation plan is designed to provide an iterative/adaptive approach to incrementally reduce exceedances at the shoreline under multiple bacteria TMDLs (summer dry weather, winter dry weather, wet weather and rolling 30-day geomean) while simultaneously gathering necessary information to make decisions and mid-course corrections as needed. Accordingly it is critical that early phases of this implementation plan develop the necessary evaluations of effectiveness in order to leverage the agencies' expenditures of resources to the maximum extent possible while enhancing other public goals, e.g., water conservation, beneficial reuse, shoreline native habitat restoration. Based on these evaluations of effectiveness, the responsible agencies can make adaptive decisions to pursue the most promising combination of management approaches to achieve water quality objectives.

4.4.2 Summary of Management Approaches

Table 4-4 is a summary of the activities included in each management approach, the phases in which the activities are planned to take place, and the sections of this report where the activities are described. Activities will be accomplished by the Jurisdictional Group 5 and 6 agencies collectively, however not every activity is applicable to every agency.

The Jurisdictional Group 5 & 6 agencies are committed to implementing the programmatic solutions listed in Table 4-3 as Phase I and Phase II activities. Phase I programmatic activities were selected because they could be implemented with a minimal amount of development and preparation time, while Phase II activities will require more lengthy development and planning before they can be implemented. The programmatic activities listed as Phase III are tentative implementation during this phase will depend on experiences and knowledge gained during Phases I and II, as well as findings from the other management approaches being implemented in parallel.

The responsible agencies are committed to piloting a suite of site-specific structural BMPs, primarily infiltration BMPs and localized beneficial reuse projects, to assess how they perform in managing wet-weather and some dry weather runoff; those activities are listed as Phase I and Phase II activities in Table 4-3. Jurisdictional Groups 5 and 6 agencies have selected two study areas as the initial focus for piloting site-specific structural BMPs during Phase I—the drainage areas associated with monitoring locations SMB 5-5 (Hermosa Pier) and SMB 6-2 (Redondo Pier). An important consideration in selecting these particular drainage areas was that both of these areas have agency-owned parks within which to site BMPs so that the process of piloting structural BMPs will be less dependent on securing cooperation from school districts which could lengthen the time required for siting, design and construction. Although the agencies do not currently have the information needed to specify exactly which types of structural BMPs will be implemented in specific locations, the methods for collecting this information and developing conceptual design alternatives are described in detail in sections 4.1.2.2 and 4.1.2.3. Once the implementation and performance evaluation of these piloted structural BMPs is complete, the agencies will consider which of the Table 4-3 activities listed as Phase III Structural BMPs are the most appropriate to pursue based not only on the Phase I and II structural BMP activities, but also on findings from the programmatic and source control approaches.

Jurisdictional Group 5 & 6 agencies will proceed with implementation of Phase I source identification activities as soon as possible. The responsible agencies believe that it is a priority to establish that sanitary sewage infrastructure is not a significant source of elevated shoreline bacteria, thus activities described in sections 4.1.3.1 and 4.1.3.2 will be prioritized, focusing on near-shore portions of high priority drainage areas. To the extent that significant sources associated with sanitary sewage infrastructure are identified, the responsible agencies commit to prompt control of these sources (early Phase II action). Such urgent findings not withstanding, the significant sources identified during Phase I will be prioritized for source control piloting in high priority areas during Phase II. The agencies currently do not have information needed to ascertain specifically which source control activities will be implemented—this will not be clear until the completion of Phase I.

Table 4-4

Summary of Management Approaches

Section	Study Category	Activities	Implementation Schedule
Programmatic Solutions			
4.1.1.1	Homeowners and Residents	Watershed Direct Mail Piece	Phase 1
		Distribute County Tip-Cards	Phase 1
		Landscape BMP Webpage	Phase 1
		Landscape Awards	Phase 1
		Speakers	Phase 1
4.2.1.1		Landscaping BMP Brochure	Phase 2
4.3.1.1		Homeowners Associations	Phase 3
4.1.1.2	Schools	Encourage Environmental Defenders Program for K-5	Phase 1
		Distribute Storm Water Videos	Phase 1
		Graphic Arts Contest	Phase 1
4.2.1.2		Environmental Defenders	Phase 2
		Material for Teachers	Phase 2
4.3.1.2		School District Administration	Phase 3
4.1.1.3	Business	Restaurant BMP Workshops	Phase 1
		Develop Restaurant Certification program	Phase 1
4.2.1.3		Restaurant Training Kits	Phase 2
		Pilot Restaurant Certification program	Phase 2
		Target Additional Land Use Activities	Phase 2
4.3.1.3		Revise/Expand Restaurant Certification program	Phase 3
4.1.1.4	Public Agency Activities	Parks and Recreation Activities	Phase 1
		Roundtable	Phase 1
4.2.1.4		Additional Roundtable	Phase 2

Table 4-4

Summary of Management Approaches

Section	Study Category	Activities	Implementation Schedule
4.3.1.4		Additional Roundtable	Phase 3
Structural BMPs			
4.1.2	Small/medium sized drainage areas	Implement alternative A, B, or C in one or two drainage areas	Phase 1
4.2.2	Small/medium sized drainage areas	Evaluate Performance of the BMPs in the selected drainage areas	Phase 2
4.3.2	Generally applicable	Expand implementation of effective structural BMPs to applicable and appropriate sites in other drainage areas within Jurisdictional Groups 5 and 6, especially in high priority areas	Phase 3
		Research emerging structural BMP technologies for applicability in Jurisdictional Groups 5 and 6	Phase 3
		Identify additional site-specific BMP technologies for piloting within Jurisdictional Groups 5 and 6	Phase 3
		Investigate potential improvements/modifications to existing infiltration and detention basins	Phase 3
		Pursue larger, regional options such as leach fields or diversion of wet weather runoff	Phase 3
Source Identification & Control			
4.1.3	High priority drainage areas	Identify Significant Sources of Bacteria and Prioritize Source Controls	Phase 1
		Conduct parallel source identification activities	Phase 1
4.2.3		Implement Source Controls	Phase 2
4.3.3		Evaluate high priority source controls and institutionalize effective source controls	Phase 3

4.5 Implementation Schedule

A schedule for implementing this plan is illustrated graphically in Figure 4-1. The length of each phase represents time allocated for development and implementation of the various programs described within this plan. Phase 3 of the programmatic solutions is shown continuing indefinitely to represent ongoing implementation of these institutionalized measures. Phase 3 of the structural BMPs is also shown continuing indefinitely to account for ongoing maintenance of installed BMPs. Phase 3 of source identification/control has a termination point because long-term implementation of source controls will be institutionalized and incorporated into ongoing programmatic solutions. What is not shown in Figure 4-1 is the length of time required for additional iterations of Phases I, II and III of each approach.

The schedule assumes no limitations in staffing or funding, and consequently this schedule represents a best-case scenario for implementing the plan. Limitations in funding or staffing (either agency staff or contract staff) may extend the schedule beyond that shown in the figure.

The first compliance deadline (summer dry-weather) occurs in July 2006. Jurisdictional Group 5 and 6 agencies have already implemented or are in the process of implementing dry weather structural diversions at six major storm drain outfalls as well as additional sand filtration BMPs to address the summer dry weather compliance deadline.

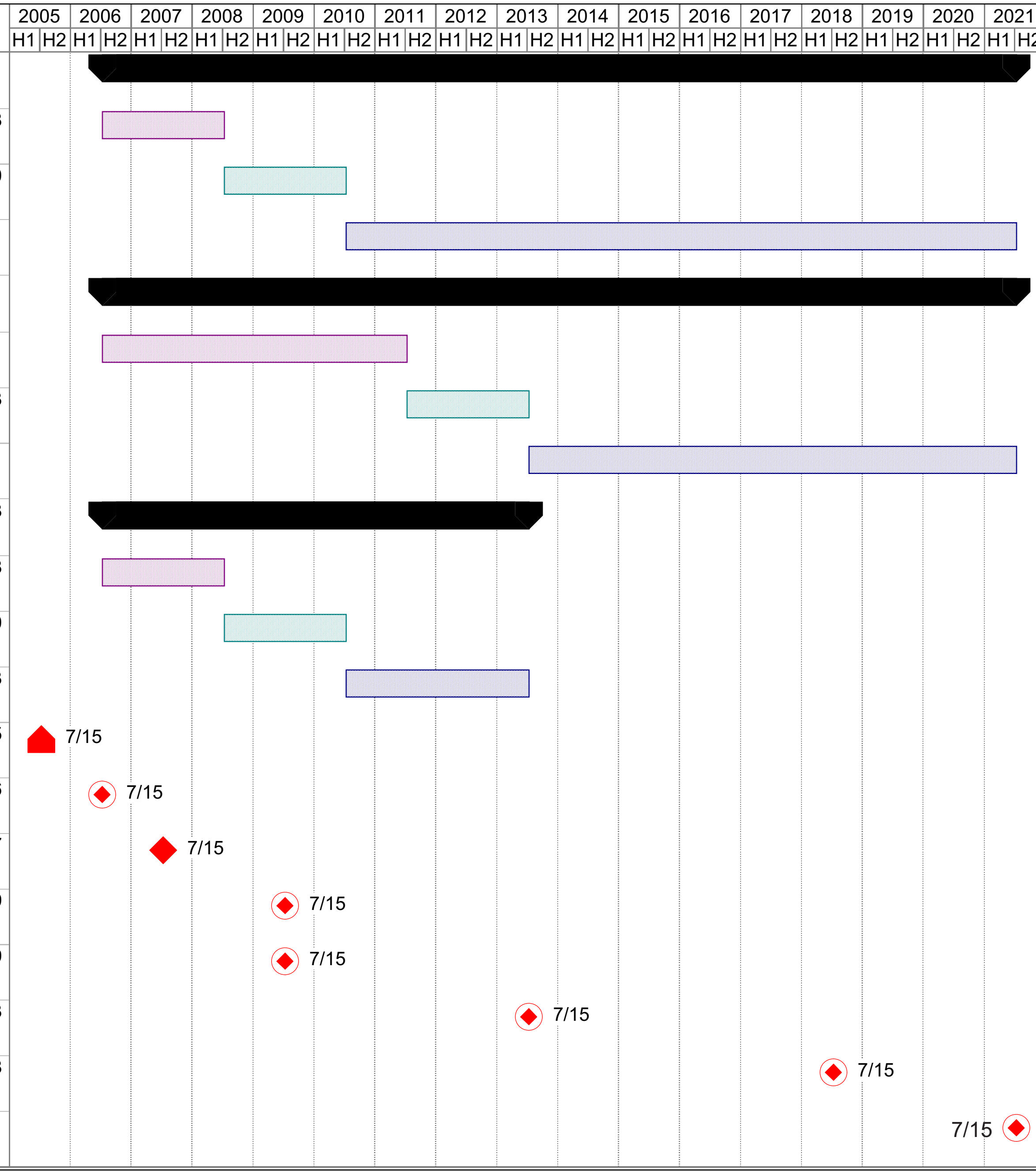
Phase I of the three management approaches will begin simultaneously. By the time the TMDL is re-opened in July 2007, Phase I of the three management approaches will be well underway.

When the second compliance deadline arrives in July 2009 (winter dry-weather and 10% wet-weather reduction), Phase I of programmatic solutions will have been implemented and Phase I source identification investigations will be complete. Additionally, Phase II of these two management approaches will also be underway and five years of Coordinated Shoreline Monitoring data will be available. It is not clear whether shoreline monitoring data will be of sufficient precision and accuracy to measure a 10% wet weather reduction in the four wet-weather exceedance days (effectively 0.4 of an exceedance day). However, the responsible agencies believe it is reasonable to expect that implementation of Phase I programmatic solutions throughout Jurisdictional Groups 5 and 6 could provide such a reduction, whether or not it can actually be measured at the shoreline.

Assuming the original schedule continues, by the 25% wet weather reduction deadline in July 2013, one entire cycle of all three phases of programmatic solutions and source control measures will be complete. Additionally the final assessment of the site-specific structural BMP study alternative will be complete (Phase II). The combined effect of source controls implemented in high priority drainage areas with appropriate expansion into other drainage areas, and all three phases of

SMBBB TMDL Implementation Plan
Jurisdictional Groups 5 and 6

ID	Task Name	Start	Finish
1	**Programmatic**	**Sat 7/15/06**	**Thu 7/15/21**
2	Phase I	Sat 7/15/06	Tue 7/15/08
3	Phase II	Tue 7/15/08	Thu 7/15/10
4	Phase III	Thu 7/15/10	Thu 7/15/21
5	**Structural BMPs**	**Sat 7/15/06**	**Thu 7/15/21**
6	Phase I	Sat 7/15/06	Fri 7/15/11
7	Phase II	Fri 7/15/11	Mon 7/15/13
8	Phase III	Mon 7/15/13	Thu 7/15/21
9	**Source Identification/Control**	**Sat 7/15/06**	**Mon 7/15/13**
10	Phase I	Sat 7/15/06	Tue 7/15/08
11	Phase II	Tue 7/15/08	Thu 7/15/10
12	Phase III	Thu 7/15/10	Mon 7/15/13
13	Implementation Plan Approved	Fri 7/15/05	Fri 7/15/05
14	Summer Dry Weather Deadline	Sat 7/15/06	Sat 7/15/06
15	Reopener # 1	Sun 7/15/07	Sun 7/15/07
16	Winter Dry Weather Deadline	Wed 7/15/09	Wed 7/15/09
17	10% Wet Weather Reduction	Wed 7/15/09	Wed 7/15/09
18	25% Wet Weather Reduction	Mon 7/15/13	Mon 7/15/13
19	50% Wet Weather Reduction	Sun 7/15/18	Sun 7/15/18
20	100% Wet Weather Reduction	Thu 7/15/21	Thu 7/15/21



programmatic solutions implemented throughout Jurisdictional Groups 5 & 6, should provide sufficient controls on bacteria loads "stored" within the watershed to achieve a 25% reduction in wet weather exceedances, and hopefully better.

This will also be the major decision point regarding distribution of future resources and effort among the three approaches. Depending on how well compliance targets have been met or exceeded through implementation of one complete cycle of source control and programmatic solutions, and on the demonstrated effectiveness of the pilot study in reducing wet-weather runoff within the pilot area, a number of potential options may be pursued. The following if/then scenarios illustrate how these decisions may be made.

- If source control measures combined with programmatic solutions appear to demonstrate promise, that is, winter dry weather allocations are not being surpassed, and wet weather exceedance allocations are still being surpassed, but are demonstrating an improving trend, then consider conducting additional source identification in high priority areas using newer source-tracking technologies and/or pilot emerging source control technologies.

- If source control measures and programmatic solutions are demonstrating an improving trend in compliance for dry weather but wet weather exceedances are not significantly improving in high priority areas, and site-specific structural BMPs appear to show promise in reducing wet-weather exceedances in the study area, then expand these site-specific BMPs into high priority areas in as many sites as are applicable and feasible from a funding standpoint.

- If the previous scenario holds true except that piloted site-specific structural BMPs are not demonstrating measurable improvements in wet weather compliance, revisit regional BMPs and consider researching and piloting medium-sized site-specific BMPs within high-priority areas that may provide more significant storage capacity for wet-weather flows.

When these major decisions regarding course of action are made, there will still be more than five years until the 50% wet weather reduction compliance date and eight years until the final compliance date. Based on lessons learned this should be sufficient time to complete a second iteration of the management approaches selected for further exploration at the major decision point.

The responsible agencies will provide an implementation progress report to Regional Board staff at each of the interim wet weather milestones. These progress reports will document accomplishments, information and findings, and planned course of action going forward. The agencies reserve the right to come before the Regional Board at any point during implementation to discuss new information or findings of significance and/or to request that the Board reconsider the TMDL in light of the information and findings.

4.6 Long Term Implementation Considerations

In order to achieve the desired objectives described in Section 2.4, additional informational inputs to the iterative, adaptive management process are needed. Although it may not be possible at this time to anticipate all future sources of information that will provide relevant and appropriate information, the following examples are illustrative of the type of information that may become available and should be considered as the plan progresses.

4.6.1 Agency-Specific Planning Factors

To assure that broader water quality benefits and public goals are given adequate consideration in the adaptive management process, each individual Jurisdictional Groups 5 and 6 agency should consider its own agency-specific factors, goals and planning issues that should influence the implementation process as it is applied within that agency's jurisdiction. Examples of such factors and issues may include, but are not limited to:

- Capital improvement projects, plans and timing
- Community Development Plans, location and timing of major redevelopment projects
- Parks and Recreation maintenance and re-landscaping schedules
- Water supply issues
- Flood control issues
- Recycled water initiatives

These factors may affect how decisions are made under the Implementation Plan with respect to location of piloted structural BMPs, timing of implementation, as well as the feasibility and cost of structural BMP and source control expansion.

4.6.2 CSMP-Initiated Source Investigations

Information relevant to the Implementation Plan may be generated as a result of Source Investigations triggered by the Coordinated Shoreline Monitoring Plan. This may occur in two ways. First and foremost, if monitoring sites within Jurisdictional Groups 5 and 6 become subject to the Source Investigation requirement, the resulting Source Investigation may assist in identifying bacteria source(s) within Jurisdictional Groups 5 and 6 that can then be mitigated in accordance with the adaptive management systems provided in this Implementation Plan. Secondly, there may be sources identified as a result of investigations in other jurisdictions that may point out the potential for similar sources within Jurisdictional Groups 5 and 6 so that lessons learned in other jurisdictions can be applied here.

4.6.3 Other Jurisdictional Group Experiences

Other Jurisdictional Groups will also be implementing their plans during this time. Findings and experiences of other groups should be considered and incorporated, if applicable or feasible, into the decision-making process for Jurisdictional Groups 5 and 6.

4.6.4 Utilize Emerging BMPs

Storm water quality management is a constantly evolving field and a key aspect of a progressive Implementation Plan is incorporating emerging technologies. There are a number of sources for identifying and obtaining information on emerging BMPs, including but not limited to:

- Los Angeles County BMP Task Force
- California Stormwater Quality Association-- www.casqa.org
- Southern California Coastal Watershed Research Project (SCCWRP) -- www.sccwrp.org
- Caltrans Stormwater Management Program technical reports-- www.dot.ca.gov/hq/env/stormwater
- Numerous professional and technical journals and conferences

Stormwater BMPs are implemented to prevent trash, sediment, and toxins from entering water bodies. Information on stormwater BMP effectiveness is not readily availabe, especially for the removal of bacteria under wet weather conditions. The International Stormwater Best Management Practices Database (USEPA, 2004) contains the results of approximately 200 historical BMP studies. The database, developed by the Urban Water Resources Research Council (UWRRC) of the American Society of Civil Engineers (ASCE) under a cooperative agreement with the USEPA, serves two key purposes: (1) to define a standard set of data-reporting protocols for use with BMP monitoring efforts, and (2) to summarize historical BMP study data in a standardized format.

An evaluation of BMP effectiveness for urban runoff is being conducted by SCCWRP to assess the effectiveness of BMPs for reducing the concentration of toxics in dry and wet weather runoff. BMPs implemented in the Southern California coastal area are being monitored both upstream and downstream for selected chemicals toxic to marine life. The types of BMPs being considered in this study include continuous deflection separation (CDS) units (with and without additional treatment modules), storm drain inserts, UV light disinfection systems, wetlands, and detention ponds. This three-year project is currently in its second year and results may be available for consideration in this TMDL within the next two years.

The mission of the County-led BMP Task Force is to address BMP requirements called for in NPDES permits, and to explore viable solutions for BMP implementation. Priorities of the Task Force include:

- Prepare guidelines for evaluating BMPs.
- Develop an objective book of standard plans and specifications for BMP selection and implementation.
- Develop guidelines for coordinating regional solutions and broad BMPs.
- Develop a website/list serve to disseminate information.
- Create a forum for exploring financing mechanisms.

As promising technologies are identified, they should be incorporated into the adaptive management process of piloting, evaluating and expanding successful technologies.

4.6.5 MS4 Permit Implications

The piloting and evaluation of BMPs under this Implementation Plan may assist agencies in identifying opportunities to petition for BMP substitutions under the storm water permits that may provide for a more cost effective water quality protection program and/or to eliminate redundancy. The municipal storm water permit provides flexibility for Permittees to petition for substitution of an alternative BMP under the Permit Stormwater Quality Management Plan (SQMP) if information and documentation on the effectiveness of the alternative is shown to be greater than the BMP prescribed in the Permit for meeting the objectives of the Permit.[5]

> *"The Regional Board Executive Officer may approve any site-specific BMP substitution upon petition by a Permittee(s), if the Permittee can document that:*
>
> > a) *The proposed alternative BMP or program will meet or exceed the objective of the original BMP or program in the reduction of storm water pollutants; or*
> >
> > b) *The fiscal burden of the original BMP or program is substantially greater than the proposed alternative and does not achieve a substantially greater improvement in storm water quality; and,*

[5] December 13, 2001, Order No. 01-182, NPDES Permit No. CAS004001, Waste Discharge Requirements for Municipal Storm Water and Urban Runoff Discharges within the County of Los Angeles and the Incorporated Cities Therein, except the City of Long Beach, Finding F.7.

c) *The proposed alternative BMP or program will be implemented within a similar period of time."*[6]

Many aspects of the Implementation Plan build on current requirements of the storm water permits. The municipal storm water permit is due for renewal in December 2006. The Caltrans statewide storm water permit is currently being renewed. Potential new requirements in the next permits should be considered in the light of their impact on this Implementation Plan.

[6] December 13, 2001, Order No. 01-182, NPDES Permit No. CAS004001, Waste Discharge Requirements for Municipal Storm Water and Urban Runoff Discharges within the County of Los Angeles and the Incorporated Cities Therein, except the City of Long Beach, Part 4.A.1.

Appendix A
Best Management Practices (BMP) Evaluation

Appendix A
Best Management Practices (BMP) Evaluation

A.1 Purpose

This technical memorandum presents an evaluation of Best Management Practices (BMPs) applicable to improving wet and dry weather runoff quality with respect to bacteria. It builds on existing stormwater BMP information provided by the Jurisdictional Group 5 and 6 agencies, and evaluates potential structural and non-structural BMPs suitable to these watersheds. Since for Jurisdictional Groups 5 and 6 it appears that dry weather runoff may be of greater concern to bacteria exceedances at the beach than wet weather runoff, this evaluation will highlight those BMPs that are applicable to dry weather runoff, as well as those that may be applicable to wet weather, or both.

The scope of this Task 2 in the Scope of Work for Jurisdictional Groups 5 and 6 is to identify and evaluate the applicability of potential programmatic non-structural source control options, on-site structural source control options (BMPs), and regional options for specific applications based on land use of dry and wet weather runoff within the Santa Monica Bay coastal watersheds of Jurisdictional Groups 5 and 6. The evaluation also ranks the effectiveness of the BMPs for wet or dry weather runoff management based on existing data, and will include planning level cost estimates.

A.2 Identification of Options

For the implementation plan, methods to manage dry and wet weather runoff are referred to as "runoff management options." For Jurisdictional Groups 5 and 6, options will be discussed in three categories: 1) programmatic non-structural source control options, which include options such as educational and outreach programs; 2) on-site structural source control options, which are structural BMPs that can be installed at individual parcels to help manage runoff before it reaches the storm drain system; and 3) regional options, which manage runoff after it has entered the storm drain system and are installed on a regional basis.

These options were chosen because they manage runoff volume and/or help to reduce bacteria concentrations in the runoff. Some of these options help to reduce concentrations of other pollutants as well.

A.2.1 Programmatic Non-Structural Source Control Options

These options are intended to prevent or reduce levels of bacteria, or bacteria sources (e.g. garbage, trash) from initially being picked up by runoff whether on-site, in the curb or on the street. One of the primary emphasis on source control is through education and outreach to change behavior. Programmatic options are an effective way to engage the commercial and residential communities and raise overall awareness of the need to reduce dry weather runoff and maintain "good housekeeping" practices. It should be noted however, that in cases of dispersed high pollutant loadings as is often typical of urban land uses, these solutions may only be minimally to moderately effective.

Based on a review of existing programmatic information provided by the Jurisdictional Group 5 and 6 agencies, most of the agencies have already adopted many programmatic non-structural source control measures and there are many examples of effective programs already in place. Outreach efforts to individuals and residents are extensive with educational brochures and flyers on stormwater pollution prevention distributed at local fairs and special city events. Several times a year pollution prevention messages are run in the local beach cities' newspapers. Materials on the need to pick up after pets are distributed through local veterinarians and animals hospitals as well as signs in popular recreation areas and walkways (such as the Strand). Prominent signs in local parks support the concept of an "Ocean Safe City." In addition to brochures, tip cards and bookmarks, several of the beach cities distribute buttons and coloring books to children.

While not impacting bacteria loading directly, nonetheless several cities have outreach programs to gardeners. The Manhattan Beach Botanical Garden, a small piece of Polliwog Park, has a garden demonstrating the use of native and drought tolerant plants and the use of "earth friendly" gardening techniques. Likewise, the cities of Redondo Beach and El Segundo distribute information to local garden clubs on how to reduce or eliminate fertilizers, pesticides, and herbicides and irrigate properly. The distribution of these materials could be expanded to include local nurseries and garden centers.

Business outreach includes restaurant outreach programs including site visits. The City of El Segundo is initiating a "green business" program to further the goals of sustainable business practices. All agencies require adherence with stormwater requirements on construction sites. All the agencies have regular training for public employees on pollution prevention practices on the job.

At the municipal level, cities across the board have regular street sweeping programs and schedules for cleaning out storm drains. When cities replace their median landscaping, it is clear that more drought tolerant landscaping is being installed, thus reducing the probability of irrigation runoff. The cities of Manhattan and Redondo Beach have a dedicated household hazardous waste drop-off facility open from Wednesday through Saturday so that residents do not have to wait for special "round-up" days. Re-stenciling of the storm drain message, "No Dumping This Drains to the Ocean," occurs regularly.

Due to their 'non-structural' nature, increased programmatic efforts may be one of the most easily implementable ways to improve runoff quality and target some source 'problem' areas. Because of this, the first phase of the implementation plan will likely include increased programmatic efforts for targeted areas and sources such as the commercial zones where nearby monitoring stations indicate high source loadings.

Since agencies in Jurisdictional Groups 5 and 6 have already taken the lead in developing and implementing many programmatic non-structural solutions, the main recommendation is to expand and share programs already in place or currently under development. Since the agencies have joined together in response to the need for a Santa Monica Bay Bacteria Implementation Plan, this coordination could be continued after the plan is submitted.

If greater coordination among all agencies occurs, targeted, broader campaigns such as those for restaurant and fast food establishments may be more effective than when done on an individual basis. Cost sharing of signs and outreach materials can help defray design and production costs while sending a consistent message repeated across a variety of media. Different kinds of messages, targeted at different audiences, could be rotated through the year. For example, working with garden clubs, nurseries, and garden centers, with stories placed in local newsletters and newspapers at the spring planting time, the message for proper irrigation and organic gardening would be strongly reinforced. Likewise, a similar campaign for pet owners through veterinarians, animal hospitals, and local pet stores could occur another month. Schools, through both direct education integrated into lesson plans and "take home" materials are extremely effective ways of reaching the public.

In addition to possibly bridging programs across agencies and increasing/enhancing current programs, there are many specific programs that target dry weather runoff issues in particular. Additional effective source control programs may include programs and education to increase xeriscape landscaping, infiltration swales, and porous pavement at both commercial and residential land uses. Near pier areas or other concentrated restaurant areas, programs and outreach to improve restaurant trash management may be effective. Agencies may want to consider techniques for reducing excessive dry weather runoff generators, for example, businesses that regularly hose down sidewalks. In addition to brochures and posters (which are passive education techniques) active education through focused educational workshops for targeted groups may be very effective, for example, chambers of commerce for commercial areas, or restaurant business districts.

A.2.2 On-Site Structural Source Control Options

On-site structural source control options provide an important step in managing wet weather runoff. They are intended to reduce the total volume and flow rate of runoff leaving properties and entering the storm drain system. Since runoff would be retained and not discharged, bacteria and other pollutants would not be discharged and would therefore be effectively prevented from entering the storm drain system.

It should be recognized that on-site structural source control options, like programmatic non-structural options, may not fully mitigate the impacts of pollutant loading, but their implementation could contribute to integrated water quality solutions, and could contribute to the reduction of the magnitude and extent of downstream impacts. However, protection of groundwater quality and prevention of soil and groundwater degradation could pose a technical implementation challenge.

Appendix A-1 includes a series of fact sheets with detailed descriptions of many BMPs applicable to Jurisdictional Groups 5 and 6, including implementation challenges and planning-level unit cost information. This set of BMPs is intended to present a wide range of options; further evaluation of which BMPs should be implemented, and where, will be evaluated in Tasks 5 and 6. These BMPs also vary in both their effectiveness and degree of maintenance required. For example, vegetated buffer systems, bioretention, and pervious paving are passive systems requiring no maintenance; their function is to mimic the natural percolation of water through soils. BMPs such as infiltration trenches and basins, catch basin systems, vortex/hydrodynamic systems, clarifiers, and media filtration, all require on-going maintenance to remove pollutants or the media that trap them. BMPs such as constructed wetlands, ponds, and cisterns require that the water being maintained in these systems is of adequate quality and do not become breeding grounds for mosquitos, especially in light of recent concerns over West Nile Virus.

Some of these on-site structural options are already implemented. Manhattan Beach, for example, has installed three Continuous Deflection Separators (CDS) units. Some municipal parking lots are being replaced with pervious paving.

The on-site BMPs listed in Appendix A-1 will vary in their effectiveness to manage dry weather flow for reducing bacteria. Some of the BMPs in Appendix A-1 will effectively reduce some pollutants from wet weather runoff, but will do little to manage dry weather runoff. These BMPs include cisterns, both residential as well as larger underground cisterns at parks and public facilities, and installation of additional CDS units. However, many of the on-site BMPs contained in the appendix are very applicable to managing dry weather runoff, and thus, may be more effective options for Jurisdictional Groups 5 and 6. These include increased capture and infiltration projects such as vegetated buffer systems, swales, bioretention, infiltration trenches, dry wells, and pervious pavement. The implementation plan will include recommendations for installing on-site BMPs in specific targeted areas. For example, in commercial areas where monitoring suggests high pollutant loadings, increased capture and infiltration projects that remove or filter pollutants may be effective.

A.2.3 Regional Options

Appendix A-1 also includes various regional BMPs that may be effective options for Jurisdictional Groups 5 and 6. One such option is to divert runoff to wastewater treatment facilities. In some parts of the greater Los Angeles region, there is enough excess capacity in both the sewer collection system and at the treatment plants to allow for year-round (both summer and winter) dry weather runoff diversions to the wastewater treatment plants.

There are other regional options that are effective for managing dry weather runoff. For example, major storm drains could be diverted to infiltration trench systems or leach fields, detention ponds (detailed in Appendix A-1). These could be implemented on a regional or even a neighborhood basis. Another option is to divert major storm drains to a dedicated dry weather runoff treatment facility for beneficial reuse or discharge. An example of such a facility is the Santa Monica Urban Runoff Recycling Facility (SMURRF) located in the City of Santa Monica.

A.3 Conclusions

In general, BMPs that control pollution and stormwater at the source are more cost effective than regional options. Planning level cost estimates are provided in Appendix A-1. Table A-1 lists the BMPs and their effectiveness in removing pollutants and/or runoff.

An evaluation of agencies' current programs was conducted. Efforts were generally found to be consistent amongst the agencies, but greater coordination among all agencies' programs may reduce costs while increasing the effectiveness of the messages being put forth. Recommendations for increased efforts and programs in the implementation plan will focus on specific areas of concern such as commercial areas, or where minor modifications to existing programs can have much greater impact.

The evaluation of structural BMPs is included here to provide information on a range of possible options. The Hydrologic Analysis Technical Memorandum will evaluate current compliance issues and identify drainage areas of concern with respect to either dry or wet weather runoff, or both. From this, it will be possible to have a basis upon which to refine BMP recommendations for particular areas.

Appendix A-1
BMP Pollutant Removal Effectiveness Summary Table and BMP Summary Fact Sheets[1]

[1] Source: BMP Fact Sheets were prepared as part of the City of Los Angeles' Integrated Resources Plan (IRP) project.

Table A-1 - BMP Polution Removal Effectiveness Summary

	Pollutants						
	Decrease/Restrict Runoff Volume	**Trash**	**Suspended Solids**	**Bacteria**	**Organics**	**Nutrients**	**Metals**
Programmatic Non-Structural Source Control							
Educational Outreach	Low	Med	Med	Med	Med	Med	Low
Street Sweeping	NA	High	Med	Med	Low	Low	Med
Restaurant Ordinance	Low	Med	Low	Med	Med	Low	Low
Onsite Structural Source Control							
Vegetated Buffer Systems	Med	Low	Med	Low	Med	Med	Med
Bioretention	Med	Low	Med	Low	Med	Med	Med
Constructed Wetlands	Med	NA	High	High	Med	High	Med
Infiltration Trench	High	NA	NA	Med	NA	High	High
Infiltration Basin	High	NA	NA	Med	NA	High	High
Cisterns	Med	NA	Med	NA	Low	NA	Low
Wet (retention) Pond	High	NA	Med	Low	Low	Low	Low
Dry (extended detention) Pond	High	NA	Med	NA	Low	Low	Low
Dry Well	Low	NA	Med	Med	Low	Low	Med
Pervious Pavement	Med	NA	NA	NA	Med	Med	Med
Catch Basin Systems	NA	High	Med	Low	Med	Low	Med
Vortex/Hydrodynamic Systems	NA	High	High	Low	Med	Med	Med
Clarifiers	Low	Med	Med	Low	High	Med	Med
Media Filtration	NA	NA	High	High	High	High	High
Regional Source Control							
Constructed Wetlands	Med	NA	High	High	Med	High	High
Infiltration Basin	High	NA	NA	Med	NA	High	High
Wet (retention) Pond	High	NA	Med	Low	Low	Low	Low
Dry (extended detention) Pond	High	NA	Med	NA	Low	Low	Low
Vortex/Hydrodynamic Systems	NA	High	High	Low	Med	Med	Med
Clarifiers	Low	Med	Med	Low	High	Med	Med
Media Filtration	NA	NA	High	High	High	High	High

High	Provides a high, consistent amount of removal.
Med	Amount of removal may vary between high or low and may be dependent upon maintenance frequency.
Low	Provides a small amount of removal.
NA	Either the type source control does not provide any removal or is not meant to be used to remove this pollutant.

BMP Summary Fact Sheet Index

On-Site Structural Source Control Options

1. **Vegetated Buffer System**
   (Biofiltration Swales, Vegetative Buffer System)

2. **Bioretention**

3. **Infiltration Trench**

4. **Cisterns**

5. **Dry Well**

6. **Pervious Pavements**
   (Asphalt, Modular Concrete Block, Poured Concrete Porous Pavements and Structural Soil)

On-Site/Regional Structural Source Control Options

7. **Constructed Wetlands**

8. **Infiltration Basin**

9. **Wet (Retention) Pond**

10. **Dry (Extended Detention) Pond**

11. **Catch Basin Systems**
    (Boarding/Coarse Screens, Generic Catch Basin Filters, Fossil Filter™,Aqua-Guard™, StormFilter™, Ultra-Urban Filter™,
    EnviroDrain®, HydroKleen™, Vortex/Hydrodynamic Systems, Generic Hydrodynamic Systems, Downstream Defender, Vortechnics™, V2B1™, Continuous Deflective Separation (CDS™), StormTreat™, Stormceptor®, Aqua-Filter™)

12. **Clarifiers**
    (Generic Clarifiers, Clarifiers with Rain Diversion, Oil/Water Separator, Jensen® Interceptor, Teichert Interceptor™, BaySaver®, Isoilater™)

13. **Media Filtration**
    (Sand/Organic Beds, Organic Filters, StormFilter™)

1. Vegetated Buffer Systems

GENERAL DESCRIPTION

Biofiltration swales and vegetated buffer strips are constructed or natural strips or areas of vegetation used for removing sediment, organic matter, and other pollutants from runoff. Swales are conveyance channels where storm water flow passes through the grass. Strips are broad surfaces with a grass cover that allows storm water to flow in relatively thin sheets.

As the runoff flows through the vegetated area or strip, the vegetation removes sediment and other pollutants from runoff by filtration, infiltration, absorption, adsorption, decomposition, and volatilization. In addition, vegetated buffers of well developed native vegetation also provide shade, coarse woody debris, nutrient uptake and numerous other benefits to water bodies.

For biofiltration swales, runoff is captured in drain inlets and routed to the swales for treatment. While, vegetated buffer strips generally receive sheet flow directly from pavement or other drainage areas.

PRIMARY BENEFITS

- Sediment and pollutant removal
- Retard runoff rates

APPLICATIONS

- Land undergoing development where buffers are needed to reduce sediment damage to adjacent property.
- Treatment of residential runoff
- Treatment of roadway runoff

DESIGN CONSIDERATIONS

- Flow must be shallow sheet flow.
- Vegetative buffers strips cannot be expected to remove all sediments. Vegetative filters should only be considered as one component of the erosion and sediment control system.
- Existing vegetation is preferred rather than replanting.
- Vegetative buffers shall be planned and established prior to disturbing the land that will produce the sediment.
- There are not precise design criteria that will guarantee a particular level of sediment removal.
- Careful plant selection can improve wildlife habitat for food and nesting.
- Land use and treatment above the strip
- Slope of land above the strip
- Length of slope above the strip
- Eroding of soil above the strip
- Slope of the land in the strip

CONSTRUCTION CONSIDERATIONS

- Grassed filter strips can be built below areas where sedimentation can be expected during construction.
- Avoid running heavy equipment into or through the swale/strip during construction and site development as well as during the life of the swale/strip.

- Disturbed soil between trees and shrubs must be mulched or planted with permanent vegetation to prevent erosion.
- The area must be protected from damage until the vegetation is properly established.

MAINTENANCE CONSIDERATIONS

- Regular inspection is required to look for signs of erosion and channelization of water.
- Any erosion or channelization must be repaired promote sheet flow conditions.
- Routinely remove accumulated trash and debris .
- Periodic fertilizing is needed to keep the vegetation healthy.

IMPLEMENTATION CHALLENGES

Technical

- Vegetative buffers require significant time to take hold and become effective treatment devices. This requires advanced planning in anticipation of their need.
- As with any vegetation, proper maintenance and care for the plants is necessary for an installation to consistently achieve the desired results.

Institutional

- Current basis of design for stormwater management system is intended to divert runoff and drain to streets and storm drains for flood control; policies do not favor on-site retention.
- Concerns about possible erosion.
- Potential insurance concerns regarding flooding.
- Funding for the maintenance of the vegetation.

COSTS

A) COST CHARACTERIZATION *(where estimates not readily available)*

Description	Capital	Operation & Maintenance	Comments
Biofiltration Swales	Low	Med	$0.5/cf
Vegetated Filter Strips	Low	Med	$1.3/cf

2. Bioretention

GENERAL DESCRIPTION

Bioretention areas are landscaping features adapted to treat stormwater runoff on the development site. They are commonly located in parking lot islands or within small pockets in residential land uses. Surface runoff is directed into shallow, landscaped depressions. These depressions are designed to incorporate many of the pollutant removal mechanisms that operate in forested ecosystems. During storms, runoff ponds above the mulch and soil in the system.

PRIMARY BENEFITS

- Provide a variety of pollutant removal mechanisms, including:
  - Filtration
  - Adsorption to soil particles
  - Biological uptake by plants
- Typically provide a higher degree of treatment due to the multiple removal mechanisms.
- Provide green space and shade

APPLICATIONS

- Commercial and residential parking areas
- Residential landscaped areas

DESIGN CONSIDERATIONS

- Drainage area should be small (i.e., five acres or less).
- Best applied to relatively shallow slopes (usually 5%).
- Sufficient slope is needed at the site to ensure that the runoff draining to a bioretention area can be conveyed to the storm drain system and accommodate peak storm flows.
- Bioretention should be separated from the water table to ensure that the groundwater never intersects with the bottom of the bioretention area, which prevents possible groundwater contamination and practice failure.
- Sites with loamy sand soils are especially appropriate for bioretention because the excavated soil can be backfilled and used as the planting soil, thus eliminating the cost of importing planting soil.
- The layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and drainage are considered.

CONSTRUCTION CONSIDERATIONS

- Avoid running heavy equipment into or through the bioretention area during construction and site development as well as during the life of the bioretention area.
- Disturbed soil between trees and shrubs must be mulched or planted with permanent vegetation to prevent erosion.
- The area must be protected from damage until the vegetation is properly established.

MAINTENANCE CONSIDERATIONS

- Periodic mulching, plant replacement, pruning, weeding is needed.

IMPLEMENTATION CHALLENGES

Technical

- Bioretention areas may require significant time to become established and become effective treatment devices. This requires advanced planning in anticipation of their need.
- As with any vegetation proper maintenance and care for the plants is necessary for an installation to consistently achieve the desired results.
- Possible problems with clogging when used to treat larger areas.
- Concerns with groundwater contamination

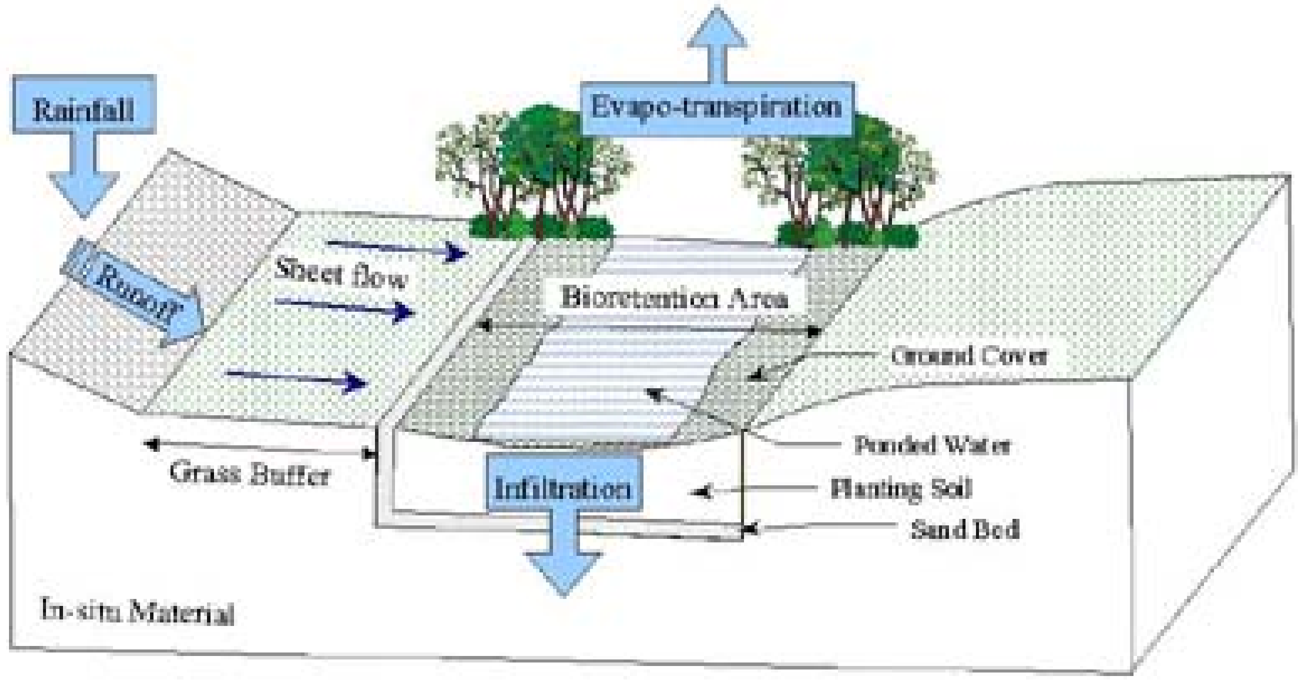
Institutional

- Current basis of design for stormwater management system is intended to divert runoff and drain to streets and storm drains for flood control; policies do not favor on-site retention.
- Concerns about possible erosion
- Potential insurance concerns regarding flooding
- Funding for the maintenance of the vegetation

COSTS

A) COST CHARACTERIZATION *(where estimates not readily available)*

Description	Capital	Operation & Maintenance	Comments
Bioretention	Med	Med	$5.3/cf


Rainfall
Evapo-transpiration
Runoff
Sheet flow
Bioretention Area
Ground Cover
Ponded Water
Planting Soil
Sand Bed
Grass Buffer
Infiltration
In-situ Material

3. Infiltration Trench

GENERAL DESCRIPTION

An infiltration trench is a rock-filled trench with no outlet that receives stormwater runoff. Stormwater runoff passes through some combination of pretreatment measures, such as a swale or sediment basin, before entering the trench. Runoff is then stored in the voids of the stones, slowly infiltrated through the bottom and into the soil matrix over a few days. The primary pollutant removal mechanism of this practice is filtration through the soil.

PRIMARY BENEFITS

- Provides 100% reduction in the load discharged to surface waters.
- Groundwater recharge
- Removal of pollutants

APPLICATIONS

- Small residential and commercial sites

DESIGN CONSIDERATIONS

- Possible accumulation of metals or other contaminents in soils
- Protection of groundwater quality
- Site infiltration rates
- Sediment removal upstream of trench
- Vegetation/landscape maintenance

CONSTRUCTION CONSIDERATIONS

- Contractor should not compact soils in the trench.
- Gravel should be washed and free from fine particles before installation.
- Trench must be protected from solids during construction activities.

MAINTENANCE CONSIDERATIONS

- Sediment, trash, and oil/grease must be removed from pretreatment devices, as well as overflow structures.
- Inspect pretreatment devices and diversion structures for sediment build-up and structural damage.
- If bypass capability is available, it may be possible to regain the infiltration rate in the short term by using measures such as providing an extended dry period.

IMPLEMENTATION CHALLENGES

Technical

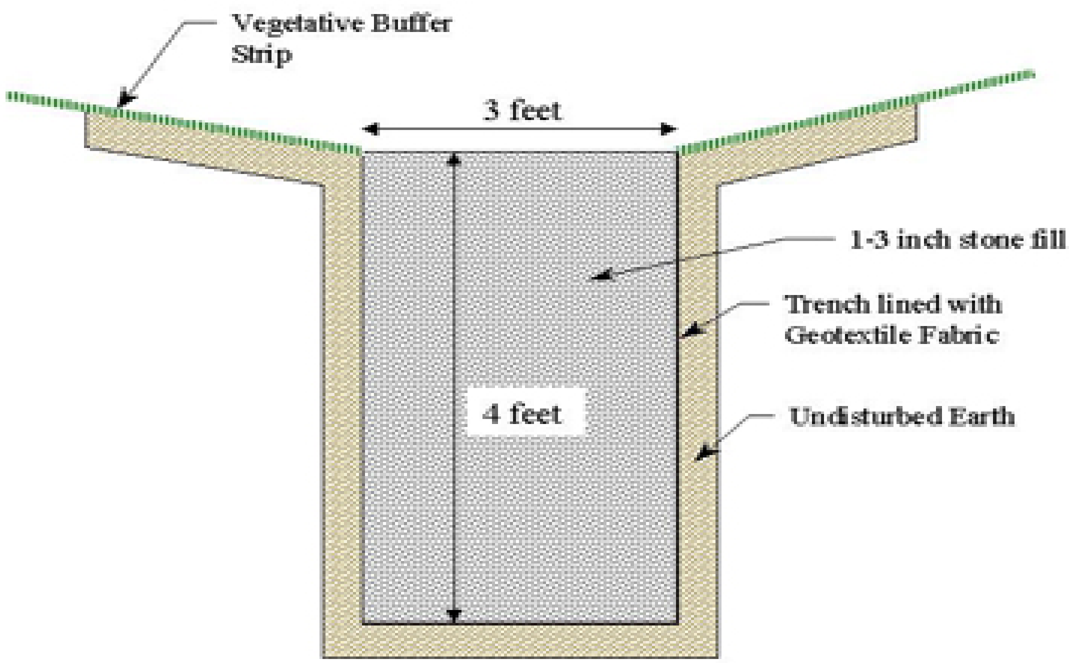
- High failure rate if soil and subsurface conditions are not suitable
- May not be appropriate for industrial sites or locations where spills may occur
- Risk of groundwater contamination in very coarse soils
- Difficult to restore functioning of infiltration trenches once clogged

Institutional

- Current basis of design for stormwater management system is intended to divert runoff and drain to streets and storm drains for flood control; policies do not favor on-site retention.
- Protection of groundwater

COSTS

A) COST CHARACTERIZATION *(where estimates not readily available)*			
Description	**Capital**	**Operation & Maintenance**	**Comments**
Infiltration Trench	Med	Med	$4/cf



4. Cisterns

GENERAL DESCRIPTION

A cistern is a tank for storing rain water which has been collected from a roof or other catchment area. Cisterns can be used for a single residential home, or for multiple homes and businesses. The captured water can be use for irrigation of landscaped or natural pervious areas. Normally for irrigation usage, a sump pump must be included in the installation.

PRIMARY BENEFITS

- Reduce runoff from site
- Reduce potable water demand for on-site irrigation
- Partial sediment removal in the cisterns
- Physical filtration of particulates through the soil profile
- Dissolved constituents uptake in the vegetative root zone by the soil-resident microbial community when used for irrigation.

APPLICATIONS

- Residential and commercial roof runoff collection
- Neighborhood or block size

DESIGN CONSIDERATIONS

- Design storm interval
- Above ground or below ground system
- Sizing of pumps and distribution pipes
- Security for public sites to prevent accidents
- Consideration of how to manage the first flush flow
- Size a cistern to provide service during extended periods of low rainfall

CONSTRUCTION CONSIDERATIONS

- Reinforced concrete, steel, and plastic are common materials.
- Concrete block cisterns are difficult to keep watertight.

MAINTENANCE CONSIDERATIONS

- Sump pump
- Requires periodic cleaning

IMPLEMENTATION CHALLENGES

Technical

- Concerns with groundwater contamination
- Concerns that installation will receive proper maintenance

Institutional

- Current basis of design for City of Los Angeles stormwater management system is intended to divert runoff and drain to streets and storm drains for flood control; policies do not favor on-site retention.

5. Dry Well

GENERAL DESCRIPTION

Dry wells are a common means of stormwater management in many areas of the United States. Driveway dry wells involve adding a drainage grate and an open bottom concrete structure at the end of the driveway. They are designed to capture and store stormwater until the water percolates into the subsurface soils.

PRIMARY BENEFITS

- Infiltration
- Physical filtration of particulates through the soil profile
- Reduce runoff from site

APPLICATIONS

- Residential properties

DESIGN CONSIDERATIONS

- Anticipated volume of storm water
- Drainage area feeding the dry well
- Characteristics of the drainage surfaces (e.g. concrete, asphalt, grass, dirt)
- Permeability and storage capacity of the subsurface soils
- Depth and local use of groundwater
- Site usage and chemical storage

CONSTRUCTION CONSIDERATIONS

- Contractor should not compact soils below dry well.
- Gravel should be washed and free from fine particles before installation.

MAINTENANCE CONSIDERATIONS

- Clogging of pipe
- Periodic cleaning of chamber and grate
- Size is also significant in a maintenance schedule, wherein a larger well will have a longer period free of maintenance.

IMPLEMENTATION CHALLENGES

Technical

- Concerns with groundwater contamination due to unmonitored installations.
- Concerns that installation will receive proper maintenance.

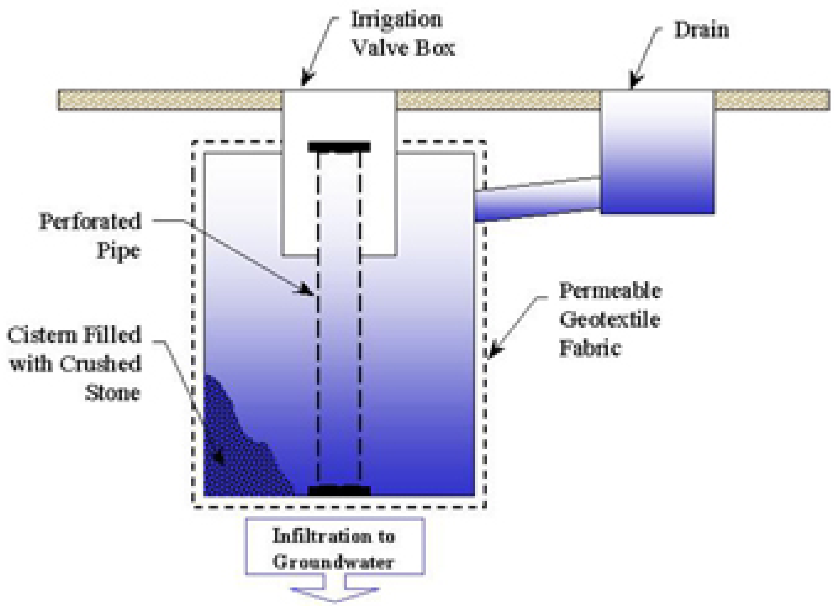
Institutional

- Current basis of design for stormwater management system is intended to divert runoff and drain to streets and storm drains for flood control; policies do not favor on-site retention.
- Potential insurance concerns regarding flooding
- Protection of groundwater

- Potential permit requirements

COSTS

A) COST CHARACTERIZATION *(where estimates not readily available)*			
Description	**Capital**	**Operation & Maintenance**	**Comments**
Dry Well	Med	Low	



6. Pervious Pavements

GENERAL DESCRIPTION

Pervious paving describes a system comprising a load-bearing, durable surface together with an underlying layered structure that temporarily stores water prior to infiltration or drainage to a controlled outlet. The surface can itself be porous such that water infiltrates across the entire surface of the material (e.g., grass and gravel surfaces, porous concrete and porous asphalt), or can be built up of impermeable blocks separated by spaces and joints, through which the water can drain. This latter system is termed 'permeable' paving. Advantages of pervious pavements is that they reduce runoff volume and are unobtrusive resulting in a high level of acceptability. Typical pervious pavements include:

- Asphalt Porous Pavements
- Modular Concrete Block Porous Pavements
- Poured Concrete Porous Pavements
- Structural Soil

PRIMARY BENEFITS

- Infiltration
- Retard runoff rates
- Provide retention
- Reduce impervious area

APPLICATIONS

- Parking lots
- Sidewalks
- Playgrounds
- Residential driveways
- Residential streets

DESIGN CONSIDERATIONS

- Determine the traffic/pedestrian loading of area.
- The subgrade should be able to sustain traffic loading without excessive deformation.
- Consider ways to maximize infiltration or storage.
- The granular capping and sub-base layers should give sufficient load-bearing to provide an adequate construction platform and base for the overlying pavement layers.

CONSTRUCTION CONSIDERATIONS

- Permeable surfaces can be laid without cross-falls or longitudinal gradients.
- The blocks should be lain level.
- The pavement should be constructed in a single operation, as one of the last items to be built, on a development site. Landscape development should be completed before pavement construction to avoid contamination by silt or soil from this source.
- Surfaces draining to the pavement should be stabilized before construction of the pavement.

MAINTENANCE CONSIDERATIONS

- Type of use
- Amount of traffic
- The local environment and any contributing catchments

IMPLEMENTATION CHALLENGES

Technical

- Possible problems with plugging
- Concerns with groundwater contamination

Institutional

- Current basis of design for stormwater management system is intended to divert runoff and drain to streets and storm drains for flood control; policies do not favor on-site retention.
- Municipal approval process for pervious pavement varies by local and may discourage implementation.

COSTS

A) COST CHARACTERIZATION *(where estimates not readily available)*

Description	Capital	Operation & Maintenance	Comments
Asphalt Porous Pavements	Med	Low	$10-$15/sf
Modular Concrete Block Porous Pavements	High	Low	$10-$15/sf
Poured Concrete Porous Pavements	High	Low	$10-$15/sf
Structural Soil	Med	Low	$10-$15/sf

7. Constructed Wetlands

GENERAL DESCRIPTION

A constructed wetland is a biological stormwater treatment technology designed to mimic processes found in natural wetland ecosystems. These wetland systems utilize wetland plants, soil and the associated microorganisms to remove contaminants found in stormwater. The installation of these systems also provides the opportunities to create or restore wetland habitat for wildlife and environmental improvement.

A typical constructed wetland is a series of rectangular plots that are filled with uniform graded sand or gravel. The bottom of the plot can be lined with materials like concrete or plastic to prevent possible contamination of the groundwater. The root mass of the wetlands plants provides filtration as well as oxygen and carbon for water treatment. The roots also offer attachment sites for microbes that consume the available oxygen in the process of breaking down pollutants. Constructed wetlands can be further classified according to the flow pattern. The most common flow patterns used are: free water surface flow, subsurface flow, vertical flow, and hybrid (i.e. combinations of the previous) flow.

PRIMARY BENEFITS

- Removal of nutrients
- Dissolved pollutants
- Retard runoff rates
- Provide retention
- Create or restore wetland habitat for wildlife

APPLICATIONS

- Commercial, industrial and residential runoff.
- Enhancement of existing open space, including parks and rivers.

DESIGN CONSIDERATIONS

- Treatment requirements and regulations
- Source water characteristics
- Area required to meet treatment requirements
- Water availability during the dry season
- Aesthetics
- Mosquito control
- Public access and wildlife needs

CONSTRUCTION CONSIDERATIONS

- Construction needs to be planned so as to not impact existing and nearby habitat.
- The area must be protected from damage until the vegetation is properly established.

MAINTENANCE CONSIDERATIONS

- Schedule semi-annual inspections for burrows, sediment accumulation, structural integrity of the outlet, and litter accumulation.
- Remove accumulated trash and debris in the basin at the middle and end of the wet season

- The frequency of this activity may be altered to meet specific site conditions and aesthetic considerations.

IMPLEMENTATION CHALLENGES

Technical

- Wetlands consume a relatively large amount of space, making them an impractical option on many sites where surface land area is constrained or land prices are high.
- Although design features can minimize the potential of wetlands to become a breeding area for mosquitoes, there can be public perception that wetlands are a mosquito source.
- Wetlands require careful design and planning to ensure that wetland plants survive and flourish after construction.
- Some evidence exists that stormwater wetlands can release some nutrients during the non-growing season.
- Designers should ensure that wetlands are not built in natural wetlands or high quality forest

Institutional

- Liability
- Operations and maintenance costs

COSTS

A) COST CHARACTERIZATION *(where estimates not readily available)*			
Description	**Capital**	**Operation & Maintenance**	**Comments**
Constructed Wetlands	High	Med	$0.6-$1.25/cf

8. Infiltration Basin

GENERAL DESCRIPTION

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater. By using plastic storage media or precast concrete boxes, infiltration basins can also be installed underground. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff.

PRIMARY BENEFITS

- Retard runoff rates
- Provide retention
- Recharge groundwater supplies

APPLICATIONS

- Residential and commercial sites
- Small to large sub-watersheds (20 to 30 acres maximum)

DESIGN CONSIDERATIONS

- Infiltration basins should be placed on flat ground.
- Pretreatment for solids, trash, oil and grease is important in extending the life of the basin and reducing maintenance.
- Possible accumulation of metals or other contaminants in soils
- Consider source water quality in design of pretreatment for protection of groundwater quality.
- Design storm event
- Site infiltration rates
- Vegetation establishment on the basin floor may help reduce the clogging.

CONSTRUCTION CONSIDERATIONS

- Contractor should take precautions to not compact soils in the basin.
- Any gravel used should be washed and free from fine particles before installation.
- Basin must be protected from solids during construction activities.
- Upstream drainage area must be completely stabilized before construction.

MAINTENANCE CONSIDERATIONS

- Inspect pretreatment devices and diversion structures for sediment build-up and structural damage.
- Sediment, trash, and oil/grease must be removed from pretreatment devices, as well as overflow structures.
- Observe drain time for the design storm after completion or modification of the facility to confirm that the desired drain time has been obtained.
- Schedule semiannual inspections for beginning and end of the wet season to identify potential problems such as erosion of the basin side slopes and invert, standing water, trash and debris, and sediment accumulation.
- Remove accumulated trash and debris in the basin at the start and end of the wet season.
- Inspect for standing water at the end of the wet season.

- Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetics and vector control.
- Periodic removal of accumulated sediment.

IMPLEMENTATION CHALLENGES

Technical

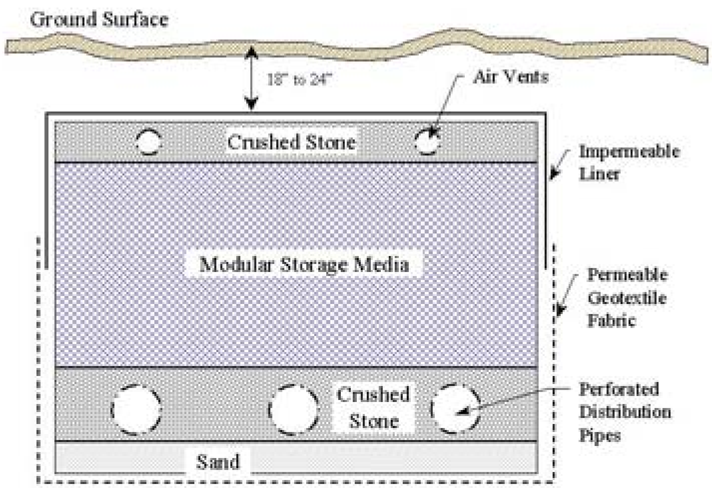
- High failure rate if soil and subsurface conditions are not suitable or if solids are not properly removed
- May not be appropriate for industrial sites or locations where spills may occur
- Not suitable on fill sites or steep slopes
- Difficult to restore functioning of infiltration basins once clogged
- Concerns with groundwater contamination
- Can be land intensive, depending on infiltration rate

Institutional

- Current basis of design for stormwater management system is intended to divert runoff and drain to streets and storm drains for flood control; policies do not favor on-site retention.
- Operation and maintenance costs
- Liability
- Protection of groundwater

COSTS

A) COST CHARACTERIZATION *(where estimates not readily available)*			
Description	**Capital**	**Operation & Maintenance**	**Comments**
Above Ground Infiltration Basin	Med	Med	$1.30/cf
Below Ground Infiltration Basin	High	Med	$7-$10/cf



9. Wet (Retention) Pond

GENERAL DESCRIPTION

Wet ponds (a.k.a. stormwater ponds, retention ponds, wet extended detention ponds) are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season) and differ from constructed wetlands primarily in having a greater average depth. Ponds treat incoming stormwater runoff by settling and biological uptake. Wetlands type planting may be used on shallow edges of pond.

PRIMARY BENEFITS

- Provide some infiltration
- Retard runoff rates
- Provide retention

APPLICATIONS

- Large open areas
- May be combined with recreational open space opportunities

DESIGN CONSIDERATIONS

- Vector control
- Sediment removal and pretreatment
- Ponds should be designed with a non-clogging outlet such as a reverse-slope pipe.
- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.
- In areas with porous soils an impermeable liner may be required to maintain an adequate permanent pool level.
- Outlet structures and piping should be installed with collars to prevent water from seeping through the fill and causing structural failure.

MAINTENANCE CONSIDERATIONS

- Note signs of hydrocarbon build-up, and manage appropriately.
- A maintenance ramp should be included in the design to facilitate access to the forebay for maintenance activities and for vector surveillance and control.
- Monitor for sediment accumulation in the facility and forebay.
- Examine to ensure that inlet and outlet devices are free of debris and operational
- Inspect facility after first large storm to determine whether the desired residence time has been achieved.

IMPLEMENTATION CHALLENGES

Technical

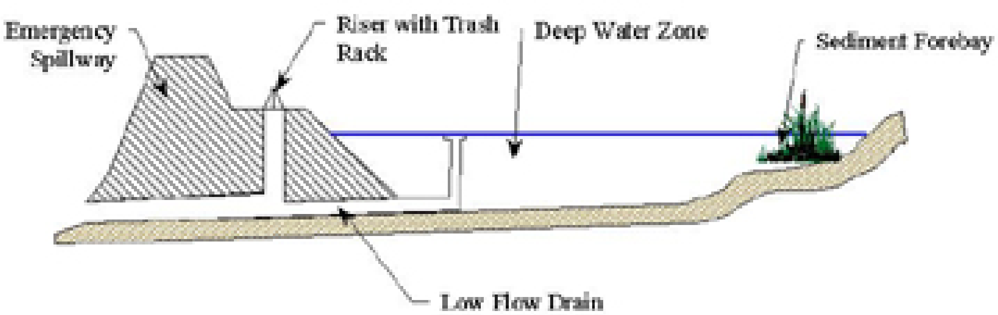
- Mosquito and midge breeding could occur in ponds
- Cannot be placed on steep, unstable slopes
- Need for base flow or supplemental water if water level is to be maintained
- Require relatively large footprints

Institutional

- Current basis of design for stormwater management system is intended to divert runoff and drain to streets and storm drains for flood control; policies do not favor on-site retention.
- Liability

COSTS

A) COST CHARACTERIZATION *(where estimates not readily available)*			
Description	**Capital**	**Operation & Maintenance**	**Comments**
Wet (Retention) Pond	High	Med	$0.5-$1/cf



10. Dry (Extended Detention) Pond

GENERAL DESCRIPTION

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (e.g., 48 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

PRIMARY BENEFITS

- Provide retention
- Provide substantial capture of sediment and other pollutants associated with particulates.

APPLICATIONS

- Large open areas
- May be combined with recreational open space opportunities

DESIGN CONSIDERATIONS

- Design storm interval
- Consideration of possible treatment of the first flush flow
- Groundwater infiltration

MAINTENANCE CONSIDERATIONS

- Inspect for damage to the embankment.
- Monitor for sediment accumulation in the facility and forebay.
- Examine to ensure that inlet and outlet devices are free of debris and operational.
- Inspect facility after first large storm to determine whether the desired residence time has been achieved.

IMPLEMENTATION CHALLENGES

Technical

- Concerns with groundwater contamination
- Dry extended detention ponds have only moderate pollutant removal when compared to some other structural stormwater practices, and they are relatively ineffective at removing soluble pollutants.
- Dry ponds can actually detract from the value of a home due to the adverse aesthetics of dry, bare areas and inlet and outlet structures.

Institutional

- Current basis of design for stormwater management system is intended to divert runoff and drain to streets and storm drains for flood control; policies do not favor on-site retention.
- Operations and maintenance costs

- Liability
- Protection of groundwater

COSTS

A) COST CHARACTERIZATION *(where estimates not readily available)*			
Description	**Capital**	**Operation & Maintenance**	**Comments**
Dry (Extended Detention) Pond	High	Med	$0.5-$1/cf

11. Catch Basin Systems

GENERAL DESCRIPTION

A catch basin (a.k.a., storm drain inlet, curb inlet) is an inlet to the storm drain system that typically includes a grate or curb opening. Catch basin systems include the installation of screens, filter units, and sediments trap at each individual basin. These systems provide the same treatment capabilities as larger installations, but at a smaller scale. Catch basin systems has been adapted to stormwater treatment by several manufacturers which includes:

- Kleen Screens™
- CSM Corp™
- Fossil Filter™
- Aqua-Guard™
- StormFilter™
- Ultra-Urban Filter™
- Enviro-Drain®
- HydroKleen™

PRIMARY BENEFITS

- Capture of trash, sediment and other pollutants
- Pretreatment for other BMPs

APPLICATIONS

- New development
- Retrofit of existing installations

DESIGN CONSIDERATIONS

- Determine the actual requirements driving installation.
- Basic design should also incorporate a hooded outlet to prevent floatable materials and trash from entering the storm drain system.
- Incorporate infiltration through the catch basin bottom if possible. However, infiltrating catch basins should not be used in commercial or industrial areas, due to possible groundwater contamination.

MAINTENANCE CONSIDERATIONS

- Catch basins can become a source of pollutants through resuspension when not frequently maintained.
- Routine maintenance is required to retain the storage available in the sump to capture sediment.

IMPLEMENTATION CHALLENGES

Technical

- Can be difficult to implement on a large scale due to the shear numbers of catch basins
- If not maintained properly, effectiveness will be limited.

Institutional

- Operations and maintenance costs
- Implementation costs

COSTS

A) COST CHARACTERIZATION *(where estimates <u>not</u> readily available)*			
Description	**Capital**	**Operation & Maintenance**	**Comments**
Boarding/Coarse Screens	Low	Med	$300/opening
Fossil Filter™	Low to Med	Med	$3.1k/cfs
Aqua-Guard™	Med to High	Med	$3k/ catch basin
StormFilter™	Med to High	Med	$36.6k-$74/cfs
Ultra-Urban Filter™	Low	Med	$4.5/cfs -$3k/catch basin
Enviro-Drain®	Low	Low	$3k-$4k/cfs
HydroKleen™	Low to Med	Low	$3.9k - $11.4k/cfs

11a. Vortex/Hydrodynamic Systems

GENERAL DESCRIPTION

Vortex separators (swirl concentrators) are gravity separators, and in principle are essentially wet vaults. The difference from wet vaults, however, is that the vortex separator is round, rather than rectangular, and the water moves in a centrifugal fashion before exiting. By having the water move in a circular fashion, rather than a straight line as is the case with a standard wet vault, it is possible to obtain significant removal of suspended sediments and attached pollutants with less space. Vortex separators were originally developed for combined sewer overflows (CSOs), where it is used primarily to remove coarse inorganic solids.

Vortex separation has been adapted to stormwater treatment by several manufacturers including:

- Downstream Defender
- Vortechnics™
- V2B1™
- Continuous Deflective Separation (CDS™)
- Stormceptor®
- Aqua-Swirl™

PRIMARY BENEFITS

- Provides removal of trash, solids, and other pollutants associated with the solids.
- May provide the desired performance in less space and therefore less cost.
- May be more cost-effective pre-treatment devices than traditional wet or dry basins.
- Mosquito control may be less of an issue than with traditional wet basins.
- Maintenance may be less costly.

APPLICATIONS

- Residential, commercial, and industrial sites
- Pretreatment for other BMPs (e.g. infiltration basins)

DESIGN CONSIDERATIONS

- Service area and design flow
- Source water quality and characteristics
- Settling velocity
- Target removal efficiency
- Determine if the unit will be inline or offline (i.e., includes bypass)
- Inlet pipe diameter

MAINTENANCE CONSIDERATIONS

- Removal of accumulated material with a vactor truck.
- Remove and dispose the floatables separately due to the presence of petroleum product.
- Could resuspend solids if not cleaned regularly

IMPLEMENTATION CHALLENGES

Technical

- Concern about mosquito breeding for systems with standing water that remains between storms
- Limited "real world" testing data
- Removal efficiencies are dependent on the sediment characteristics of the individual site.
- The non-steady flows of stormwater decrease the efficiencies of vortex separators relatve to what may be estimated or determined from testing under constant flow.
- Do not remove dissolved pollutants.

Institutional

- Operations and maintenance costs

COSTS

A) COST CHARACTERIZATION *(where estimates not readily available)*			
Description	**Capital**	**Operation & Maintenance**	**Comments**
Downstream Defender	Med to High	Med	$5.2k-$16.1k /cfs
Vortechnics™	Med to High	Med	$9k-$36.8k /cfs
V2B1™	Med to High		$7k-$17k /cfs
Continuous Deflective Separation (CDS™)	Med to High		$7.5k-$12k /cfs
Stormceptor®	Med to High	Med	$16.7k-$33.1k /cfs $40k/7,200-gal
Aqua-Swirl™	Med to High	Med	

12. Clarifiers

GENERAL DESCRIPTION

Clarifiers also commonly called trapping catch basins, oil/grit separators or oil/water separators, consist of one or more chambers that promote sedimentation of coarse materials and separation of free oil (as opposed to emulsified or dissolved oil) from stormwater. Some clarifiers also contain screens to help retain larger or floating debris, and many of the newer designs also include a coalescing unit that helps promote oil/water separation. A typical unit consists of a sedimentation chamber, an oil separation chamber, and a discharge chamber.

Clarifiers have been adapted to stormwater treatment by several manufacturers including:

- StormGate Separator™
- Jensen® Interceptor
- Teichert Interceptor™
- BaySaver®
- Isoilater™

PRIMARY BENEFITS

- Sediment removal
- Oil/water separation

APPLICATIONS

- Residential, commercial, and industrial sites
- Pretreatment for other BMPs (e.g. infiltration basins)

DESIGN CONSIDERATIONS

- Service area and design flow
- Source water quality and characteristics
- Settling velocity
- Target removal efficiency
- Determine if the unit will be inline or offline (i.e., includes bypass)
- These devices are appropriate for oils and grease, but to provide the same amount of sediment removal as the hydrodynamic system, they would need to be much larger.

MAINTENANCE CONSIDERATIONS

- Typical maintenance includes trash removal if a screen or other debris capturing device is used, and removal of sediment using a vactor truck.
- Operators need to be properly trained in clarifier's maintenance.
- Could resuspend solids if not cleaned regularly

IMPLEMENTATION CHALLENGES

Technical

- Typically capture only the first portion of runoff for treatment and are generally used for pretreatment before discharging to other best management practices (BMPs).

- Standing water in the devices may provide a breeding ground for mosquitoes.
- Size of clarifiers for significant sediment removal can be quite large.

Institutional

- Operations and maintenance costs
- Implementation costs to treat larger flows

COSTS

A) COST CHARACTERIZATION *(where estimates not readily available)*			
Description	**Capital**	**Operation & Maintenance**	**Comments**
Oil/Water Separator	Med	Med	$10k/5,000-gal tank
Jensen® Intercept or	Low to Med	Low	$11.8k -$12.4k/cfs
Teichert Interceptor™	Low	Low	$8.7/cfs
BaySaver®	Low to Med	Low	$2.4k/cfs treated
Isoilater™	Med	Med	$4.7k/cfs treated

13. Media Filtration

GENERAL DESCRIPTION

Stormwater media filters are usually two-chambered, including a pretreatment settling basin and a filter bed filled with sand or other absorptive filtering media. As stormwater flows into the first chamber, large particles settle out, and then finer particles and other pollutants are removed as stormwater flows through the filtering media in the second chamber. The pre-manufactured filters generally do not have the two chambers, but are installed with a clarifier or hydrodynamic system upstream to remove the "gross" pollutants.

There are a number of design variations and pre-manufactured units including:

- Sand/Organic Beds
- Organic Filters
- CDS Media Filter
- Aqua-Filter™
- StormFilter™

There are also specialized media that can be used to remove targeted dissolved pollutants.

PRIMARY BENEFITS

- High removal of sediment
- Possible removal of dissolved pollutants

APPLICATIONS

- Residential, commercial, and industrial sites
- Polishing to meet stricter discharge limits
- Pretreatment for other BMPs (e.g. infiltration basins)

DESIGN CONSIDERATIONS

- Work best for relatively small flows.
- Source water quality to determine the required removal efficiency.
- Identifying target pollutants for removal.
- Need to include proper access for changing of the filter media.
- Requires significant hydraulic head.

MAINTENANCE CONSIDERATIONS

- Ensure that contributing area, filtering practice, inlets and outlets are clear of debris.
- Ensure that the contributing area is stabilized and mowed, with clippings removed.
- Check regularly, particularly after moderate and major storms, to ensure that the filter surface is not clogging.
- Ensure that activities in the drainage area minimize oil/grease and sediment entry to the system.

- If a permanent pool is present, ensure that the chamber does not leak, and normal pool level is retained.
- Periodic (2 to 5 years) removal and replacement of filter media.

IMPLEMENTATION CHALLENGES

Technical

- More expensive to construct than many other BMPs.
- May require more maintenance that some other BMPs depending upon the sizing of the filter bed.
- Generally require more hydraulic head to operate properly (minimum 4 feet).
- Filters in residential areas can present aesthetic and safety problems if constructed with vertical concrete walls.

Institutional

- Operations and maintenance costs
- Installation costs

COSTS

A) COST CHARACTERIZATION *(where estimates not readily available)*			
Description	**Capital**	**Operation & Maintenance**	**Comments**
StormFilter™	High	Med	$50,000/cfs treated
Stormceptor®	High	Med	
BMP3	High	Med	$18.6k/cfs treated

Appendix B
Hydrologic Analysis

Appendix B
Hydrologic Analysis

B.1 Purpose

The purpose of this TM is to perform a hydrologic study of the major drainage areas and storm drain outlets that discharge to the Santa Monica Bay beaches within Jurisdictions 5 and 6. The goal is to determine an overall approach to managing stormwater runoff by evaluating land use, generating dry and wet weather runoff volume estimates, and analyzing historic rainfall data.

First, the locations of the regulated beach monitoring locations and major storm drainage areas were used to divide Jurisdictions 5 and 6 into ten larger drainage areas. Following selection of drainage areas, historic rainfall and water quality compliance data at the beach monitoring locations was reviewed to assess the effect of wet and dry weather runoff on bacteria exceedances at the beach. Of key importance is to identify and prioritize areas within the J5/6 where compliance is anticipated to be the most problematic and to evaluate whether the prioritization is different for wet and dry weather. This analysis will lead to development of an approach of how to prioritize runoff management solutions in order to meet the TMDL requirements in a cost effective manner. In addition, the analysis will assist in identifying appropriate localized options for managing runoff.

Section 2 describes the subwatershed drainage areas and land use analysis. Section 3 presents results of the analysis of historic water quality monitoring data. Section 4 provides estimates of runoff volume for each of the drainage areas. This memorandum is intended to be utilized in the context of other task deliverables in support of the Implementation Plan.

B.2 Subwatersheds and Land Use Analysis

Over 70 subwatershed drainage areas and their corresponding drain outlets were identified by the Jurisdictions, as shown in Appendix B. Using a watershed and beach outlet map developed by the four major agencies (Manhattan Beach, Hermosa Beach, Redondo Beach and Torrance), the drainage areas were grouped together to form ten larger drainage areas. In order to determine their impact on nearby regulated beach monitoring sites, each drainage area corresponds to one or two monitoring locations. The resulting monitoring zone boundaries were shifted slightly to compensate for the Pacific Ocean's southward currents.

Compliance monitoring locations for Jurisdictions 5 and 6 were identified in the Coordinated Monitoring Plan and are listed in Table 1. Many of the compliance monitoring sites were selected to coincide with sites long used in beach monitoring programs conducted by the City of Los Angeles Environmental Monitoring Division (EMD) and by the County of Los Angeles Department of Health Services (DHS). Since 1999, the county environmental health departments in California have monitored all beaches with more than 50,000 annual visitors or with storm drains that flow throughout the summer in accordance with AB 411. Closures or advisories are issued for beaches that fail to meet the state's standards for total coliform, fecal coliform or enterococcus bacteria. DHS has periodically added new beach monitoring locations and has renumbered its sites several times. In Table 1 the Historical ID column lists the DHS abbreviation corresponding to the most recent Department of Health Service beach monitoring sites, and the S abbreviation refers to the City of Los Angeles stormwater monitoring sites.

Table B-1

Compliance Monitoring Sites

Site ID	Historical ID	Location Description
SMB-5-1	S13	40^{th} St., Manhattan Beach
SMB-5-2	DHS 113	$27/28^{th}$ St. extended, Manhattan Beach
SMB-5-3	S14	50 yards south of Manhattan Beach Pier
SMB-5-4	DHS 114	26^{th} St. extended, Hermosa Beach
SMB-5-5	S15	50 yards south of Hermosa Beach Pier
SMB-6-1	DHS 115	Herondo St. extended (at Herondo drain)
SMB-6-2	S16	50 yards south of Redondo Beach Pier
SMB-6-3	N/A	Project of Sapphire St. drain
SMB-6-4	DHS 116	Topaz St. extended (north of groin/jetty)
SMB-6-5	S17	Avenue I, Redondo Beach
SMB-6-6	S18	Malaga Cove

Each of the ten drainage areas corresponds to one or two monitoring site(s). The drainage areas are named according to the monitoring site(s) they represent. Appendix A shows the drainage areas and their corresponding land use as described in Section 2.2. The black lines represent the drainage area boundaries. The purple line is the Jurisdiction 5 boundary, and the red line is the Jurisdiction 6 boundary.

B.2.1 Land Use

Land use was determined by analyzing parcel data from each agency and inserting the data into the Subwatersheds and Land Use map (Appendix A). Land use was divided into six general categories: commercial, manufacturing/industrial, mixed use, open space, public facility, and residential. As shown in Appendix A, approximately 75% of the total area within Jurisdictions 5 and 6 is residential. Public facilities occupy approximately 13% of the total area. Commercial areas are located mainly along the Piers and Pacific Coast Highway, and comprise about 8% of the total area. There are very few manufacturing/industrial facilities, mixed use developments, and open space areas (totaling approximately 5% of the total area). Table 2 shows the land use breakdown for each monitoring zone.

Table B-2

Land Use per Drainage Area

Monitoring Zone	Residential (ac)	Commercial (ac)	Public Facility (ac)	Manufacturing/ Industrial (ac)	Mixed Use (ac)	Open Space (ac)	Total (ac)
SMB-5-1	55.4 (~68%)	7.6 (~9%)	18.6 (~23%)	---	---	---	**81.6**
SMB-5-2	1008.2 (~81%)	72.5 (~6%)	125.7 (~10%)	---	---	42.5 (~3%)	**1248.9**
SMB-5-3	90.1 (~63%)	12.9 (~9%)	32.9 (~23%)	---	---	7.5 (~5%)	**143.4**
SMB-5-4	187.5 (~91%)	6.8 (~3%)	5.4 (~3%)	---	---	5.8 (~3%)	**205.5**
SMB-5-5	217.1 (~74%)	44.4 (~15%)	---	4.2 (~1%)	---	29.3 (~10%)	**295**
SMB-6-1	1572.5 (~68%)	207.9 (~9%)	320.0 (~14%)	65.9 (~3%)	101.8 (~4%)	28.2 (~1%)	**2296.3**
SMB-6-2	497.5 (~65%)	77.9 (~10%)	184.8 (~24%)	---	9.8 (~1%)	---	**770**
SMB-6-3 & SMB-6-4	96.6 (~64%)	6.5 (~4%)	46.3 (~31%)	---	2.0 (~1%)	---	**151.4**
SMB-6-5	578.5 (~86%)	41.6 (~6%)	33.3 (~5%)	---	22.0 (~3%)	---	**675.4**
SMB-6-6	225.3 (~96%)	---	9.2 (~4%)	---	---	---	**234.5**
Total	**4528.7**	**478.1**	**776.2**	**70.1**	**135.6**	**113.3**	**6102.0**

The majority of the drainage areas are comprised of residential areas, ranging from 63% of the total area in drainage area SMB-5-3 to 96% of the total area in drainage area SMB-6-6. However, the drainage areas vary in their amount of open space, mixed use, public facility, commercial, and manufacturing/industrial land uses. Drainage areas SMB-5-3 and SMB-5-5 have the greatest amount of open space, whereas four of the remaining drainage areas in Figure 3 do not have any open space at all. Drainage areas SMB-6-2 and SMB-6-3/SMB-6-4 have the highest amount of public facility land use, which includes the beaches. Overall, the land use is relatively similar in each drainage area, with residences occupying the majority of space within Jurisdictions 5 and 6.

B.3 Data Analysis

B.3.1 Background

Both compliance requirements and deadlines are relevant considerations when prioritizing actions within the Implementation Plan. The SMBBB TMDLs established compliance requirements and deadlines for Summer and Winter Dry-Weather and Wet-Weather[1] (year-round). Compliance requirements of the two TMDLs are described in Resolution 2002-004 and Attachment A to the Resolution (Dry Weather TMDL), and Resolution 2002-022 and Attachments A and B to the Resolution (Wet Weather TMDL).

Compliance with the SMBBB TMDL is established by analyzing ocean water for four bacterial indicators (total coliform density, fecal coliform density, enterococcus density, and total coliform density when the ratio of fecal-to-total coliform density exceeds 0.1). There are single-sample limits for all four of the indicators, and rolling 30-day geometric mean limits on the first three indicators:

<u>Single Sample Limits</u>

- Total coliform density shall not exceed 10,000/100 ml
- Fecal coliform density shall not exceed 400/100 ml
- Enterococcus density shall not exceed 104/100 ml
- Total coliform density shall not exceed 1,000/100 ml if the ratio of fecal-to-total coliform exceeds 0.1

<u>Rolling 30-day Geometric Mean Limits</u>

- Total coliform density shall not exceed 1,000/100 ml
- Fecal coliform density shall not exceed 200/100 ml
- Enterococcus density shall not exceed 35/100 ml

The SMBBB TMDLs sets multi-part numeric allocations for each of the historic monitoring sites. At each site a separate allocation was set for each of the three weather-season scenarios (Summer-Dry, Winter-Dry and Wet). These allocations establish the number of days within a "storm year" (November 1 through October 31) that sample results from the Compliance Monitoring Plan can exceed any of the

[1] Dry weather days are defined as those with <0.1 inch of rain and those days not less than 3 days after a rain day. Rain days are defined as those with >=0.1 inch of rain. (ref. Attachment A to Resolution No. 02-004, footnote in Table 7-4.2a)

single-sample limits, i.e., the number of allowable exceedance days. The allocation for Rolling Geometric Mean and Summer Dry Weather is zero exceedances at all sites. The allocations for Winter Dry-Weather and Wet Weather at each site are shown in Table 3.

Table B-3 Waste Load Allocations							
				Single Sample Allowable Exceedance Days			
Site ID	Hist. ID	Location description	Type of Site	Winter Dry Daily Sampling	Winter Dry Weekly Sampling	Wet Weather Daily Sampling	Wet Weather Weekly Sampling (daily/7)
Leo Carillo Beach			**reference beach**	3	1	17	3
SMB-5-1	S13	Manhattan State Beach at 40th Street	existing open beach	1	1	4	1
SMB-5-2	DHS 113	27/28th St. extended in Manhattan Beach	moved to point zero	*3*	*1*	*17*	*3*
SMB-5-3	S14	Manhattan Beach Pier--50 yds south	moved to point zero	1	1	5	1
SMB-5-4	DHS 114	26th Street extended in Hermosa Beach	existing open beach	0	0	12	2
SMB-5-5	S15	Hermosa Beach Pier--50 yds south	existing open beach	2	1	8	2
SMB-6-1	DHS 115	Herondo Street extended (at Herondo drain)	moved to point zero	3	1	17	3
SMB-6-2	S16	Redondo Beach Pier--50 yds south	existing open beach	3	1	14	2
SMB-6-3	N/A	Projection of Sapphire Street drain	new site at point zero	*3*	*1*	*17*	*3*
SMB-6-4	DHS 116	Topaz Street extended (north of groin/jetty)	existing open beach	3	1	17	3
SMB-6-5	S17	Redondo State Beach at Avenue I	moved to point zero	3	1	6	1
SMB-6-6	S18	Malaga Cove	existing open beach	1	1	3	1
J5/6 Total				23	10	120	22
Note:	The Reference Beach is used in setting maximum waste load allocations to ensure that water quality is at least as good as that of the reference system. A reference system is an area and associated monitoring site that is not impacted by human activities that could potentially affect bacteria densities in the receiving water body.						
(shaded)	Signifies that the value was not explicitly provided in the TMDL Weekly allocations for wet weather were obtained by dividing the daily allocations in the TMDL by "7" and rounding up.						
Italic	No allocations for SMB-5-2 and SMB-6-3 were provided in the TMDL so values equal to the reference beach were assumed.						
	Note that the Regional Board staff derived both wet and winter dry weather allocations by calculating a five-year average exceedance rate for each site and multiplying the site-specific exceedance rate by the number of wet or dry days in the 90th percentile storm year (1993), the baseline year. If exceedance rate is proportional to the number of wet or dry days, then only 1 in 10 years will be wetter than the baseline year and likely to have a wet weather exceedance. In contrast, 9 out of 10 years are dryer than the baseline year, most of the time there are likely to be more dry weather exceedances than in the baseline year. Single-Sample Exceedance: Total coliform >10,000, fecal coliform >400, Enterococcus >104, or if Total coliform >1,000 when fecal-to-total coliform ratio exceeds 0.1 Rolling 30-day Geometric Mean Exceedance: Total coliform >1,000, fecal coliform >200, Enterococcus >35						

CDM

Compliance with the SMBBB TMDL is to be determined based on monitoring conducted in accordance with the Coordinated Shoreline Monitoring Plan (CMP) which has been submitted jointly by all the jurisdictional groups and approved by the Regional Board and is scheduled to begin in November 2004. In the CMP certain historical monitoring sites were relocated to the zero point of storm drains. Historical data for these sites had previously been collected 50 yards south of the storm drains. Those historical monitoring sites that were relocated to the zero point, as well as one required new site, are identified in Table 3.

Compliance deadlines set in the SMBBB TMDL include:

- Summer dry-weather single-sample and geometric mean targets must be achieved within 3 years of the effective date (by July 15, 2006)

- Winter dry-weather single-sample allocations and geometric mean targets must be achieved within 6 years of the effective date (by July 15, 2009)

- The implementation schedule for wet weather compliance will be determined for each jurisdictional group based on the Implementation Plan submitted, allotting up to 18-year implementation time frame if an integrated water resources approach is employed, and otherwise no more than a 10-year implementation time frame.

B.3.2 Historical Data

Since compliance monitoring has not yet begun, and once it begins, it will be several years before clear compliance trends can be seen, this Hydrologic/Water Quality Compliance Prioritization is based on historical information. Historical shoreline monitoring data is available for all of the proposed CMP monitoring sites except for SMB-6-3, with the caveat that historical data has been collected 50-yards away from drain discharge points.

Two different agencies have been collecting historical shoreline monitoring data from J5/6 sites. The City of Los Angeles Environmental Monitoring Division of the Bureau of Sanitation (City LA EMD) has been conducting daily shoreline monitoring for total coliform and fecal coliform, and weekly shoreline monitoring for enterococcus at the following J5/6 sites: SMB-5-1, SMB-5-3, SMB-5-5, SMB-6-2, SMB-6-5, and SMB-6-6. Storm years 1995 through 2002 were evaluated for this analysis.

The Los Angeles County Department of Health Services (DHS) has also been collecting historical shoreline monitoring data in J5/6 on a weekly basis for all three bacterial indicators. DHS monitors a different set of J5/6 sites: SMB-5-2, SMB-5-4, SMB-6-1, and SMB-6-4. DHS data was readily available only for the four most recent monitoring years: 2000 through 2003. For SMB-5-2 only two years of historical data is available. DHS 2004 data was also available but since the 2004 storm year was not yet ended at the time of this analysis, 2004 data was not considered in this evaluation. This data is provided in the form of monthly excel spreadsheets, which cannot be easily merged into a single spreadsheet for data manipulation. Accordingly, this evaluation relies on DHS calculation of geometric mean on a monthly basis rather than use of a rolling 30-day calculation.

The Regional Board staff derived both wet and winter dry weather targets by calculating a five-year average exceedance rate for each site over the period from November 1995 to October 2000.[2] For sites with five-year exceedance rates higher than the reference beach site, the allocated exceedances were set equal to the reference beach. For sites with historical five-year exceedance rates lower (better) than the reference beach (anti-degradation sites), the site-specific exceedance rate for each site was multiplied by the number of wet or dry days in the 90th percentile storm year (1993), the baseline year, to arrive at a site-specific wet or dry exceedance allocation. Assuming that exceedance rate is proportional to the number of wet or dry days, then theoretically only 1 in 10 years will be wetter than the baseline year and will be likely to surpass the wet weather exceedance allocation. In contrast, on average, nine out of ten years will be dryer than the baseline year and will be more likely than the baseline to surpass the dry weather exceedance allocation. Since compliance will be evaluated on a yearly basis, the actual performance of historical data on an annual basis will be reviewed in the next section against the allocations developed from five-year averages to provide a more accurate projection of compliance from year-to-year.

B.3.3 Historical Wet Weather Findings

Historical shoreline monitoring data were evaluated for wet weather exceedances of the single sample limits for all four bacterial indicators. The frequency of exceedances that occurred on wet weather days were manually tabulated by storm year and by location.

Sites monitored by the City of Los Angeles on a daily basis are tabulated for the five storm years from 1998 through 2002 in Table 4. The frequency of exceedances is compared with the SMBBB TMDL *daily* exceedance allocation for each individual site and yellow shading is used to denote whenever the exceedance allocation was surpassed in a particular storm year.

In a similar manner the data from sites monitored by the Department of Health Services (DHS) on a weekly basis has been tabulated in Table 5 for four storm years from 2000 through 2003. For DHS data the frequency of exceedances is compared with the SMBBB TMDL *weekly* exceedance allocation for each site during wet weather and yellow shading denotes when allocated exceedances were surpassed.

---

[2] Santa Monica Bay Beaches Wet-Weather Bacteria TMDL Staff Report, Version 4.1 11/07/02, Sec. 8 Waste Load Allocations

Table B-4

Historical Single-Sample Compliance Evaluation for Daily Monitored Sites (LA EMD-Monitored Sites)

	Dry Weather Exceed		Wet
SMB-5-1	**Summer**	**Winter**	**Weather**
Allocation	0	1	4
1998	0	0	3
1999	0	0	3
2000	0	0	2
2001	0	0	2
2002	0	0	1

	Dry Weather Exceed		Wet
SMB-5-3	**Summer**	**Winter**	**Weather**
Allocation	0	1	5
1998	0	0	5
1999	0	0	5
2000	1	1	5
2001	2	1	0
2002	3	2	1

	Dry Weather Exceed		Wet
SMB-5-5	**Summer**	**Winter**	**Weather**
Allocation	0	2	8
1998	0	1	8
1999	0	4	4
2000	1	0	6
2001	0	0	3
2002	1	3	1

	Dry Weather Exceed		Wet
SMB-6-2	**Summer**	**Winter**	**Weather**
Allocation	0	3	14
1998	17	12	20
1999	5	14	4
2000	12	9	4
2001	14	18	9
2002	20	30	7

	Dry Weather Exceed		Wet
SMB-6-5	**Summer**	**Winter**	**Weather**
Allocation	0	3	6
1998	5	0	7
1999	2	3	4
2000	1	3	4
2001	2	5	0
2002	0	7	2

	Dry Weather Exceed		Wet
SMB-6-6	**Summer**	**Winter**	**Weather**
Allocation	0	1	3
1998	2	0	7
1999	0	1	1
2000	0	0	1
2001	0	0	0
2002	1	0	0

Table B-5
Historical Compliance Evaluation for Weekly Monitored Sites (DHS Monitored Sites)

SMB 5-2	Dry Weather Exceed		Wet Weather	Geo Mean
	Summer	**Winter**	**Exceed**	**Exceed**
Allocation	0	*1**	*2.4**	0
2000	NA	NA	NA	NA
2001	NA	NA	NA	NA
2002	1	0	1	1
2003	2	2	1	3

SMB 5-4	Dry Weather Exceed		Wet Weather	Geo Mean
	Summer	**Winter**	**Exceed**	**Exceed**
Allocation	0	0	1.7	0
2000	0	0	2	0
2001	1	0	0	0
2002	0	0	3	1
2003	1	1	2	1

SMB 6-1	Dry Weather Exceed		Wet Weather	Geo Mean
	Summer	**Winter**	**Exceed**	**Exceed**
Allocation	0	1	2.4	0
2000	2	1	7	5
2001	1	1	5	4
2002	4	3	5	4
2003	1	4	3	4

SMB 6-4	Dry Weather Exceed		Wet Weather	Geo Mean
	Summer	**Winter**	**Exceed**	**Exceed**
Allocation	0	1	2.4	0
2000	4	0	2	2
2001	1	0	2	1
2002	1	0	2	1
2003	1	3	1	2

Table 6 compares the annual rainfall, the number of wet days and the frequency of wet weather exceedances at SMB 6-1 (Herondo) which was the only clearly problematic site for wet weather exceedances. The trends in this data suggest that the frequency of wet weather exceedances is more closely correlated with the number of wet days than with the total annual rainfall. Thus even in a year such as Storm Year 2002 which had less than 4 inches of rain, the allocated exceedances were surpassed because the rainfall was widely distributed.

Table B-6

Comparison of Rainfall, Wet Days and Exceedances at SMB 6-1

Storm Year (Nov-Oct)	Rainfall[3] (inches)	Wet Days	SMB 6-1 Wet Exceedances (weekly sampling)
1998	27.95	104	NA
1999	7.47	56	NA
2000	11.17	57	7
2001	14.6	39	5
2002	3.41	38	5
2003	10.12[4]	30	3

The following observations could be made based on the historical wet weather data:

- Most of the J5/6 sites were at or below the allocated exceedance frequencies during wet weather, except for the 1998 year.

- During the 1998 storm year three out of the six daily monitored sites surpassed allocated exceedances. According to the Regional Board staff report, 1998 was in the 98th percentile for frequency of wet days while exceedance allocations were based on the 90th percentile storm year. Data for the weekly monitored sites was not readily available for 1998 so a similar observation could not be confirmed for those locations.

- One weekly monitored site, SMB-6-1 Herondo Drain, surpassed allocated exceedances in three of the four storm years evaluated. A second weekly monitored site (SMB-5-4 26th in Hermosa) surpassed its allocation in one of the four storm years evaluated and was right on the allocation in two other years—this seems to be a higher rate than expected of an anti-degradation site.

[3] Los Angeles County Department of Public Works Daily Precipitation data for Station 42 C Redondo Beach City Hall, http://ladpw.org/wrd/precip/data/

[4] Does not include October 2003 rain data—not yet available.

B.3.4 Summer Dry Weather Findings

Historical shoreline monitoring data were evaluated for summer dry weather exceedances of the single sample limits for all four bacterial indicators. The frequency of exceedances that occurred on dry days (not within 72 hours after a 0.1 inch or greater storm event) was manually tabulated by storm year and by location.

Sites monitored by the City of Los Angeles on a daily basis are tabulated for the five storm years from 1998 through 2002, as shown in Table 4 on page 11. Recall that the target compliance objective for summer dry weather for all sites is zero exceedances of the single-sample limits at any time. Yellow shading is used to denote whenever the single sample limits were surpassed in a particular storm year.

In a similar manner the data from sites monitored by the Department of Health Services (DHS) on a weekly basis has been tabulated and is shown in Table 5 on page 12 for four storm years from 2000 through 2003. There is no difference between targets for daily and weekly sampling for summer dry weather—the target is zero exceedances at all locations regardless of the frequency of sampling.

The following observations could be made based on the historical data:

- Most sites exhibited occasional summer dry weather exceedances.
- The daily monitored sites with the greatest frequency of summer dry weather exceedances were SMB-6-2 (Redondo Beach Pier) and to a lesser degree, SMB-6-5 (Avenue I)
- Weekly monitored sites with regular summer dry weather exceedances were: SMB-6-1 (Herondo Drain), and SMB-6-4 (Topaz)
- Sites with the lowest incidences of summer dry weather exceedances were SMB-5-1 (40th in Manhattan) which had no exceedances during the five years of data evaluated, and SMB-6-6 (Malaga Cove)

B.3.5 Historical Winter Dry Weather Findings

Historical shoreline monitoring data were evaluated for winter dry weather exceedances of the single sample limits for all four bacterial indicators. The frequency of exceedances that occurred on winter (November 1-March 31) dry weather days was manually tabulated by storm year and by location. Sites monitored by the City of Los Angeles on a daily basis are tabulated for the five storm years from 1998 through 2002 in Table 4. The frequency of exceedances is compared with the SMBBB TMDL *daily* exceedance allocation for each individual site and yellow shading is used to denote whenever the exceedance allocation was surpassed in a particular storm year. In a similar manner the data from sites monitored by the Department of Health Services (DHS) on a weekly basis has been tabulated in Table 6 for four storm years from 2000 through 2003. For DHS data the frequency of exceedances is compared with the SMBBB TMDL *weekly* exceedance allocation for each site during wet weather. The following observations could be made based on the historical winter dry weather data:

- Most sites surpassed winter dry weather allowances occasionally. The exceptions were SMB 5-1 (40th Manhattan) and SMB-6-6 (Malaga Cove) neither of which surpassed their allocations during the five years of data evaluated.

- Daily monitored sites which surpassed winter dry allocations with greatest frequency were SMB-6-2 (Redondo Beach Pier) and to a lesser degree, SMB-5-5 (Hermosa Pier) and SMB-6-5 (Avenue I)

- The weekly monitored site which surpassed winter dry allocations most often was SMB-6-1 (Herondo Drain)

B.3.6 Historical Geometric Mean Findings

The geometric mean of a set of data is calculated by finding the n^{th} root of the product of "n" data points. To calculate a Rolling 30-day Geometric Mean for sites which were historically sampled on a daily basis, one would take the 30^{th} root of the product of the last 30 data points. The Wet Weather TMDL states that *if weekly sampling is conducted, the weekly sample result will be assigned to the remaining days of the week in order to calculate the daily rolling 30-day geometric mean*.[5]

The Los Angeles County Department of Health Services (DHS) has historically employed a different calculation method for geometric mean than that described in the Wet Weather TMDL. DHS has historically monitored for all bacterial indicators on a weekly basis. DHS reports a single monthly geometric mean value for each indicator bacteria by calculating the 4^{th} or 5^{th} root of the product of the data points for that month, depending on whether there were four or five samples collected during the month.

There is still another approach to managing weekly sampling data. The proposed California Ocean Plan Amendments to be heard by the State Water Resources Control Board on October 6, 2004 proposes a rolling geometric mean calculation as follows: *Geometric Mean – Samples shall be collected from each station at least weekly, with the five most recent sample results used to calculate the geometric mean.*[6] In this case there is no "filling in" of data required in the objective, but the calculation is to be made on a rolling basis rather than monthly as DHS does. It may be that the SMBBB TMDL could be modified to be in line with the Ocean Plan which sets water quality objectives for ocean waters throughout California.

---

[5] Attachment A to Resolution No. 2002-022, Numeric Target last paragraph, p. 4.

[6] 06 Issue 1.doc page 23 posted on the SWRCB website for the October 6, 2004 Public Hearing

B.3.6.1 Historical Geometric Mean Results for City of Los Angeles EMD Monitored Sites

Table 7 presents the results of the 30-day Rolling Geometric Mean (geometric mean) calculations for data collected by City of Los Angeles Environmental Monitoring Division. These sites were sampled daily for total coliform and fecal coliform, but were sampled approximately weekly for enterococcus.

Geometric mean exceedance calculation for enterococcus as reported in Table 5 followed the method prescribed in the Wet Weather TMDL for "filling in" data for the remainder of the days in the week until the next sample was collected. This "filling in" of data appears to magnify the frequency of geometric mean exceedances because once data has been "filled in" it stays in the subsequent geometric mean calculations for approximately seven days, effectively magnifying the apparent frequency of geometric mean exceedances by as much as a factor of seven.

It should be noted that under the weekly Coordinated Monitoring Plan (CMP) schedule, regular sampling will occur on Mondays. An exceedance of any of the single-sample limits will necessitate "accelerated sample collection" so that additional samples will be collected on Wednesday and Friday of that week. For the geometric mean calculation this should somewhat offset a single poor result by allowing the Wednesday and Friday sample results to be used for "filling in" of the rest of the week and could reduce the magnification of exceedances observed in Table 5 for enterococcus.

Nonetheless, the foregoing discussion should not be interpreted to suggest that there is not a history of enterococcus geometric mean exceedances. Careful examination of the data confirms that there is a problem with geometric mean exceedances for enterococcus at all of the City of LA EMD monitored sites except SMB-5-1 (40^{th} Manhattan), and had the method in the proposed Ocean Plan amendment been applied to this data, there still would have been exceedances of the enterococcus geometric mean, but they would have been fewer.

The enterococcus geometric mean compliance problem is particularly troublesome for SMB-6-2 (Redondo Pier) where there were also historical problems with fecal coliform and total coliform geometric mean exceedances. It is interesting to note, however, that none of the other City of LA EMD monitored sites exhibited historical problems with fecal coliform or total coliform geometric mean exceedances, only with enterococcus.

Table B-7

Evaluation of Geometric Mean Value for Daily Sampled Sites (LA EMD-Monitored Sites)

S13 Geometric Mean Exceedances

SMB-5-1 storm year	Enterococcus	Fecal coliform	Total coliform
1995	0	0	0
1996	0	0	0
1997	0	0	0
1998	0	0	0
1999	0	0	0
2000	0	0	0
2001	0	0	0
2002	0	0	0

S14 Geometric Mean Exceedances

SMB-5-3 storm year	Enterococcus *	Fecal coliform	Total coliform
1995	0	0	0
1996	0	0	0
1997	0	0	0
1998	15	0	0
1999	0	0	0
2000	0	0	0
2001	0	0	0
2002	17	0	0

S15 Geometric Mean Exceedances

SMB-5-5 storm year	Enterococcus*	Fecal coliform	Total coliform
1995	0	0	0
1996	6	0	0
1997	23	0	0
1998	47	0	0
1999	0	0	0
2000	0	0	0
2001	0	0	0
2002	0	0	0

S16 Geometric Mean Exceedances

SMB-6-2 storm year	Enterococcus*	Fecal coliform	Total coliform
1995	91	0	0
1996	107	1	0
1997	118	11	0
1998	92	0	58
1999	40	0	24
2000	54	0	0
2001	61	3	0
2002	38	26	0

S17 Geometric Mean Exceedances

SMB-6-5 storm year	Enterococcus*	Fecal coliform	Total coliform
1995	55	0	0
1996	0	0	0
1997	19	0	0
1998	4	0	0
1999	28	0	0
2000	0	0	0
2001	0	0	0
2002	27	0	0

S18 Geometric Mean Exceedances

SMB-6-6 storm year	Enterococcus*	Fecal coliform	Total coliform
1995	14	0	0
1996	0	0	0
1997	0	0	0
1998	2	0	0
1999	0	0	0
2000	17	0	0
2001	0	0	0
2002	0	0	0

Notes:

Geometric mean is calculated as the nth root of the product of "n" numbers.

For daily sampling the 30-day geometric mean calculation is calculated as the 30th root of the product of the 30 most recent daily test results--this has been done for Fecal and Total coliform results above.

* For weekly sampling (Enterococcus above) the TMDL requires that the weekly result be applied to the remaining days in the week in order to calculate a daily rolling 30-day geometric mean--This has been done for the Enterococcus historical data with the outcomes shown above. However, DHS does not use this method, instead DHS simply calculates the geomean for however many samples were actually collected in the preceeding 30 days, so if "n" samples were collected, the geometric mean is the nth root of the product of those n values. The proposed Ocean Plan amendment simply requires that the geometric mean "be calculated using the five most recent sample results".

B.3.6.2 Historical Geometric Mean Results for DHS Monitored Sites

Table 5 includes the results of Geometric mean calculations as reported by DHS on a monthly basis according to the method described previously (no "filling in" of data, and no rolling calculation). These data were compiled from the monthly DHS reports into Table 5 for storm years 2000 through 2003. Data were tabulated without distinguishing the cause of the exceedances (total coliform, fecal coliform or enterococcus), however a review of the data shows the same pattern of primarily enterococcus geometric mean exceedances at DHS sites. The clear conclusion can be drawn that all of the DHS sites exhibit historical problems with enterococcus geometric mean exceedances.

B.3.7 Effect of Zero Point Monitoring

A key uncertainty that is not reflected in the above observations is that four of the historical sites are to be relocated to the zero point of drainage discharge under the Coordinated Monitoring Plan (CMP). Additionally there is a new site included in the CMP that is to be located at the zero point of a storm drain. Relocation of historical monitoring sites to the zero point is likely to have an adverse effect on the frequency of exceedance days associated with discharges from storm drains, during either wet or dry weather, because the dilution and dispersion of indicator bacteria from storm drain discharges will be reduced.

When considering the effect of relocating sites to the zero point, one must also consider that many of the sites in J5/6 are assigned wet weather exceedance allocations well below the reference beach average annual wet weather exceedance rate of 17 exceedance days for daily monitoring (3 for weekly monitoring), i.e., anti-degradation sites. Relocating a site to the zero point may require re-evaluation of its assigned exceedance allocations once several years of compliance monitoring data become available under the CMP.

B.3.8 Summary of Data Analysis

Summer dry weather compliance is the most pressing from a compliance schedule standpoint since the deadline is July 15, 2006. Summer dry weather single-sample exceedances are concentrated in the SMB-6-1 (Herondo) and SMB-6-2 (Redondo Pier) drainage areas with occasional exceedances possible at virtually any location.

Winter dry weather compliance issues are less focused than summer dry issues. It is possible that the more widespread nature of dry weather compliance issues is partly due to the selection of the baseline year.

Except in extremely wet years, wet weather compliance does not appear to be a concern for most of the J5/6 sub watersheds. The SMB-6-1 (Herondo) sub watershed is the clear exception, however this location has year-round compliance issues, both wet and dry. Since the exceedance allocation at this location is already set at the reference beach value, there is no prospect that its allocation could be increased based on CMP monitoring results.

Widespread problems with geometric mean exceedances, particularly for enterococcus are problematic. Identification of the causes and sources of these exceedances will require further investigation, possibly field sampling as well as research into the basis for setting the enterococcus geometric mean objective.

It is of key importance to note, however, that the two best performing locations are consistently the best locations year-round, wet or dry. They also happen to be the most northerly and southerly locations in J5/6 (SMB-5-1 40th in Manhattan and SMB-6-6 Malaga Cove). A study of detailed land use activities in these two sub watersheds compared with those in sub watersheds with the highest rates of summer dry weather exceedances (SMB-6-1 and SMB-6-2) could assist in identifying sources and source control implementation strategies for dry weather compliance year-round. Consideration should also be given to differences in watershed hydrologic characteristics, as well as potential issues associated with near-shore circulation patterns in the stretch of beach near the King Harbor/Redondo Pier/Topaz jetty.

B.3.9 Limitations of Historical Data Evaluation

This evaluation of historical data was necessarily limited in scope and focused on identifying and prioritizing compliance issues as a focus for developing the Implementation Plan. When reviewing the findings it is important to consider the following limitations on the data evaluation:

- Data files were not readily available and were not evaluated for weekly monitored sites during the 1998 storm year which is in the 98th percentile for frequency of wet
- Geometric mean exceedance data was evaluated by storm year rather than by season and so did not evaluate likelihood of compliance with the summer 2006 dry weather deadline.
- The Background section for data analysis did not include research into the basis for the enterococcus geometric mean water quality objective and whether that basis makes compliance with the objective more difficult than for the other indicator bacteria.
- Basis for the status of SMB 5-4 as an anti-degradation site has not been evaluated.

B.4. Dry Weather Runoff

Discharges from the storm drain system occur during dry weather periods at most locations throughout the watersheds where cities are located. These discharges, or “low flows,” are the result of a combination of factors including landscape irrigation runoff, street washing, car washing, ground water seepage, illegal connections, hydrant flushing, construction runoff, and other commercial and residential activities. Dry weather flow is the suspected cause of exceedances at Jurisdiction 5 and 6 monitoring locations. Although dry weather flow is a primary concern, there are other sources of bacteria in addition to urban runoff that may contribute to exceedances. Estimates of the volume of dry weather runoff produced in Jurisdictions 5 and 6 are described in the following section.

B.4.1 Dry Weather Runoff Estimates

In order to estimate dry weather runoff, it was necessary to determine a reasonable runoff rate for each drainage area. The drainage areas are listed according to their corresponding monitoring sites in the first column of Table 8. Since land use in Jurisdictions 5 and 6 is similar to land use in Jurisdictions 2 and 3 (Ballona Creek watershed), the runoff rate previously calculated for the Ballona Creek watershed (230 gpd/ac) was applied in calculations for Jurisdictions 5 and 6. Dry weather runoff was calculated using the following equation:

Dry weather runoff (mgd) = Runoff rate x total area

Table B-8

Dry Weather Runoff Estimates

Drainage Area	Runoff Rate (gpd/ac)	Total area (ac)	Dry weather runoff estimate (mgd)
SMB-5-1	230	81.6	0.19
SMB-5-2	230	1248.9	0.29
SMB-5-3	230	143.4	0.03
SMB-5-4	230	205.5	0.05
SMB-5-5	230	295	0.07
SMB-6-1	230	2296.3	0.53
SMB-6-2	230	770	0.18
SMB-6-3 & SMB-6-4	230	151.4	0.03
SMB-6-5	230	675.4	0.16
SMB-6-6	230	234.5	0.05
Total		**6102.0**	**1.58**

The calculations show that the estimated dry weather runoff for the entire watershed is approximately 1.6 mgd, with the greatest amount of runoff occurring in drainage area SMB-6-1, the location of the Herondo drain where exceedances are more common.

B.5 Wet Weather Runoff

Wet weather runoff does not appear to cause as many exceedances as dry weather runoff in Jurisdictions 5 and 6. However, there are several drains that have been shown to experience wet weather exceedances, including the Herondo drain in Redondo Beach and the 26th Street drain in Hermosa Beach.

B.5.1 Wet Weather Runoff Estimates

To estimate daily precipitation volume, requiring treatment in order to comply with the SMBBB TMDL, the Runoff Draft Interim Deliverable for the City of Los Angeles was reviewed. The report analyzes 50 years of precipitation data recorded at Los Angeles International Airport (LAX) and the observed daily volume of the 18th largest rain day for each year of the 50-year period. The TMDL allows for 17 exceedance days in a given wet season. Based on this volume, the 90-percentile precipitation amount was calculated to be 0.45 inches (0.0375 feet). The implication is that having the capacity to manage a 0.45-inch rainfall will maintain exceedances to 17 or less each year, over 90 percent of the time. Wet weather runoff was calculated using the following equation:

Runoff Volume (MG) = Rc * P * A * Cf, whereas

Rc = 0.9*(%IMP) + 0.1* (1-%IMP).

Rc = Runoff coefficient
P = Daily precipitation volume (ft)
A = Subwatershed area (ft^2)
Cf = Conversion factor equal to 7.48*10-6 (Mgd/ft^3)

The value for %IMP (percent impervious) was determined by comparing the land use categories in Jurisdictions 5 and 6 with Los Angeles County's land use data. Table 9 shows the estimated wet weather runoff volume in million gallons per day for a .45-inch rainfall event. A sample calculation for SMB-5-1 is included in Appendix B-1.

Table B-9

Wet Weather Runoff Estimates

Drainage Area	Wet weather runoff estimate (mgd)
SMB-5-1*	0.65
SMB-5-2	9.22
SMB-5-3	1.12
SMB-5-4	1.46
SMB-5-5	2.09
SMB-6-1	18.07
SMB-6-2	6.25
SMB-6-3 & SMB-6-4	1.23
SMB-6-5	5.05
SMB-6-6	1.69
Total	**46.83**

*Sample calculation included in Appendix B-1

The calculations show that the estimated wet weather runoff for the entire watershed is approximately 47 mgd, with the greatest amount of runoff occurring in monitoring zone SMB-6-1, the location of the Herondo drain where exceedances are more common.

In addition to calculating wet weather runoff, an alternative approach for considering wet weather exceedances is to examine the size of rainfall events associated with recorded exceedances. This is done in the following Table 10 for SMB 6-1 (Herondo drain), the most problematic site from a wet weather compliance perspective. The rainfall events associated with wet weather exceedances for each of four storm years at SMB 6-1 are sorted according to size of rainfall event as measured at the closest rainfall monitoring station (Redondo Beach City Hall) for the day of and the three days preceding the sampling event. Recall that for SMB 6-1 the wet weather allocated exceedances under weekly monitoring is three (3) exceedance days, so the fourth largest rainfall event for each storm year is highlighted to show for that year the size of the event that would cause the site to surpass the allocated exceedances in that year.

Table B-10

Rainfall Events associated with Wet Weather Exceedances at SMB 6-1

SY 2000	SY 2001	SY 2002	SY 2003
1.92	3.95	0.52	1.56
1.69	1.6	0.42	0.89
1.32	0.99	0.22	0.04
1.28	0.63	0.06	
1.0	0.18	0.05	
0.15			
0.13			
0.04			

Due to the large drainage area associated with SMB-6-1, and the analysis of historical rainfall and exceedance data for four storm years, one may tentatively conclude that it may not be possible to identify a rain event of a manageable size that if captured and treated would bring SMB 6-1 into compliance in the majority of storm years for SMB 6-1.

B.6 Conclusions

This TM presents results regarding analysis of drainage areas, land use, historical water quality monitoring data, and dry and wet weather runoff.

The land use data does not provide strong evidence for the cause of exceedances at monitoring sites. On a comparison basis, the land use is fairly evenly distributed throughout the jurisdictions; the areas with a large number of exceedances have similar land uses to the areas with a small number of exceedances.

The analysis reveals that dry weather runoff is more problematic than wet weather runoff in relation to bacteria exceedances at many of the beach monitoring locations. Based on the historical data reviewed, SMB 6-1 (Herondo) was the only clearly problematic site from a wet weather compliance perspective. However, because of the size of the drainage area associated with this site, and based on the analysis of historical rainfall and exceedance data for four storm years, it may not be possible to identify a rain event of a manageable size that if captured and treated would bring SMB 6-1 into compliance in the majority of storm years for SMB 6-1.

The hydrologic analysis and methodology presented herein presents a useful means of predicting potential risk of TMDL exceedance assuming a direct correlation of exceedances to runoff events. It can be used as a tool to focus on areas with exceedances and be able to prioritize and recommend appropriate solutions.

B.7 References

CH:CDM and City of Los Angeles Department of Public Works, Bureau of Sanitation. *Integrated Resources Plan Facilities Plan Interim Deliverable, Volume 3, Runoff Management*. August 2003.

Cities of Redondo Beach, Hermosa Beach, Manhattan Beach, and Torrance. *GIS land use database.*

City of El Segundo. *Land use PDF file.*

City of Los Angeles, Watershed Protection Division. *Water Quality Monitoring Data.*

City of Redondo Beach. *GIS stormdrain database.*

Los Angeles County Department of Health Services Ocean Water Monitoring Data: http://lapublichealth.org/eh/ehftp/

Los Angeles County, Watershed Management Division. *County of Los Angeles Land use data.*

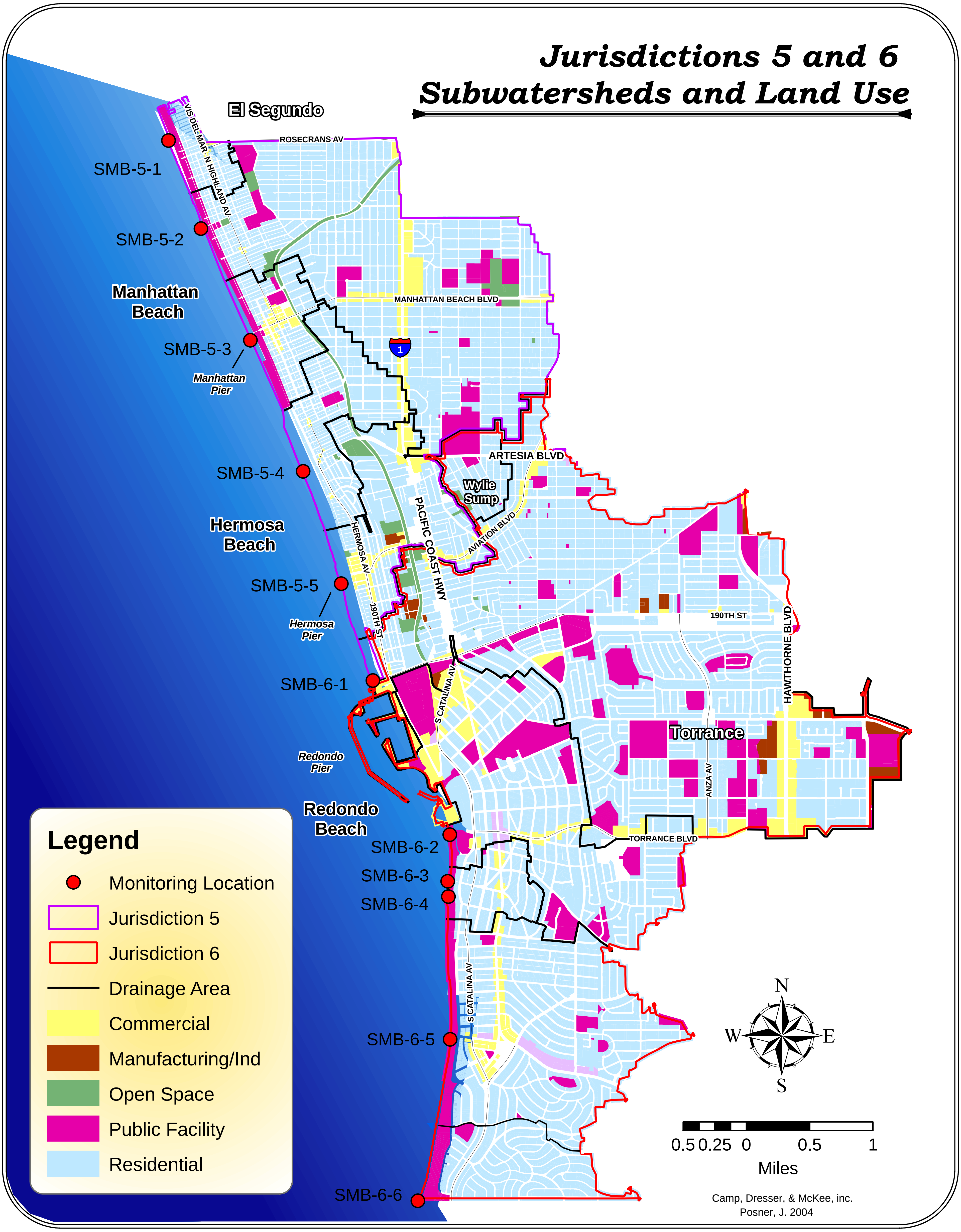
Los Angeles County Rainfall Data: http://ladpw.org/wrd/precip/index.cfm.

Regional Water Quality Control Board. *GIS Jurisdictions database.*

Technical Steering Committee Co-chairs City and County of Los Angeles. *Santa Monica Bay Beaches Bacterial TMDLs Coordinated Shoreline Monitoring Plan*. April 2004.

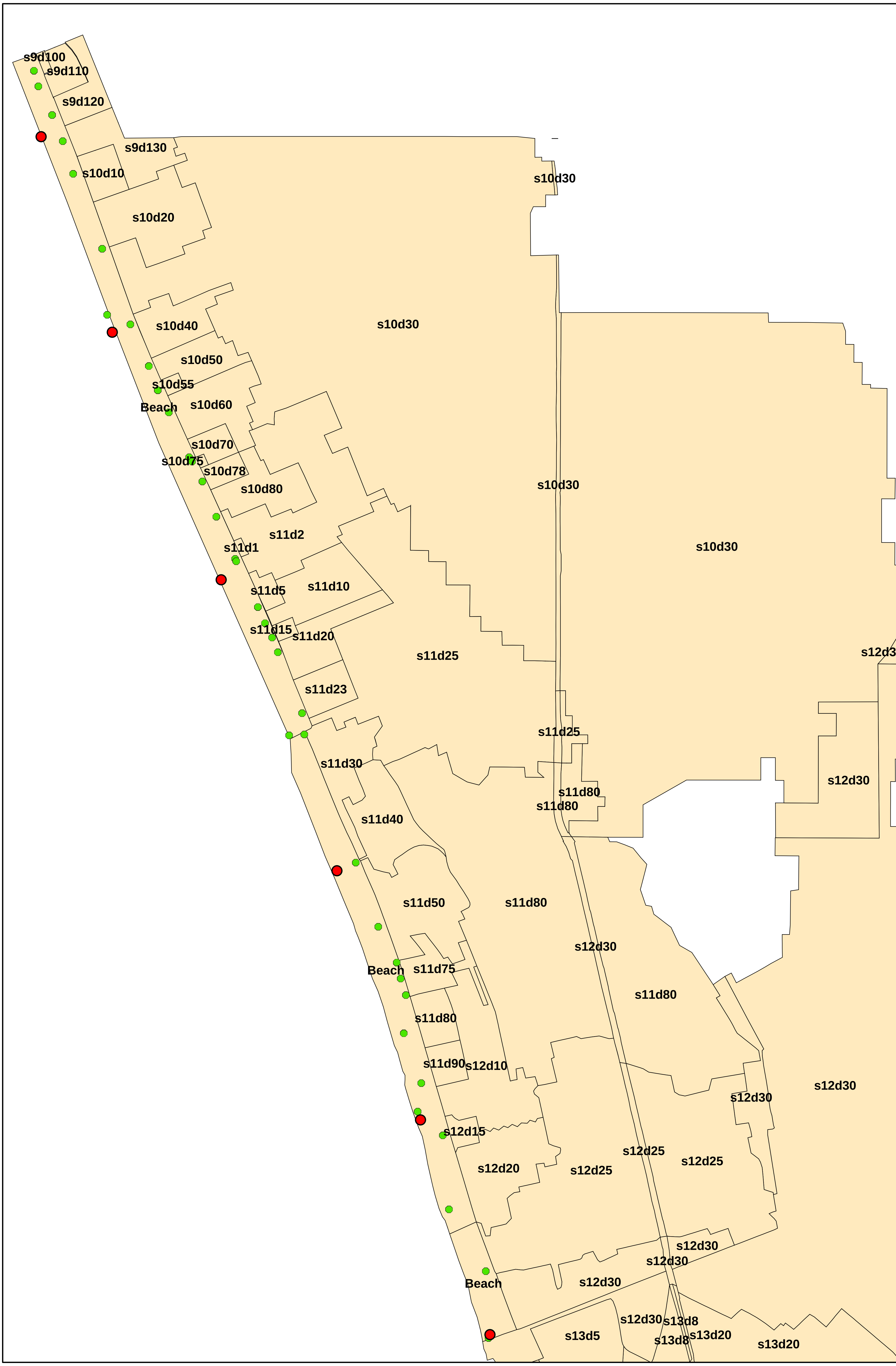
Weather Bureau. LAX Rainfall Data.

Appendix B-1
Jurisdictions 5 and 6 Subwatersheds and Land Use

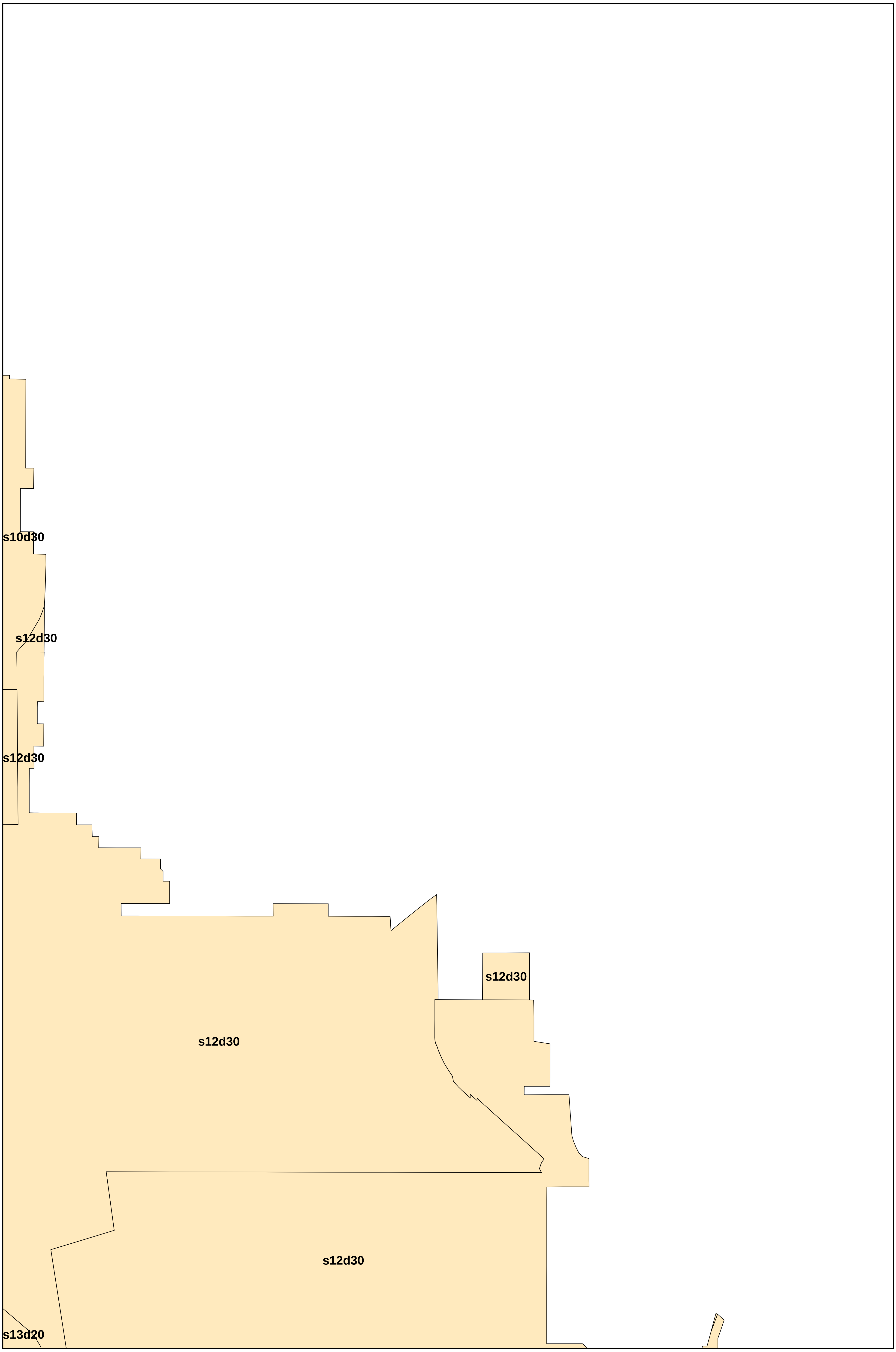


Jurisdictions 5 and 6
Subwatersheds and Land Use
El Segundo
ROSECRANS AV
SMB-5-1
SMB-5-2
Manhattan Beach
MANHATTAN BEACH BLVD
SMB-5-3
Manhattan Pier
ARTESIA BLVD
Wylie Sump
SMB-5-4
AVIATION BLVD
Hermosa Beach
PACIFIC COAST HWY
HERMOSA AV
SMB-5-5
Hermosa Pier
190TH ST
SMB-6-1
S CATALINA AV
HAWTHORNE BLVD
Torrance
ANZA AV
Redondo Pier
Redondo Beach
SMB-6-2
TORRANCE BLVD
SMB-6-3
SMB-6-4
SMB-6-5
SMB-6-6
Legend
Monitoring Location
Jurisdiction 5
Jurisdiction 6
Drainage Area
Commercial
Manufacturing/Ind
Open Space
Public Facility
Residential
N
W
E
S
0.5 0.25 0 0.5 1
Miles
Camp, Dresser, & McKee, inc.
Posner, J. 2004

Appendix B-2
Drainage Areas, Drainage Outlets, and Monitoring Locations

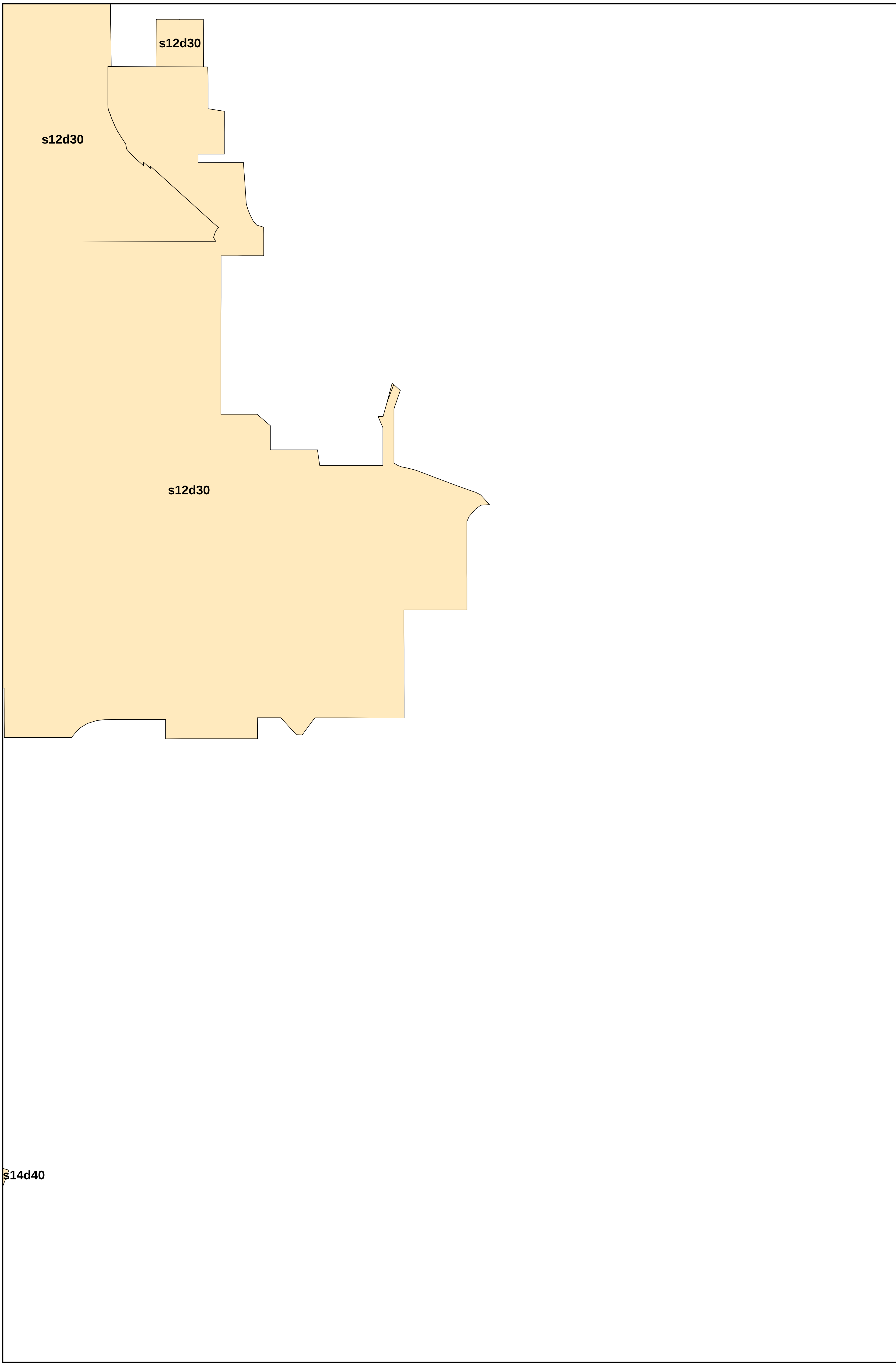


s9d100
s9d110
s9d120
s9d130
s10d10
s10d30
s10d20
s10d40
s10d30
s10d50
s10d55
Beach
s10d60
s10d70
s10d75
s10d78
s10d80
s10d30
s10d30
s11d2
s11d1
s11d10
s11d5
s11d15
s11d20
s11d25
s12d30
s11d23
s11d25
s11d30
s11d80
s11d80
s12d30
s11d40
s11d50
s11d80
s12d30
Beach
s11d75
s11d80
s11d80
s11d90
s12d10
s12d30
s12d30
s12d15
s12d25
s12d20
s12d25
s12d25
s12d30
s12d30
Beach
s12d30
s12d30
s13d8
s13d5
s13d8
s13d20
s13d20



s10d30
s12d30
s12d30
s12d30
s12d30
s12d30
s13d20


s12d25
s12d30
s12d30
s12d30
Beach
s12d30
s12d30
s13d8
s13d5
Not Listed
Not Listed
s13d8
s12d30
s13d10
Not Listed
s13d12
s13d20
s13d20
s13d15
s13d18
s13d20
Not Listed
s13d27
s13d25
s13d29
s13d28
Not Listed
s14d10
s14d10
s13d40
s12d30
s14d12
s14d30
s14d10
s14d30
s14d30
Beach
s14d40
s14d40
s14d40
s14d45
s14d50
s14d40
Beach
s14d50
s14d60
s14d50
s14d60
s14d40
s14d40
Beach
Beach
s14d66
s14d50
Beach
Beach
s14d70



s12d30
s12d30
s12d30
s14d40

Appendix B-3
Sample Wet Weather Runoff Calculations

Wet weather runoff calculation for SMB-5-1

Runoff Volume (MG) = Rc * P * A * Cf, whereas Rc_{res} = 0.9*(%IMP) + 0.1* (1-%IMP). Rc = Runoff coefficient P = Daily precipitation volume (ft) A = Subwatershed area (ft^2) Cf = Conversion factor equal to $7.48*10^{-6}$ (Mgd/ft^3)

The value for %IMP (percent impervious) was determined by comparing the land use categories in Jurisdictions 5 and 6 with Los Angeles County's land use data. Calculations estimate a wet weather runoff volume in million gallons (MG) per day for a .45-inch (.0375ft) rainfall event.

Runoff estimate for residential land use

Residential Impervious Rate (based on LA County land use data) = 0.60

Rc_{res} = 0.9*(0.60) + 0.1* (1-0.60)

Rc_{res} = 0.58

Residential Area = 55.4ac (from Table 2) = 2,413,224ft^2

Runoff volume (MG) = (0.58)(.0375ft)(2,413,224ft^2)($7.48*10^{-6}$ MG/ft^3) = 0.26MG_{res}

Runoff estimate for commercial and public facility land use

Commercial and Public Facility Impervious Rate (based on LA County land use data) = 0.90

$Rc_{com/pub}$ = 0.9*(0.90) + 0.1* (1-0.90)

$Rc_{com/pub}$= 0.82

Commercial/Public Facility Area = 7.6ac + 18.6ac (from Table 2) = 26.2ac = 1,141,272ft^2

Runoff volume (MG) = (0.82)(.0375ft)(1,141,272ft^2)(7.48*10-6 MG/ft^3) = 0.39$MG_{com/pub}$

Total runoff volume (MG) = 0.26MG_{res} + 0.39$MG_{com/pub}$ = 0.65MG

Appendix C
Beneficial Reuse Evaluation

Appendix C
Beneficial Reuse Evaluation

C.1 Purpose

This technical memorandum evaluates beneficial reuse opportunities for various runoff management options. The evaluation will identify specific direct reuse or groundwater recharge opportunities for runoff within the SMB beaches watersheds.

The hydrologic analysis for Task 3 revealed that the majority of historical bacteria exceedances occurred during dry weather periods. Most of the monitoring sites, with a few exceptions such as the Herondo drain, did not exhibit wet weather compliance problems. Therefore, this evaluation focuses on beneficial reuse opportunities for dry weather runoff. For specific areas where historical data indicates compliance problems during wet weather, such as the Herondo drain, runoff management options and their beneficial reuse opportunities are included as well.

In preparing for the Implementation Plan, the hydrologic analysis task estimated that the total volume of dry weather runoff from Jurisdictions 5 and 6 is approximately 1.5 million gallons per day. Managing dry weather runoff through various on-site or "localized" source control solutions that retain and infiltrate or evapotranspirate dry weather runoff can help reduce the volume of stormwater entering the storm drain system. Since the runoff is reused or infiltrated on-site, these options are considered beneficial reuses of runoff. Runoff that is not beneficially reused locally can be reused regionally. Regional reuse generally involves "end of pipe" solutions, meaning that the runoff has entered the storm drain system. This evaluation identifies potential quantities of runoff that can be managed through local or regional beneficial reuse options.

Local beneficial reuse opportunities evaluated herein include:

- On-site infiltration projects
- Cisterns and larger underground storage and reuse projects
- Regional beneficial reuse opportunities evaluated herein include:
- Regional surface groundwater recharge to enhance water supply
- Groundwater injection to create a salt water intrusion barrier and/or enhance water supply
- Regional capture and reuse as irrigation or other non-potable supply

C.2. Land Use Analysis

C.2.1 Methodology

The approach to evaluating beneficial reuse opportunities involves identifying potential locations for the implementation of the opportunities at both local and regional levels, and estimating the amount of dry and wet weather runoff that could be managed by those beneficial reuse options. The potential for beneficial reuse is related to land use. For example, land uses with a greater amount of pervious space offer more opportunity for reuse, such as landscape irrigation for parks and golf courses. Both the spatial distribution and size of land use areas was determined in Task 3.

As developed in TM 3, Appendix C-1 shows the distribution of six land use categories within the ten larger drainage areas in Jurisdictions 5 and 6.

C.3 Local (On-Site) Beneficial Reuse Opportunities

Local (on-site) beneficial reuse opportunities evaluated include:

- On-site infiltration of runoff
- Irrigation use of roof runoff captured via cisterns

C.3.1 On-Site Infiltration

On-site infiltration involves capturing runoff at the site where it is generated and storing it in a basin or structural feature of some type where it can infiltrate to the local groundwater. On-site infiltration measures are intended to reduce the total volume and flow rate of runoff leaving a particular site and entering the storm drain system. This reduction in flow will also assist in the reduction of bacteria and other constituents that drains to the beaches. In addition to reducing the amount of runoff from a site, infiltration projects also allow some of the runoff to percolate into the groundwater basin. No direct treatment would be required since the infiltration process will act as a treatment mechanism.

Infiltrating runoff requires that the soils be permeable enough to allow percolation into the underlying groundwater basin in a reasonable time and without excessive mounding or surfacing. Since the groundwater aquifer under Jurisdictions 5 and 6 is largely confined (refer to Section 4.1 of this TM), it is unlikely that there is significant opportunity for groundwater recharge through on-site infiltration projects. There is the potential, however, for some runoff to infiltrate into the top layers of soil, where it will reduce the overall runoff volume leaving the site.

Types of soil within the J5/6 Santa Monica Bay area were identified based on data provided by the Los Angeles County Department of Public Works hydrology GIS database[1]. The three primary soil types within Jurisdictions 5 and 6 are Chino Silt

[1] http://www.ladpw.com/wrd/Publication/Engineering/online/Maps/00_Soil_Map_Index.pdf

Loam, Oakley Fine Sand, and Ramona Sandy Loam. Based on an analysis of the runoff coefficient curves for each soil type, Chino Silt Loam was identified as having "good" infiltration capacity, and Oakley Fine Sand and Ramona Sandy Loam as having "fair/poor" infiltration capacity. This data was merged with jurisdiction boundaries to develop a geographic distribution of soil types within the study area. A plot of the distribution of the "good, fair" and "fair/poor" infiltration capacities of the soils types throughout the Santa Monica Bay area is presented in Figure 1.

It should be noted that although this analysis generally describes the soil conditions throughout Jurisdictions 5 and 6, it is not intended to assist in the design of infiltration BMPs for specific sites. Due to the widely variable infiltration capacities on a site-by-site basis, site-specific soil studies should be conducted prior to implementing infiltration BMPs.

Figure 1 shows that much of the area within Jurisdictions 5 and 6 appears to have soils with "fair/poor" infiltration capacities. Soils with "good" infiltration rates are located along the coast and extend approximately 2 miles inland. It should be noted that there may be additional opportunities to infiltrate runoff in the areas designated as "fair/poor". For example, Wylie Sump is an area that presumably has soil with a high infiltration rate. The sump, located west of the Artesia Boulevard/Aviation Boulevard intersection, is known to accumulate stormwater runoff, allowing the runoff to percolate into the ground over time. Further studies should be conducted in order to determine the extent of infiltration for soils within Jurisdictions 5 and 6.

Figure C-1
Soil Infiltration Capabilities

Additional factors must be considered prior to implementing an infiltration project. Some of these factors include the depth to the water table and space availability. For instance, the data suggests that J5/6 beaches have high soil infiltration rates. However, these areas are not necessarily suitable for infiltration projects due to the lack of space and shallow groundwater.

Infiltration projects will be most effective in areas that have adequate space, highly infiltrating soils and a deep water table. If the conditions are suitable, various infiltration BMPs will capture dry and wet weather runoff on-site, allow it to infiltrate into the ground, thereby managing the runoff and reducing off-site flow. In particular, the following infiltration BMPs may help to manage dry and wet weather runoff within Jurisdictions 5 and 6:

- Porous Pavement
- Vegetated Buffer Strips
- Swales
- French drains
- Infiltration Trenches
- Infiltration Basins
- Bioretention
- Wet Ponds
- Constructed Wetlands

Expanded descriptions of these infiltration-type BMPs are included in TM 2 (BMP Evaluation). As with any infiltration project, pre-design considerations should be taken into account, including the presence of contaminated groundwater/subsurface soils, and the potential impacts of introducing pollutants into the subsurface system, the proximity to potentially impacted structures, and maintenance to prevent long-term clogging. In addition, accurate and site-specific soil data should be obtained before implementing these types of BMPs. The potential effectiveness of the BMPs for Jurisdictions 5 and 6 is examined in further detail below.

C.3.1.1 Porous Pavement

Jurisdictions 5 and 6 have many areas with low volumes of vehicle and pedestrian traffic that are ideal for porous pavement. Examples include walk streets, patios, jogging paths, overflow parking lots, and driveways. Municipal facilities and parks can benefit from porous pavement projects. For example, The City of Redondo Beach recently completed a “Water Wise Demonstration Garden” in their Civic Center courtyard that features both a formal and an informal system of permeable walkways. The permeable walkways allow water to flow directly into the ground where the water is naturally filtered and retained in the garden. The formal walkways consist of a decorative pattern of colored pavers set on layers of gravel and sand. The informal walkways are made of discarded, broken pieces of concrete from the City's public sidewalks2.

C.3.1.2 Vegetated Buffer strips

Buffer strips are defined as an area of planted or naturally occurring vegetation located between a source of contamination and a water body. Buffer strips are particularly effective for areas with steep slopes. In Jurisdictions 5 and 6, there are many areas along the Strand that slope toward the beach, most of which have native plants that reduce runoff. Consideration should be given to those areas sloping towards the beach that do not have a buffer strip. These areas will be identified in Task 5: Siting.

C.3.1.3 Swales

Vegetated swales can be used as an alternative to conventional storm sewers in common areas of residential subdivisions and along property boundaries. They can also be used within landscaping islands within parking lots. Therefore, swales are commonly implemented in residential, industrial, and commercial areas with low flow and smaller populations.

Evidence suggests that swales export bacteria, according to several studies listed in the California Stormwater Quality Association's BMP handbook[3]. Table 1 lists the bacteria removal results for three different studies.

Table C-1

Grassed swale bacteria removal efficiency

Removal Efficiencies (% Removal)		
Study	**Bacteria**	**Type**
Caltrans 2002	-33	dry swales
Goldberg 1993	-100	grassed channel
Seattle Metro and Washington Department of Ecology 1992	-25	grassed channel

The negative removal efficiencies suggest that swales may actually increase levels of bacteria. Although the reasons are unclear, one explanation is that bacteria thrive in the warm swale soils. Alternatively, the Environmental Protection Agency (EPA) has suggested that the negative removal rate for bacteria may reflect sampling errors, such as failure to account for bacterial sources in the practice[4]. Due to the potential for an increase in bacteria loads, swales are not recommended for bacteria reduction in Jurisdictions 5 and 6 until further studies have been conducted.

[2] City of Redondo Beach, 2004
[3] California Stormwater Quality Association, 2003
[4] EPA, 2004

C.3.1.4 French drains

French drains are more effective and suitable for areas with soils that have higher infiltration rates. In Jurisdictions 5 and 6, the areas with highly infiltrating soils generally have a high water table. The high water table in these areas will most likely prevent water from infiltrating properly, possibly flooding the drain. In addition, French drains should be placed at least 15 feet from building foundations at the bottom of sloped landscaped areas, thereby making proper placement of drains difficult due to the lack of space on most residential lots. Although the initial soil data analysis indicates that French drains are not feasible for most areas, site specific soil and water table data should be collected before this BMP is considered ineffective.

C.3.1.5 Infiltration trenches and basins

Infiltration trenches are suitable for small drainage areas. Since they require a limited amount of space, they can be placed in a wide variety of locations, including parks, residences, commercial developments, near parking lots, at municipal facilities, and on school grounds. Specific locations will be further examined in Task 6. In all locations, trenches should be implemented in conjunction with other BMPs such as vegetated buffer strips to remove coarse sediments before they reach the trench.

An infiltration basin requires a significant amount of space and is suitable for large drainage areas (10 to 50 acres). Due to the large amount of space required, infiltration basins are generally recommended for parks. Infiltration basins, which are empty when not in use, could be dual-purpose. A grass-covered area in a park, for example, could function as an infiltration basin during the wet season, and serve as parkland when dry.

C.3.1.6 Bioretention

Bioretention is ideal for median strips and parking lot islands. These areas can be designed or modified so that runoff is either diverted directly into the bioretention area or conveyed into the bioretention area by a curb and gutter collection system. Bioretention should be considered in streetscaping plans for future improvement projects throughout Jurisdictions 5 and 6. In addition, residents could use bioretention, often referred to as "rain gardens," along sidewalks and near driveways to infiltrate dry weather runoff from pet waste, car washing fluids, and excess irrigation water.

C.3.1.7 Wet Ponds

Wet ponds have a high level of bacteria uptake and are recommended for areas with a large amount of space, such as parks. Many wet ponds have been designed as an aesthetic site amenity, to create wildlife habitat or as a development focal point or recreational area. Due to the large number of parks throughout Jurisdictions 5 and 6, stormwater diversions into wet ponds may be an effective method of reducing bacteria from dry and wet weather runoff.

The City of Manhattan Beach currently maintains a retention basin in Polliwog Park. Dry and wet weather runoff is discharged into the pond through a storm drain outlet at the north end of the park. A valve allows fresh water from the City's supply to supplement the pond's water supply as needed. A continuous deflective separator (CDS) unit has been installed to remove pollutants from the stormwater before it enters the pond.

C.3.1.8 Constructed Wetlands

Constructed wetlands have a high infiltration rate for bacteria from dry weather runoff. Therefore, possible locations for implementation within Jurisdictions 5 and 6 should be identified. The main consideration in constructing a wetland is available space. There are several parks throughout the area that should sufficient space for a small constructed wetland. Hopkins Wilderness Park is an 11-acre site in Redondo Beach that offers camping sites as well as nature study and conservation programs. This gated overgrown natural park has nature trails, streams, and two ponds, making it ideal for the inclusion of a wetland. Other large parks should be evaluated for land use availability and considered for a constructed wetland. Such parks may include Valley Park in Hermosa Beach, and Entradero Park in Torrance.

The City of Laguna Niguel in Orange County has constructed several wetlands, primarily to reduce bacteria concentrations in dry weather flows. The wetlands have been very successful in this regard. Even though there is not enough perennial flow to maintain the permanent pool at a constant elevation, the wetland vegetation has thrived[5].

C.3.2 Cisterns

Rain barrels and cisterns are low-cost water conservation devices that can be used to reduce runoff volume and, for smaller storm events, delay and reduce the peak runoff flow rates. Rain barrels and cisterns are used to control wet weather flow by diverting and storing wet weather runoff from impervious roof areas. The stored runoff can provide a source of chemically untreated 'soft water' for gardens and compost, free of most sediment and dissolved salts. Because residential irrigation can account for up to 40 percent of domestic water consumption, water conservation measures such as rain barrels can be used to reduce the demand on the municipal water system, especially during the hot summer months.

Individual cisterns can be located beneath each downspout, or the desired storage volume can be provided in one large, common cistern that collects rainwater from several sources. Pre-manufactured residential-use cisterns come in sizes ranging from 100 to 10,000 gallons.

In Jurisdictions 5 and 6, wet weather exceedances most frequently occur at monitoring locations SMB-6-1 and SMB-5-4. Public facilities occupy a large portion of the land just south of SMB-6-1. Cisterns could be used at these facilities to capture runoff to

---

5 California Stormwater Quality Association, 2003

reuse for on-site landscaping purposes. Residential lots are located north of SMB-6-1, which are ideal for the use of cisterns. The majority of land use in the area surrounding SMB-5-4 is also residential. Therefore, residents should be encouraged to use cisterns as they are a practical and cost effective solution for conserving wet weather runoff for future beneficial uses such as irrigation water. The use of cisterns and rain barrels for the other remaining subwatersheds in Jurisdictions 5 and 6 is not a useful option because wet weather exceedances do not appear to be as much of a concern.

The Fulton Playfield at 529 Earle Lane in Redondo Beach is a local example of how cisterns can be used in public parks. Upon completion of the Green Flag drainage project, the playfield reopened in 2002 with a new concrete lined holding tank installed to collect storm water runoff. The soil was re-graded at the park and a drainage system was installed to carry away groundwater.

In addition to the Fulton Playfield, the use of rain barrels and cisterns is being encouraged in other areas of Southern California. Tree People, an environmental organization based in Los Angeles, has installed a 250,000-gallon cistern as part of the new Tree People Center for Community Forestry. The cistern will collect stormwater runoff from the parking lot and campus, filter out pollutants that would normally run to the ocean and provide irrigation water for the property. Tree People has also installed cistern collection systems at demonstration sites (e.g., Hall House) and have been developing models to test their effectiveness. The agencies in Jurisdictions 5 and 6 should use the models to encourage residents to use cisterns near drains where wet weather exceedances are common. Parks, playfields, and schools throughout Jurisdictions 5 and 6 may also benefit from installation of cisterns.

C.4 Regional Reuse Opportunities

Regional reuse opportunities evaluated include:

- Regional surface groundwater recharge to enhance water supply,
- Groundwater injection to create a salt water intrusion barrier and/or enhance water supply, and
- Regional capture and reuse as irrigation or other non-potable supply.

C.4.1 Regional Groundwater Recharge

C.4.1.1 Groundwater Basins

Jurisdictions 5 and 6 lie on the Coastal Plain groundwater basin, which consists of five different groundwater sub-basins as shown in Figure 9:

- Central
- Hollywood
- La Habra
- Santa Monica
- West Coast Basins

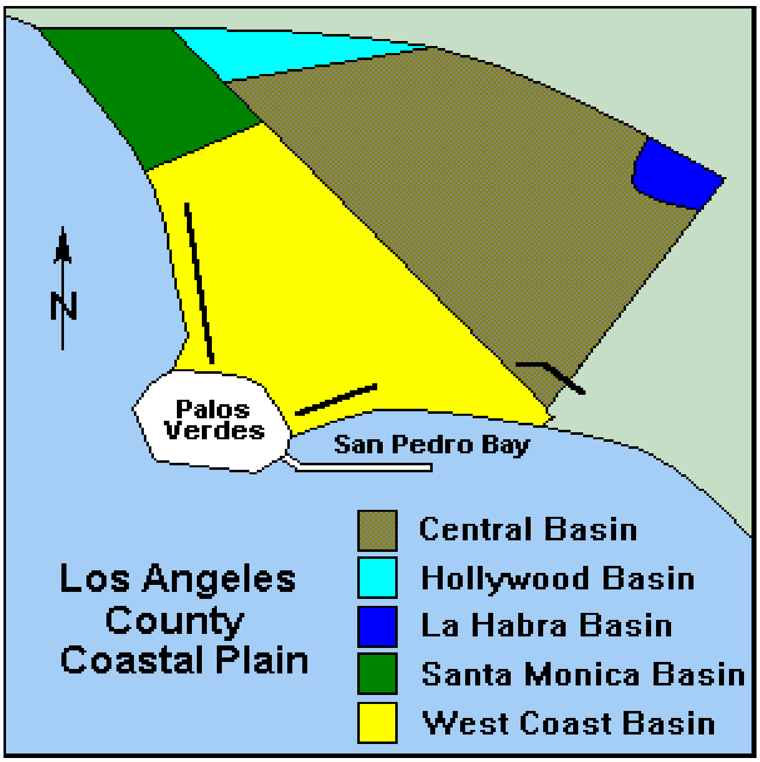


Figure C-2
Los Angeles County Coastal Plain Groundwater Basins[6]

Jurisdictions 5 and 6 are located on the West Coast Basin, which underlies 140 square miles of the Coastal Plain, extending from the Pacific Ocean east to the Newport-Inglewood fault zone. The northern boundary of the West Coast Basin is the Ballona escarpment, and the southern boundary is the ocean.

---

[6] Source: www.ladpw.org

C.4.1.2 Surface Groundwater Recharge

The West Coast Basin that underlies Jurisdictions 5 and 6 contains mostly confined or semi-confined alluvial aquifers. Because of this, large-scale regional recharge projects, or spreading grounds, will not be an effective means of managing runoff. On the other side of the Santa Monica Mountains, opportunity exists in the San Fernando Valley for expanding or adding new spreading grounds; however, managing runoff volume by building conveyance facilities to transport wet weather runoff outside of the Jurisdiction 5/6 area and to higher elevations in the Valley is not a desirable option for several reasons. In addition to the high cost of new conveyance infrastructure, the San Fernando Valley area has its own regulatory responsibilities regarding increasing capture and groundwater recharge of runoff. Use of Jurisdiction 5/6 runoff would not be as efficient as use of local runoff supplies, and therefore, is not considered a likely opportunity.

As discussed in Section 3.1, there may be localized opportunities, particularly in areas with soils that have high infiltration rates, to consider infiltration projects that may function largely as treatment options without having to recharge the groundwater basin.

C.4.1.3 Groundwater Injection

Groundwater injection is a method of groundwater recharge at regional level that not only augments groundwater supplies, but also often serves an additional purpose of protecting the groundwater against seawater intrusion. The water (generally imported and/or reclaimed supplies) injected through a series of injection wells creates a pressure ridge that impedes the inland movement of the salt water front, and maintains protective groundwater elevations in the aquifers.

Stormwater runoff can be a source for regional groundwater injection if it is treated appropriately for the intended use. The capture and injection of runoff eliminates discharge of that quantity of surface water downstream to the beach, thereby potentially reducing the number of exceedance days. For this evaluation, groundwater injection is explored as a means to manage wet weather runoff.

The Los Angeles County Department of Public Works has created three barrier projects to halt seawater intrusion into the basins where they are exposed to the ocean: West Coast Basin Barrier Project (WCBBP), Dominguez Gap Barrier Project (DGBP), and Alamitos Barrier Project (ABP). Of these projects shown in Figure 10, WCBBP is the only project of interest because it is located closest to Jurisdictions 5 and 6, and it injects reclaimed water mixed with imported water.

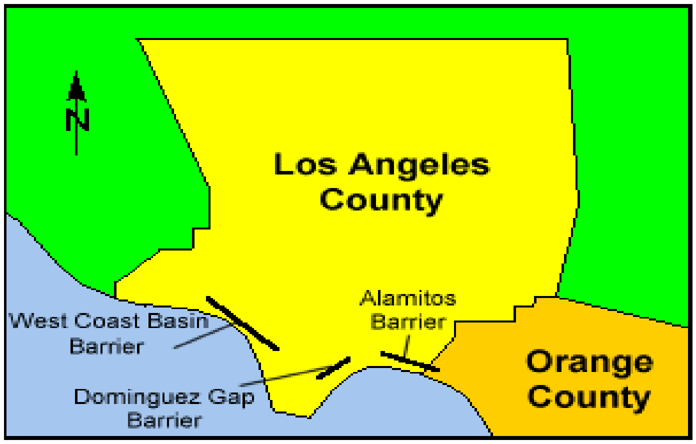


Figure C-3
Los Angeles County Seawater Barrier Projects[7]

The WCBBP currently injects approximately 17.5 mgd of water (50% imported, and 50% recycled) into the aquifers of the West Coast Basin. The reclaimed water used in WCBBP is advanced treated effluent from the West Basin Water Recycling Plant (WBWRP) in the City of El Segundo, which is owned and operated by the West Basin Municipal Water District.

The existing Barrier Treatment process at the WBWRP treats secondary effluent from Hyperion Wastewater Treatment Plant, and produces 7.5 mgd of recycled water that is subsequently blended with imported water and injected into West Basin aquifer through West Basin Barrier Project. After the completion of the WBWRP Expansion, the new Barrier Water Treatment System will produce 12.5 mgd of recycled water. The new Barrier Treatment process includes pre-treatment by microfiltration (MF) followed by RO, hydrogen peroxide addition, and ultraviolet (UV) treatment. The WBWRP Expansion is part of an effort to provide up to 100% recycled water to the Barrier (17.5 mgd) in the near future.

Injection of stormwater runoff in an independent system similar to West Basin, which consists of treatment at WBWRP and injection at WCBBP, is theoretically possible, but is not feasible due to the variable quality, quantity and overall lack of reliability of stormwater runoff as a source, as well as the extensive permitting and operational issues.

West Basin is an efficient system because it reserves a consistent quantity of secondary effluent from Hyperion, and has designed tertiary treatment systems to effectively treat that quantity. Furthermore, since the quality of the Hyperion effluent is consistent, it can be effectively treated. Unlike the secondary effluent of Hyperion, stormwater runoff has a more variable water quality, which can make effective tertiary treatment difficult and could produce poor quality effluent if it were the primary source.

[7] Source: www.ladpw.org

From a quantity perspective, Hyperion effluent is available in abundant supply year-round, whereas the quantity and quality of stormwater runoff is unpredictable. As an independent project, to procure and treat the volume of stormwater runoff to be managed, and then inject it throughout the year, expensive plants would need to be constructed to treat and store the runoff.

While stormwater quality is variable, most of the constituents in runoff are similar to or better than those in secondary effluent. In particular, total dissolved solids (TDS) are much lower, and therefore the runoff could have value as a supplemental, low TDS source water that could, under the right conditions, be blended with Hyperion effluent as a feed to the West Basin Plant. For smaller local watersheds, if runoff could be captured to meet the TMDL requirement and blended, it may be worthwhile to explore the concept of supplying runoff as a low cost, low TDS source of supplemental supply to the West Basin Project. This would require careful review of the water quality issues, as well as contractual agreements in place between all parties.

C.4.2 Reuse as Non-Potable Supply for Irrigation or Other Uses

Since dry weather runoff appears to be the main concern in Jurisdictions 5 and 6, it may be beneficial to treat the runoff on a regional basis and reuse it for landscape irrigation, industrial use, toilet flushing in buildings with dual piping systems, and other non-potable water uses. In order to do so, the option to modify, expand, or add to the cities' wastewater and stormwater conveyance and treatment facilities is explored in further detail.

Reuse of runoff would require not only capture, storage, and treatment systems; but also construction of pipelines and pump stations to distribute treated runoff to water customers. In addition, most water customers do not have dual plumbing systems—meaning separate pipelines for potable and non-potable uses, such as irrigation. Therefore, retrofits for the plumbing system would be needed.

The majority of the monitoring locations within Jurisdictions 5 and 6 indicate a relatively small amount of bacteria exceedances. Therefore, construction of a dry weather runoff treatment plant similar to Santa Monica's Urban Runoff Recycling (SMURRF) Facility may not be a cost effective option to reduce bacteria exceedances. The SMURRF facility treats dry-weather urban runoff water (approximately 500,000 gallons per day) previously discharged into the Santa Monica Bay through storm drains. Although a facility similar to SMURRF may reduce bacteria exceedances in Jurisdictions 5 and 6, the compliance and cost benefits may be limited by variable quantities of dry weather runoff, a low number of potential recycled water customers, or insufficient demand for recycled water. Therefore, a thorough analysis of regional recycled water demands should be conducted to determine if dry weather runoff would be an adequate source of non-potable irrigation water.

The analysis should include the following:

- *Size of potential water demand per customer* – by focusing on larger water customers first, smaller customers along the routes can be economically added later.
- *Type of water use* – landscape irrigation usually requires less cost (from a treatment standpoint) and regulatory hurdles; whereas industrial use may very likely require advanced treatment (such as MF/RO)
- *Proximity to existing recycled water system* – the sites with those potential customers nearest to potential recycled water supplies and existing recycled water pipelines would be the most cost-effective to develop because of the lower distribution cost (pipelines and pump stations)
- *Willingness to use recycled water* – not all potential water customers have a desire to use recycled water; and many base the decision to use such water on costs and/or reliability—meaning in most cases DWP must provide proper incentives.

C.5 Conclusions

This evaluation explores the opportunity to beneficially reuse dry and wet weather runoff using various methods. Regarding on-site opportunities, infiltration projects and cisterns were evaluated. Runoff is best managed by on-site infiltration projects with high bacteria infiltration rates. A comparison of various on-site infiltration BMPs shows that the BMPs to consider include porous pavement, bioretention, wet ponds, constructed wetlands, and bioretention. These methods have been proven to be effective in managing stormwater runoff in coastal communities. Site-specific soil data should be collected to determine most appropriate BMPs that would provide the greatest amount of infiltration. It should be recognized that a portion of the infiltrated runoff can be considered a source of beneficially used runoff either due to percolation to the groundwater basin or subsurface infiltration that would assist in irrigating any immediate vegetation.

Installing cisterns in residences, schools, parks, and municipal facilities near areas with wet weather exceedances will beneficially reuse runoff. The installation of cisterns is not a reasonable option for areas with dry weather exceedances. Cisterns alone will not eliminate the need for other runoff management options, but their installation may be the best option for reusing wet weather runoff.

Regionally, existing groundwater injection projects were evaluated to determine if runoff could be an additional source of supply. While stormwater quality is variable, most of the constituents in runoff are similar to or better than those in secondary effluent. In particular, total dissolved solids (TDS) are much lower. If runoff from small watersheds could be captured to meet the TMDL requirement and blended, it would be worthwhile to explore the concept of supplying runoff as a low cost, low TDS source of supplemental supply to the West Basin Project.

A preliminary analysis of reusing runoff for irrigation was conducted. Due to high level of treatment required for recycled water in relation to the relatively low number of bacteria exceedances, it is doubtful that a dry weather runoff treatment facility such as SMURRF would be a cost effective option. An in depth analysis of potential recycled water customers and potential demand for recycled water should be conducted prior to modifying or constructing facilities. Localized opportunities such as on-site storage and reuse are a more practical option for meeting irrigation demands without the need for high levels of treatment.

Overall, considering the relatively low number of exceedances at Jurisdiction 5 and 6 monitoring locations, on-site projects infiltration projects and cisterns may be the best options for managing dry and wet weather runoff. Although there are opportunities to beneficially reuse wet weather runoff through local and regional solutions, even full implementation of these options would not eliminate the need for other management options. These options, including treatment and discharge, and diversions to the wastewater system will be addressed in upcoming technical memoranda (Tasks 6 and 7). The options presented in these tasks will be combined to create several alternatives for managing the dry and wet weather runoff volume.

C.6 References

California Stormwater Quality Association. *California Stormwater BMP Handbook: New Development and Redevelopment*. January 2003.

City of Redondo Beach. *Civic Green*. 2004. http://www.redondo.org/in_the_city/civic_green/default.asp

Environmental Protection Agency. *Fact Sheet: Post-Construction Storm Water Management in New Development and Redevelopment*. http://cfpub.epa.gov/npdes/stormwater/menuofbmps/post_4.cfm.

http://www.ladpw.com/wrd/Publication/Engineering/online/Maps/00_Soil_Map_Index.pdf

Santa Monica Bay Beaches Wet Weather Bacteria TMDL Implementation Plan. *Task 3 Technical Memorandum, Hydrologic Analysis*. October 2004. Prepared by CDM.

Santa Monica Bay Beaches Wet Weather Bacteria TMDL.

William James. The Journal for Surface Water Quality Professionals. *Green Roads: Research into Permeable Pavers*. January 2004.

Appendix D
Research Potential Sites for Localized BMP's, Beneficial Reuse, and Diversion

Appendix D
Research Potential Sites for Localized BMPs, Beneficial Reuse, and Diversion

D.1 Purpose

This technical memorandum evaluates potential sites for localized BMPs, Beneficial Reuse Facilities, Diversion Facilities, and leach fields within Jurisdictions 5 and 6. The evaluation will include the evaluative criteria and a preliminary feasibility analysis.

The beneficial reuse analysis for Task 4 recommended several types of localized infiltration BMPs to consider including porous pavement, bioretention, wet ponds, constructed wetlands, and vegetated buffer strips. The general recommendations provided in Task 4 will be expanded upon in this TM to include specific sites for localized BMPs. Cisterns were also evaluated in Task 4 as a beneficial reuse option; potential sites for cistern placement are included in Section 3.0.

Task 3 presented regional BMPs which included dry weather diversion facilities and leach fields. Potential sites for diversion facilities and leach fields have been evaluated and are included in Section 4.0.

To assist in evaluating potential sites for BMPs, several software tools are available. These products and services are free of charge and are available online. Two examples are the Parcel Runoff Calculator (PARC) and the TreePeople cistern model. Both are examined in Section 5.0.

Potential Sites have been identified for the following localized (infiltration) BMPs:

- Porous pavement
- Bioretention
- Wet ponds
- Constructed wetlands
- Vegetated buffer strips
- Potential sites have been identified for the following beneficial reuse options:
- Cisterns
- Rain barrels
- Potential sites have been identified for the following regional options:
- Low flow diversion facilities

- Leach fields

D.2 Infiltration BMPs

D.2.1 Porous Pavement

Most municipal facilities have the option of converting impermeable pavement and asphalt into permeable pavement in areas of low volume vehicle traffic or pedestrian traffic. For example, the City of Redondo Beach could expand the use of permeable walkways presently built into the Water Wise Demonstration Garden to include all the walkways throughout the Center. Most Civic Center visitors and employees park in an underground structure, so permeable pavement is not feasible in this area. The City of Torrance's Civic Center and the City of Hermosa Beach's City Hall could utilize permeable pavement in walkways and parking spaces depending on the volume of vehicle traffic. Permeable pavement could also be used for walkways and parking spaces at Manhattan Beach's Public Works Maintenance Yard. Fire stations and police stations are generally not an optimal option for porous pavement due to the high volume of traffic and traffic loading at these facilities. Though, as porous pavement technology improves such that it would accommodate high traffic loading, this option at these facilities can be considered. Before implementing this BMP for major facilities, "pilot tests" should be conducted at small public parking lots.

Most single-family and multi-family residences in Jurisdictions 5 and 6 could benefit from porous pavement, specifically in areas with low volumes of traffic such as driveways and patios. Many of the walk streets in Hermosa Beach and Manhattan Beach, maintained partly by the residents and partly by the City, could also be converted to permeable pavement. Porous pavement designs would enhance the aesthetic appeal of streets near the beach. Residents should be advised to test the permeable pavement on a small patch of driveway or patio before recovering the entire surface. This is especially true for residences nearest to the coast, which may have a high water table that does not permit extensive infiltration.

Porous pavement could be utilized in parking areas and playgrounds at nearly every park within Jurisdictions 5 and 6. Since these areas are heavily used by pedestrians, safety should be a primary concern prior to any consideration of changing the surface. Certain types of porous pavement may be safer for foot traffic than others. For example, asphalt porous pavements may offer a smoother surface than modular concrete block porous pavements, making them more effective for playgrounds. In order to test the durability, safety, and infiltration effectiveness of porous pavement, each city should choose one parking area within a park as a pilot test site. Sites should be selected by their distance from the beach (parks farther from the beach most likely have a lower water table, making them better options for infiltration BMPs). The depth to groundwater and soil infiltration capacity should be evaluated prior to implementation. The parks below are recommended for consideration due to their distance from the coast, as well as the presence of variable types of impermeable space (playgrounds, parking lots, etc.):

- Las Arboles "Rocketship" Park, Torrance
- South Park, Hermosa Beach
- Polliwog Park, Manhattan Beach
- Franklin Park, Redondo Beach

Porous pavement systems are variable in cost, depending on site conditions and design requirements. Generally, unit costs for pervious paving are on the order of $10 to $15 per square foot (s.f.). Based on these rates, a pilot project involving 6,000 square feet of surface to be replaced with pervious paving may cost approximately $60,000-90,000 for installation. Maintenance requirements include inspections and wet high pressure-low volume vacuum treatment. Estimated costs for an average annual maintenance program of a porous pavement parking lot are approximately $3,500 per acre per year or $500 for a 6,000 s.f. parking area. To avoid plugging and potential groundwater contamination, the depth to the groundwater table and soil infiltration capacity should be determined prior to implementation.

D.2.2 Bioretention

Implementing bioretention cells in parking lots and streets, especially near the beach, would direct runoff into areas of vegetation as opposed to the storm drain system. Examples of where bioretention cells may reduce runoff include roadways such as Pacific Coast Highway, grocery store parking lots, shopping centers, and public parking lots. Jurisdiction 5 and 6 agencies and commercial developers should incorporate bioretention into streetscapes and commercial center designs. Bioretention cells are particularly useful in small pockets of residential communities. Residents should be encouraged to use bioretention near driveways and sidewalks to infiltrate dry weather runoff from pet waste, car washing, and excess irrigation water.

Unit costs for bioretention cells range from $3-4/s.f. for residential operations to $10-$40/s.f. for commercial applications, with the upper end reflecting the additional costs associated with retrofitting an existing developed site. A pilot project that retrofits six parking lots islands with bioretention, 200 square feet each, at a commercial facility may cost approximately $48,000.00 for design and installation. This is based on the estimate of $40 per square foot. The operation and maintenance costs for a bioretention facility will be comparable to that of typical maintenance required for landscaped areas.

D.2.3 Wet ponds

Due to the large amount of space required, wet ponds are typically integrated into park settings. Smaller parks (less than five acres) generally do not provide enough space for the inclusion of a wet pond. Though a wet pond can be designed into smaller parks, a more creative use of space would be required. Many of the larger parks contain playing fields, which cannot be considered when siting a wet pond.

Several parks larger than five acres have been selected which could accommodate a wet pond:

- Alta Vista Park
- Valley Park
- Entradero Park

Costs for wet pond installation and maintenance are on the same order as for constructed wetlands.

A wet pond is a feasible option, as demonstrated by the pond in Polliwog Park. The pond functions as a biological filtering system in addition to improving the aesthetic value of the park. Construction costs associated with wet ponds vary considerably depending on the degree to which the existing topography will support a wet pond, the complexity and amount of concrete required for the outlet structure, and whether it is installed as part of new construction or implemented as a retrofit of existing storm drain system[5].

D.2.4 Constructed Wetlands

Constructed wetlands are similar to wet ponds in that they require a large amount of space. Several larger parks were selected for each city that could accommodate a constructed wetland. The Hopkins Wilderness Area in Redondo Beach is an 11-acre site that includes four ecological habitats: forest, meadows, streams, and ponds. The inclusion of a wetland would add a fifth ecological habitat. In addition to Hopkins Wilderness Park, Entradero Park and El Nido Park in Torrance are potential sites.

Reported costs for design and installation of constructed wetlands have been in the range of $200,000 to $500,000 per acre. Literature indicates that annual maintenance and operational costs typically range between 3 to 5 percent of construction costs, but this assumes that there will be regular harvesting of vegetation which is typically done for nutrient and control of pollutants that accumulate in the plant material, itself. If the wetland is intended primarily for bacteria and sediment removal, harvesting of plants may not be necessary and then maintenance costs will be substantially less.

Constructed wetlands are a feasible option, as exemplified by the Madrona March Preserve in the City of Torrance. The marsh is an excellent example of how a wetland can be incorporated into an urban landscape. Madrona is a remnant of once extensive natural wetland systems that existed along the coastal plain and coastal terraces of the South Bay. The marsh is situated on land that has been in oil production since 1924 and was never developed as commercial or residential uses. Other similar undeveloped land with potential to accommodate a wetland may exist within the City of Torrance, but field reconnaissance would be necessary to determine this. In addition, high land values may prevent establishment of additional wetlands.

D.2.5 Vegetated Buffer Strips

Vegetated buffer strips are normally used as a natural buffer between a pollution source and an adjacent water body. However, buffers can also be used in areas where a water body is not present. The buffers diffuse harmful pollutants such as bacteria before they leave the site through stormwater runoff. Potential sites where this BMP may be effective include dog parks and parks requiring heavy irrigation.

The Redondo Beach Dog Park is an example of a park where a vegetated buffer strip may be effective. Although owners are legally required to pick-up and dispose of their dog's feces both in and out of the park, it is unlikely that all dog feces are picked up and discarded of properly. A vegetated buffer strip surrounding the dog park may reduce the levels of bacteria that flow through stormwater.

The strips could also be used at parks near the beach that are currently covered with grass that require heavy irrigation. Examples of these parks include the Veteran's Park and Czuleger Park in Redondo Beach. Replacing the grass with a buffer strip composed of native or drought tolerant plants could serve as a final buffer before stormwater runoff reaches the beach.

Costs in the literature for buffer strips are often based on use of turf as the buffer. A pilot project to installation a 1-acre vegetated buffer strip may cost approximately $30,000 for turf, but costs could be higher for native or xeric landscaping due to the additional cost of plants and mulch to hold the soil while the plants fill in. Initial cost for xeric or native planting will depend on the size and density of initial planting and the type of mulch applied. Conversely, long term maintenance costs of native plantings will be far less than a turf buffer because there is no mowing or fertilizing required and very little irrigation once the plants are established (after 2 years). The only long-term maintenance for native plantings is occasional dry weather irrigation and periodic pruning or replacement of plants for aesthetics.

D.3 Beneficial Reuse

D.3.1 Cisterns

Stormwater runoff cisterns are roof water management devices that provide retention storage volume in above or underground storage tanks. They are typically used for water supply. Cisterns are generally larger than rain barrels, with some underground cisterns having the capacity of 10,000 gallons1. There are six components to a cistern collection system: the roof or catchment area, gutters and downspouts, leaf screens and roof washers, the cistern, a conveyance system of pipes, and water treatment (if necessary). Most importantly, a catchment system is required to direct stormwater runoff into pipes. Therefore, only sites with substantial roofed structures such as schools, community centers, and recreation centers have been considered. The second criteria for a cistern to be effective is the amount of irrigation water that is consumed at the site. Various parks and schools, especially those with playing field turf, are

[1] http://www.lid-stormwater.net/raincist/raincist_home.htm

particularly good sites for the installation of a cistern because irrigation requirements are typically high.

Sites do not have to be large in order to be a potential site for an underground cistern. A cistern facility can be installed, for example, underneath playing fields that are 0.25 to 0.50 of an acre. Various parks and schools have been selected which have roofed structures and most likely high irrigation needs:

- Redondo Union High School (roofs of school buildings could serve as catchments)
- Live Oak Park (roofs of the Live Oak Recreation Center & Joslyn Community Center could serve as catchments)
- Manhattan Heights Park (roof of Manhattan Heights Community Center could serve as a catchment)
- Alta Vista Park (roof of Community Center or tennis courts could serve as a catchment)

The cost of constructing an underground cistern can vary greatly depending upon its volume and the material of which it is constructed. Sizes can vary from hundreds of gallons for residential use to tens of thousands of gallons for commercial use [2]. The degree of water treatment required can also significantly affect the construction cost. For the purposes of this task, typical design, permitting and installation costs for a cistern are estimated at $2 - $2.50 per gallon of cistern volume.

The relatively high cost of installing an underground cistern makes this option more difficult to implement than others discussed previously. However, the cost may eventually be offset by a reduction in demand for irrigation water.

Maintenance considerations include inspecting gutters, gutter guards, downspouts and roof washers for debris. Cracks and leaks must be repaired promptly. In addition, cisterns must be cleaned out on a regular basis for sanitation and vector control purposes.

Limitations include treatment requirements, the sixth element of a cistern system. Title 22 sets bacteriological water quality standards on the basis of the expected degree of public contact with recycled water. For applications with a lower potential for public contact, such as irrigation, Title 22 requires three levels of secondary treatment, basically differing by the amount of disinfection required[3]. Article 3 of Title 22 states that recycled water used for surface irrigation of parks and playgrounds, school yards, residential landscaping, and unrestricted access golf courses shall be a disinfected tertiary recycled water[4]. However, further

[2] http://www.lid-stormwater.net/raincist/raincist_cost.htm

[3] http://www.watereuse.org/Pages/title22.html

[4] http://www.dhs.ca.gov/ps/ddwem/publications/waterrecycling/purplebookupdate6-01.PDF

investigation into Title 22 requirements is necessary to determine if cistern water could be reused for irrigation under specific, controlled conditions without needing to meet full Title 22 treatment standards.

D.3.2 Rain Barrels

Rain barrels are low-cost, effective, and easily maintainable retention and detention devices that are applicable to residential, commercial and industrial sites to manage rooftop runoff[5]. Residences are the most practical sites for rain barrels due to less strict treatment requirements for non-potable uses and ability to store large amounts of rainwater. For uses that don't involve direct human consumption or contact (i.e. on-site irrigation, clothes washing, etc.), treatment beyond sediment removal is generally not required. Residents can expect to collect approximately 600 gallons of rainwater for every inch of rain that falls on a catchment area of 1,000 square feet[6]. Rain barrels can also be used for potable water use, but the treatment requirements make this less economically feasible than obtaining potable water from municipal sources.

Costs for rain barrels and accessories used for residential purposes range from $200-$300. Residents should be able to offset this cost by reducing their reliance on municipal water.

Maintenance considerations are relatively minimal and include cleaning out gutters and screens, inspection and/or replacement of rain barrel components, and cleaning out the rain barrel at least once per year, ideally during the summer when water levels are low.

Rain barrels are a feasible option for Jurisdictions 5 and 6 because they are easy to implement, are relatively inexpensive, have low maintenance requirements, and the potential to store large amounts of water. This option is especially applicable to homeowners who use large amounts of water for landscaping purposes.

D.4 Regional Options

D.4.1 Low-Flow Diversion Facilities

A portion of dry weather urban runoff from the storm drain system is (or will be) diverted through low-flow diversions to the sewer main for treatment at the Joint Water Pollution Control Plant (JWPCP) in Carson, operated by the Los Angeles County Sanitation Districts. Diversion systems are designed to operate only during periods of dry weather. During wet weather, the systems are typically shut off or bypassed to avoid a combined sewer overflow[7]. In Jurisdictions 5 and 6, the following monitoring sites are equipped with, or will soon be equipped with low-flow diversion facilities:

---

5 http://www.lid-stormwater.net/raincist/raincist_home.htm

6 http://rainbarrelguide.com

7 http://www.surfrider.org/a-z/diversion_ca.pdf

- SMB-5-2
- SMB-5-3
- SMB-6-1
- SMB-6-2
- SMB-6-3
- SMB-6-5

The capital cost to install diversions varies widely, depending on such factors as the flow, the nearness and relative elevation of sewer lines, and the degree of automatic control desired[13]. The costs of constructing the SMB-6-5 diversion facility, for example, are estimated to be approximately $550,000. There may be additional costs from the sewer agency related to the flow rate and the concentration of contaminants.

The County Sanitation Districts of Los Angeles County (Districts) conducted a Dry Weather Characterization Study from May 2002 through October 2002. The study assessed 125 storm drains and provided a baseline for setting priorities for dry weather urban runoff diversions in the coastal area from Manhattan Beach to Long Beach. The study was designed to collect information to assess the feasibility of dry weather diversion of storm drains to the District's sewerage system. The results of this study were summarized in a final report to the Regional Board on December 30, 2002[8]. The study findings highlighted four drains of interest, three of which were within Jurisdictions 5 and 6. The "drains of interest" were the Herondo Street drain, the 28th Street drain in Manhattan Beach, and the Redondo Beach Pier drain.

The Herondo Street drain has since been equipped with a diversion facility. A second "drain of interest", the 28th Street drain, has been identified by the County for installation of a diversion facility. The ability of these diversion facilities to reduce exceedances is limited by the Los Angeles County Sanitation District's policies on accepting low flow diversions. Currently, the LACSD has placed restrictions on the amount of dry weather runoff that is accepted for three months out of the year. However, the study indicates that the Districts are working with the County Department of Public Works on an acceptable diversion structure design which would allow the diversion to operate year-round during dry weather. The third "drain of interest," located at the Redondo Beach Pier, was observed to be flowing up to 9 gallons per minute with relatively low concentrations of indicator bacteria. The Districts concluded that it was unlikely that this discharge was the source of AB411 exceedances at the beach monitoring station 50 yards south. Seagulls and fecal matter were observed, which the Districts believed was more likely the cause of exceedances. The Districts did not recommend diversion at this location due to the relatively low or non-existent flows and low bacteria concentrations.

---

[8] County Sanitation Districts of Los Angeles County, 2002

The study presented three key points: 1) not all drains that discharge dry weather flows contribute to exceedances of receiving water objectives; 2) due to lack of flow, it may not be necessary to divert all drains; and 3) a greater amount of discharge is not necessarily associated with a higher number of exceedances. Therefore, there is no "one size fits all" strategy for evaluating placement of diversion facilities (County Sanitation Districts of Los Angeles County, 2002). Although no additional diversion facilities are recommended for Jurisdictions 5 and 6 at this time, continued monitoring and evaluation on a drain by drain basis will be necessary.

D.4.2 Leach Fields

Leach fields are most commonly associated with sewage treatment, but they can also be used for stormwater runoff from low flows. A leach field is similar in concept to an infiltration trench in that it includes subgrade gravel beds for runoff storage and infiltration. Unlike trenches, however, flow enters the beds through a conduit, such as a perforated pipe or a box culvert. The gravel beds in a leach field are not exposed, as in a trench configuration. Rather, the entire facility is underground and may be covered.[9] This allows low flows to infiltrate into the ground, while high volume flows are allowed to pass through. A wide variety of conduits are available for use in leach fields. Equipment designed for septic systems may be applicable for stormwater use.

In Jurisdictions 5 and 6, leach fields are best suited for placement near storm drain outlets. Prioritization for installation should be based on the outlet's proximity to a monitoring site. Leach fields may reduce dry weather exceedances and could be considered diversion mechanisms. A small portion (30-40ft) of storm drain pipe nearest the outlet would be removed and replaced with a leach field to allow for greater infiltration of low flows. At least 5 feet should separate the bottom of the leach field from the groundwater table to prevent contamination.

Cost estimates for a leach field are difficult to determine. Traditional septic leach fields, which are similar in function, range anywhere from $1,700-$3,000 for a single family home. Since a leach field is similar to an underground infiltration trench, costs can be expected to be at least $7-$10/cf, perhaps considerably more depending on structural features such as the incorporation of a box culvert into the system. Maintenance considerations include regular inspections for removal of trash and debris, structural soundness, and drain time.

Possible limitations include the depth to the groundwater table and corresponding regulations. If the depth to groundwater is less than five feet, there may be risk of contamination. Thorough studies should be conducted to determine the depth of the groundwater table prior to installation. In addition, the EPA has implemented an Underground Injection Control (UIC) Program under the Safe Water Drinking Act. Some stormwater structures are classified as Class V injection wells in the UIC program and may require a permit. The EPA characterizes Class V wells as structures

---

[9] http://www.vcstormwater.org/infiltration.doc

that "inject nonhazardous fluids into or above a [underground source of drinking water] and are typically shallow, on-site disposal systems, such as floor and sink drains, dry wells, leach fields, and similar types of drainage wells10." The EPA reports that storm water drainage wells do not require a permit if they do not endanger underground sources of drinking water and they comply with federal UIC program requirements11. Further investigation would be necessary to determine if a site-specific leach field complies with state and federal regulations.

D.5 Siting Tools

D.5.1 PARC

PARC is an online tool that allows agencies to estimate the volume of runoff reduced by implementing water-capture BMPs on a specific piece of land. PARC can also be used to size BMPs by calculating peak flow rates. The program allows users to interactively size BMPs for optimal performance and cost efficiency[12]. An unlimited number of BMPs can be entered into the system to determine how they will function together to reduce runoff at a particular site. At sites where multiple BMPs have been recommended, such as Entradero Park, a virtual BMP model can be developed using the PARC program. For this park, the user might enter criteria on porous pavement, a cistern, and the presence of trees to determine the volume of runoff that may be reduced. This is a unique tool that will assist Jurisdictions with the planning process. Results are instantaneous and are stored in an online server for at least 30 days.

D.5.2 TreePeople Cistern Model

Using the TreePeople's cistern model[13], users are able to build a virtual cistern and see how it would have performed during the 1997-1998 rainy season in Los Angeles. First, the user calculates the square footage of the structure's roof catchment area. The figure is entered into the cistern Model on the appropriate slider. The model can be tweaked to try out various cistern capacities and daily irrigation rates to determine how a cistern would perform. As the user changes the physical structure or operating procedures of the cistern, the chart reflects the daily changes in the cistern's water volume. This model may be useful in determining if a cistern is a viable option for a particular site.

D.6 Conclusions

This technical memorandum evaluated potential sites for facilities proposed by the runoff management options. Potential sites and evaluative criteria were discussed for localized BMPs, beneficial reuse options, and regional options.

Numerous public parks, government facilities, schools, and residences were identified as possible sites for implementation of on-site storage and reuse projects that manage

---

[10] Kaspersen 2004

[11] http://www.epa.gov/safewater/uic/pdfs/fact_class5_stormwater.pdf

[12] www.parconline.com/whatis.htm

[13] http://www.treepeople.org/trees/cistern2.htm

runoff before it enters the storm drain system. Small-scale projects such as localized BMPs are preferred due to the relatively low cost/low maintenance requirements and the ability to infiltrate stormwater as opposed to diverting it. Cisterns and rain barrels can be useful at residences and schools, but will most likely require more public support. Potential sites for regional facilities have been considered, but these types of facilities are typically associated with high cost, political issues, regulatory constraints, and land acquisition.

Site specific soil and groundwater table data should be collected prior to implementation. In addition, pilot tests are recommended before full-scale implementation to ensure that the BMP or facility will be successful.

D.7 References

California Stormwater Quality Association. *California Stormwater BMP Handbook: New Development and Redevelopment*. January 2003.

CH:CDM. Santa Monica Bay Beaches Wet Weather Bacteria TMDL Implementation Plan. *Task 2 Technical Memorandum, BMP Evaluation*. December 2004.

County Sanitation Districts of Los Angeles County 2002. Dry Weather Characterization Study-Final Report for Supplemental Environmental Project No. 1 for Order of Complaint No. 00-171 for Administrative Civil Liability, County Sanitation Districts of Los Angeles County (NPDES Permit No. CA0053813, CI-1758)

http://www.dhs.ca.gov/ps/ddwem/publications/waterrecycling/purplebookupdate6-01.PDF

http://www.epa.gov/owm/mtb/porouspa.pdf

http://www.epa.gov/safewater/uic/pdfs/fact_class5_stormwater.pdf

http://www.lid-stormwater.net/bioretention/bio_costs.htm

http://www.lid-stormwater.net/raincist/raincist_cost.htm

http://www.lid-stormwater.net/raincist/raincist_home.htm

http://www.parconline.com/whatis.htm

http://www.rainbarrelguide.com

http://www.surfrider.org/a-z/diversion_ca.pdf

http://www.treepeople.org/trees/cistern2.htm

http://www.vcstormwater.org/infiltration.doc

http://www.watereuse.org/Pages/title22.html

Kaspersen, Janice. Stormwater Journal. *Regulating Stormwater Underground.* March/April 2004.

Santa Monica Bay Beaches Wet Weather Bacteria TMDL.

Appendix E
Santa Monica Bay Beaches Wet-Weather Bacteria TMDL

State of California
California Regional Water Quality Control Board, Los Angeles Region

RESOLUTION NO. 2002-022
December 12, 2002

Amendment to the Water Quality Control Plan (Basin Plan) for the Los Angeles Region to Incorporate Implementation Provisions for the Region's Bacteria Objectives and to Incorporate a Wet-Weather Total Maximum Daily Load for Bacteria at Santa Monica Bay Beaches

WHEREAS, the California Regional Water Quality Control Board, Los Angeles Region, finds that:

1. The federal Clean Water Act (CWA) requires the California Regional Water Quality Control Board, Los Angeles Region (Regional Board) to develop water quality standards which include beneficial use designations and criteria to protect beneficial uses for each water body found within its region.

2. The Regional Board carries out its CWA responsibilities through California's Porter-Cologne Water Quality Control Act and establishes water quality objectives designed to protect beneficial uses contained in the Water Quality Control Plan for the Los Angeles Region (Basin Plan).

3. Section 303(d) of the CWA requires states to identify and to prepare a list of water bodies that do not meet water quality standards and then to establish load and waste load allocations, or a total maximum daily load (TMDL), for each water body that will ensure attainment of water quality standards and then to incorporate those allocations into their water quality control plans.

4. Many of the beaches along Santa Monica Bay were listed on California's 1998 section 303(d) list, due to impairments for coliform or for beach closures associated with bacteria generally. The beaches appeared on the 303(d) list because the elevated bacteria and beach closures prevented full support of the beaches' designated use for water contact recreation (REC-1).

5. A consent decree between the U.S. Environmental Protection Agency (USEPA), Heal the Bay, Inc. and BayKeeper, Inc. was approved on March 22, 1999. This court order directs the USEPA to complete TMDLs for all the Los Angeles Region's impaired waters within 13 years. A schedule was established in the consent decree for the completion of 29 TMDLs within 7 years, including completion of a TMDL to reduce bacteria at Santa Monica Bay beaches by March 2002. The remaining TMDLs will be scheduled by Regional Board staff within the 13-year period.

6. The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and section 303(d) of the CWA, as well as in USEPA guidance documents (e.g., USEPA, 1991). A TMDL is defined as "the sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2). Regulations further stipulate that TMDLs must be set at "levels necessary to attain and maintain the applicable narrative and numeric water quality standards with seasonal variations and a margin of safety that takes into account any lack of knowledge concerning the relationship between effluent limitations

and water quality" (40 CFR 130.7(c)(1)). The provisions in 40 CFR 130.7 also state that TMDLs shall take into account critical conditions for stream flow, loading and water quality parameters.

7. Upon establishment of TMDLs by the State or USEPA, the State is required to incorporate the TMDLs along with appropriate implementation measures into the State Water Quality Management Plan (40 CFR 130.6(c)(1), 130.7). The Basin Plan and applicable statewide plans serve as the State Water Quality Management Plans governing the watersheds under the jurisdiction of the Regional Board.

8. Santa Monica Bay is located in Los Angeles County, California. The proposed TMDL addresses documented bacteriological water quality impairments at 44 beaches from the Los Angeles/Ventura County line, to the northwest, to Outer Cabrillo Beach, just south of the Palos Verdes Peninsula.

9. The Regional Board is establishing the above-mentioned TMDL to preserve and enhance the water quality at Santa Monica Bay beaches and for the benefit of the 55 million beachgoers, on average, that visit these beaches each year. At stake is the health of swimmers and surfers and associated health costs as well as sizeable revenues to the local and state economy. Estimates are that visitors to Santa Monica Bay beaches spend approximately $1.7 billion annually.

10. The Regional Board's goal in establishing the above-mentioned TMDL is to reduce the risk of illness associated with swimming in marine waters contaminated with bacteria. Local and national epidemiological studies compel the conclusion that there is a causal relationship between adverse health effects, such as gastroenteritis and upper respiratory illness, and recreational water quality, as measured by bacteria indicator densities. The water quality objectives on which the TMDL numeric targets are based will ensure that the risk of illness to the public from swimming at Santa Monica Bay beaches generally will be no greater than 19 illnesses per 1,000 swimmers, which is defined by the US EPA as an "acceptable health risk"in marine recreational waters.

11. Interested persons and the public have had reasonable opportunity to participate in review of the amendment to the Basin Plan. Efforts to solicit public review and comment include staff presentations to the Santa Monica Bay Restoration Project's Bay Watershed Council and Technical Advisory Committee between May 1999 and October 2001 and creation of a Steering Committee in July 1999 to provide input on scientific and technical components of the TMDL with participation by the Southern California Coastal Water Research Project, City of Los Angeles, County of Los Angeles Department of Public Works, County Sanitation Districts of Los Angeles County, Heal the Bay, and Santa Monica Bay Restoration Project.

12. A first draft of the TMDL for bacteria at Santa Monica Bay beaches was released for public comment on November 9, 2001; an interim draft TMDL covering wet weather only was released on June 21, 2002, for discussion at a public workshop; and a public workshop on the draft Wet-Weather TMDL was held on June 27, 2002 at a regularly scheduled Regional Board meeting.

13. A final draft of the Wet-Weather TMDL along with a Notice of Hearing and Notice of Filing were published and circulated 45 days preceding Board action; Regional Board staff responded to oral and written comments received from the public; and the Regional Board

held a public hearing on September 26, 2002 to consider adoption of the Wet-Weather TMDL.

14. The Regional Board continued the item from the September 26, 2002 Board meeting to the December 12, 2002 Board meeting to give staff time to make revisions based on public comments and Board discussion at the September 26, 2002 Board meeting. Specifically, the Board wanted an implementation program that was reasonable and as short as practicable given the testimony on impairments to the REC-1 beneficial use.

15. The Regional Board recognizes that there are two broad approaches to implementing the TMDL. One approach is an integrated water resources approach that takes a holistic view of regional water resources management by integrating planning for future wastewater, storm water, recycled water, and potable water needs and systems; focuses on beneficial re-use of storm water, including groundwater infiltration, at multiple points throughout a watershed; and addresses multiple pollutants for which Santa Monica Bay or its watershed are listed on the CWA section 303(d) List as impaired. The other approach is a non-integrated water resources approach.

    Some responsible jurisdictions and agencies have indicated a preference to take an integrated water resources approach to realize the benefits of re-using storm water to preserve local groundwater resources and to reduce reliance on imported water. The Regional Board recognizes that an integrated water resources approach not only provides water quality benefits to the people of the Los Angeles Region, but also recognizes that the responsible jurisdictions implementing this TMDL can serve a variety of public purposes by adopting an integrated water resources approach. An integrated water resources approach will address multiple pollutants, and as a result, responsible jurisdictions can recognize cost-savings because capital expenses for the integrated approach will implement several TMDLs that address pollutants in storm water. In addition, jurisdictions serve multiple roles for their citizenry, and an integrated approach allows for the incorporation and enhancement of other public goals such as water supply, recycling and storage; environmental justice; parks, greenways and open space; and active and passive recreational and environmental education opportunities.

    The Regional Board acknowledges that a longer timeframe is reasonable for an integrated water resources approach because it requires more complicated planning and implementation such as identifying markets for the water and efficiently siting storage and transmission infrastructure within the watershed(s) to realize the multiple benefits of such an approach.

16. Therefore, after considering testimony, the Regional Board directed staff to adjust the implementation provisions of the TMDL to allow for a longer implementation schedule (up to 18 years) only when the responsible jurisdictions and agencies clearly demonstrate their intention to undertake an integrated water resources approach and justify the need for a longer implementation schedule. In contrast, testimony indicated that a shorter implementation schedule (up to 10 years) is reasonable and practicable for non-integrated approaches because the level of planning is not as complicated.

17. A revised draft of the Basin Plan amendment and Tentative Resolution were circulated 45 days preceding Board action. Regional Board staff responded to oral and written comments received from the public on the revised draft. The Regional Board held a second public hearing on December 12, 2002 to consider adoption of the Wet-Weather TMDL.

18. On October 25, 2001, the Regional Board adopted Resolution 2001-018 establishing revised bacteriological water quality objectives for the Water Contact Recreation (REC-1) beneficial use, and the TMDL is intended to accompany and to implement the revised water quality objectives. The State Water Resources Control Board approved the Regional Board's Basin Plan amendment on July 18, 2002 in State Board Resolution 2002-0142, the Office of Administrative Law approved it on September 19, 2002 in OAL File No. 02-0807-01-S, and the US EPA approved it on September 25, 2002.

19. Under certain circumstances and through the TMDL development process, the Regional Board proposes to implement the aforementioned revised bacteria objectives using either a 'reference system/anti-degradation approach' or a 'natural sources exclusion approach.' As required by the CWA and Porter-Cologne Water Quality Control Act, the Basin Plan includes beneficial uses of waters, water quality objectives to protect those uses, an anti-degradation policy, collectively referred to as water quality standards, and other plans and policies necessary to implement water quality standards. This TMDL and its associated waste load allocations, which will be incorporated into relevant permits, are the vehicles for implementation of the bacteria standards as required under Water Code section 13242.

20. Both the 'reference system/anti-degradation approach' and the 'natural sources exclusion approach' recognize that there are natural sources of bacteria that may cause or contribute to exceedances of the single sample objectives.

21. The Regional Board's intent in implementing the bacteria objectives using a 'reference system/anti-degradation approach' is to ensure that bacteriological water quality is at least as good as that of a reference site and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of a reference site. The Regional Board's intent in implementing the bacteria objectives using a 'natural sources exclusion approach' is to ensure that all anthropogenic sources of bacteria are controlled such that they do not cause an exceedance of the single sample objectives. These approaches are consistent with state and federal anti-degradation policies (State Board Resolution No. 68-16 and 40 C.F.R. 131.12), while acknowledging that it is not the intent of the Regional Board to require treatment or diversion of natural coastal creeks or to require treatment of natural sources of bacteria from undeveloped areas. While treatment and diversion of natural sources may fully address the impairment of the water contact recreation beneficial use, such an approach may adversely affect valuable aquatic life and wildlife beneficial uses in the Region.

22. For the Wet-Weather and Dry-Weather Bacteria TMDLs at Santa Monica Bay beaches, Leo Carrillo Beach and its associated drainage area, Arroyo Sequit Canyon, were selected as the local reference system until other reference sites or approaches are evaluated and the necessary data collected to support the use of alternative reference sites or approaches when the TMDL is revised four years after the effective date. Leo Carrillo Beach was selected as the interim reference site because it best met the three criteria for selection of a reference system. Specifically, its drainage is the most undeveloped subwatershed in the larger Santa Monica Bay watershed, the subwatershed has a freshwater outlet (i.e., creek) to the beach, and adequate historical shoreline monitoring data were available. It is the intent of the Regional Board to re-evaluate the use of Leo Carrillo Beach due to potential problems arising from the heavy recreational use of the beach and the close proximity of two campgrounds.

23. Northern Bay beach monitoring sites are fewer in number and provide less comprehensive data than the extensive shoreline monitoring network elsewhere in Santa Monica Bay.

24. The numeric targets in this TMDL are not water quality objectives and do not create new bases for enforcement against dischargers apart from the water quality objectives they translate. The targets merely establish the bases through which load allocations and wasteload allocations (WLAs) are calculated. WLAs are only enforced for a dicharger's own discharges, and then only in the context of it National Pollutant Discharge Elimination System (NPDES) permit, which must be consistent with the assumptions and requirements of the WLA. The Regional Board will develop permit requirements through a subsequent permit action that will allow all interested persons, including but not limited to municipal storm water dischargers, to provide comments on how the waste load allocations will be translated into permit requirements.

25. The Regional Board has the authority to authorize compliance schedules through the basin planning process. In this Basin Plan amendment, the Regional Board establishes a schedule for implementation that affords the responsible jurisdictions and agencies up to ten or eighteen years, depending on the implementation approaches pursued, to implement this Wet-Weather Bacteria TMDL.

26. Previously, the Regional Board adopted a Dry-Weather Bacteria TMDL for the Santa Monica Bay Beaches. The Dry-Weather TMDL includes implementation provisions contained in Table 7-4.3 of the Basin Plan, including a provision to reconsider two years after the effective date the Dry-Weather TMDL and specifically the reference beach(es) used. Because that effort overlaps with reconsideration of the reference beach(es) anticipated by this Wet-Weather TMDL, the Regional Board proposes to coordinate the reconsiderations of the reference beach approach to assure efficiency and consistency in implementing the two Santa Monica Beaches TMDLs.

27. The basin planning process has been certified as functionally equivalent to the California Environmental Quality Act requirements for preparing environmental documents (Public Resources Code, Section 21000 et seq.) and as such, the required environmental documentation and CEQA environmental checklist have been prepared.

28. The proposed amendment results in no potential for adverse effect (de minimis finding), either individually or cumulatively, on wildlife.

29. The regulatory action meets the "Necessity" standard of the Administrative Procedures Act, Government Code, section 11353, subdivision (b).

30. The Basin Plan amendment incorporating a TMDL for bacteria at Santa Monica Bay beaches must be submitted for review and approval by the State Water Resources Control Board (State Board), the State Office of Administrative Law (OAL), and the USEPA. The Basin Plan amendment will become effective upon approval by OAL and USEPA. A Notice of Decision will be filed.

THEREFORE, be it resolved that pursuant to Section 13240 and 13242 of the Water Code, the Regional Board hereby amends the Basin Plan as follows:

1. Pursuant to sections 13240 and 13242 of the California Water Code, the Regional Board, after considering the entire record, including oral testimony at the hearing, hereby adopts the amendments to Chapters 3 and 7 of the Water Quality Control Plan for the Los Angeles Region, as set forth in Attachment A hereto, to incorporate the elements of the Santa Monica

Bay Beaches Bacteria TMDL for wet weather and to implement the water quality objectives for bacteria set to protect the water contact recreation beneficial use.

2. Pursuant to sections 13240 and 13242 of the California Water Code, the Regional Board, after considering the entire record, including oral testimony at the hearing, hereby adopts the amendments to Chapter 7 of the Water Quality Control Plan for the Los Angeles Region, as set forth in Attachment B hereto, to amend Table 7-4.3 of the Santa Monica Bay Beaches Bacteria TMDL for dry weather to change the date for revision of the TMDL from two years after the effective date to four years after the effective date [of the Wet-Weather TMDL] to achieve consistency in scheduling between the Dry-Weather and Wet-Weather TMDLs.

3. The Executive Officer is directed to exercise authority under Water Code section 13267, or other applicable law, to require additional monitoring data in the northern Bay beach regions to ensure that wet weather bacteria exposure is adequately quantified before the TMDL is reconsidered in four years.

4. The Executive Officer is directed to forward copies of the Basin Plan amendment to the State Board in accordance with the requirements of section 13245 of the California Water Code.

5. The Regional Board requests that the State Board approve the Basin Plan amendment in accordance with the requirements of sections 13245 and 13246 of the California Water Code and forward it to OAL and the USEPA.

6. If during its approval process the State Board or OAL determines that minor, non-substantive corrections to the language of the amendment are needed for clarity or consistency, the Executive Officer may make such changes, and shall inform the Board of any such changes.

7. The Executive Officer is authorized to sign a Certificate of Fee Exemption.

I, Dennis A. Dickerson, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a resolution adopted by the California Regional Water Quality Control Board, Los Angeles Region, on December 12, 2002.

ORIGINAL SIGNED BY
Dennis A. Dickerson
Executive Officer

Attachment A to Resolution No. 2002-022

Amendment to the Water Quality Control Plan – Los Angeles Region to incorporate Implementation Provisions for the Region's Bacteria Objectives and to incorporate the Santa Monica Bay Beaches Wet-Weather Bacteria TMDL

Adopted by the California Regional Water Quality Control Board, Los Angeles Region on December 12, 2002.

Amendments:

List of Figures, Tables and Inserts
Add under Chapter 7, Section 7-4 (Santa Monica Bay Beaches Bacteria TMDL):
Tables

Chapter 3. Water Quality Objectives, "Bacteria, Coliform"

Add under "Implementation Provisions for Water Contact Recreation Bacteria Objectives"

The single sample bacteriological objectives shall be strictly applied except when provided for in a Total Maximum Daily Load (TMDL). In all circumstances, including in the context of a TMDL, the geometric mean objectives shall be strictly applied. In the context of a TMDL, the Regional Board may implement the single sample objectives in fresh and marine waters by using a 'reference system/antidegradation ap□roach' or 'natural sources exclusion approach' as discussed below. A reference system is defined as an area and associated monitoring point that is not impacted by human activities that potentially affect bacteria densities in the receiving water body.

These approaches recognize that there are natural sources of bacteria, which may cause or contribute to exceedances of the single sample objectives for bacterial indicators. They also acknowledge that it is not the intent of the Regional Board to require treatment or diversion of natural water bodies or to require treatment of natural sources of bacteria from undeveloped areas. Such requirements, if imposed by the Regional Board, could adversely affect valuable aquatic life and wildlife beneficial uses supported by natural water bodies in the Region.

Under the reference system/antidegradation implementation procedure, a certain frequency of exceedance of the single sample objectives above shall be permitted on the basis of the observed exceedance frequency in the selected reference system or the targeted water body, whichever is less. The reference system/anti-degradation approach ensures that bacteriological water quality is at least as good as that of a reference system and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of the selected reference system.

Under the natural sources exclusion implementation procedure, after all anthropogenic sources of bacteria have been controlled such that they do not cause or contribute to an exceedance of the single sample objectives and natural sources have been identified and quantified, a certain frequency of exceedance of the single sample objectives shall be permitted based on the residual exceedance frequency in the specific water body. The residual exceedance frequency shall define the background level of exceedance due to natural sources. The 'natural sources exclusion' approach may be used if an appropriate reference system cannot be identified due to unique characteristics of the target water body. These approaches are consistent with the State Antidegradation Policy (State Board Resolution No. 68-16) and with federal antidegradation requirements (40 CFR 131.12).

The appropriateness of these approaches and the specific exceedance frequencies to be permitted under each will be evaluated within the context of TMDL development for a specific water body, at which time the Regional Board may select one of these approaches, if appropriate.

These implementation procedures may only be implemented within the context of a TMDL addressing municipal storm water, including the municipal storm water requirements of the Statewide Permit for Storm Water Discharges from the State of California Department of Transportation (Caltrans), and non-point sources discharges. These implementation provisions do not apply to NPDES discharges other than MS4 discharges.[1]

Chapter 7. Total Maximum Daily Loads (TMDLs) Summaries, Section 7-4 (Santa Monica Bay Beaches Bacteria TMDL)

Santa Monica Bay Beaches Bacteria TMDL (Wet Weather Only)*

This TMDL was adopted by the Regional Water Quality Control Board on December 12, 2002.

This TMDL was approved by:

The State Water Resources Control Board on [Insert Date].
The Office of Administrative Law on [Insert Date].
The U.S. Environmental Protection Agency on [Insert Date].

The following table summarizes the key elements of this TMDL.

[1] Municipal storm water discharges in the Los Angeles Region are those with permits under the Municipal Separate Storm Sewer System (MS4) NPDES Program. For example, the MS4 permits at the time of this amendment are the Los Angeles County Municipal Storm Water NPDES Permit, Ventura County Municipal Storm Water NPDES Permit, City of Long Beach Municipal Storm Water NPDES Permit, and elements of the statewide storm water permit for the California Department of Transportation (Caltrans).

Attachment A to Resolution No. 2002-022

Table 7-4.4. Santa Monica Bay Beaches Bacteria TMDL (Wet Weather Only): Elements

Element	Key Findings and Regulatory Provisions
Problem Statement	Elevated bacterial indicator densities are causing impairment of the water contact recreation (REC-1) beneficial use at many Santa Monica Bay (SMB) beaches. Swimming in waters with elevated bacterial indicator densities has long been associated with adverse health effects. Specifically, local and national epidemiological studies compel the conclusion that there is a causal relationship between adverse health effects and recreational water quality, as measured by bacterial indicator densities.
Numeric Target *(Interpretation of the numeric water quality objective, used to calculate the waste load allocations)*	The TMDL has a multi-part numeric target based on the bacteriological water quality objectives for marine water to protect the water contact recreation (REC-1) use. These targets are the most appropriate indicators of public health risk in recreational waters. These bacteriological objectives are set forth in Chapter 3 of the Basin Plan, as amended by the Regional Board on October 25, 2001. The objectives are based on four bacterial indicators and include both geometric mean limits and single sample limits. The Basin Plan objectives that serve as numeric targets for this TMDL are: 1. Rolling 30-day Geometric Mean Limits a. Total coliform density shall not exceed 1,000/100 ml. b. Fecal coliform density shall not exceed 200/100 ml. c. Enterococcus density shall not exceed 35/100 ml. 2. Single Sample Limits a. Total coliform density shall not exceed 10,000/100 ml. b. Fecal coliform density shall not exceed 400/100 ml. c. Enterococcus density shall not exceed 104/100 ml. d. Total coliform density shall not exceed 1,000/100 ml, if the ratio of fecal-to-total coliform exceeds 0.1. These objectives are generally based on an acceptable health risk for marine recreational waters of 19 illnesses per 1,000 exposed individuals as set by the US EPA (US EPA, 1986). The targets apply throughout the year. The final compliance point for the targets is the wave wash[2] where there is a freshwater outlet (i.e., publicly-owned storm drain or natural creek) to the beach, or at ankle depth at beaches without a freshwater outlet. Implementation of the above bacteria objectives and the associated TMDL numeric targets is achieved using a 'reference system/anti-degradation approach' rather than the alternative 'natural sources exclusion approach' or strict application of the single sample objectives. As required by the CWA and Porter-Cologne Water Quality Control Act, Basin Plans include beneficial uses of waters, water quality objectives to protect those uses, an anti-degradation policy, collectively referred to as water quality standards, and other plans and policies necessary to implement water quality standards. This TMDL and its associated waste load allocations, which shall be incorporated into relevant permits, are the vehicles for implementation of the Region's

[2] The wave wash is defined as the point at which the storm drain or creek empties and the effluent from the storm drain initially mixes with the receiving ocean water.

Element	Key Findings and Regulatory Provisions
	standards. The 'reference system/anti-degradation approach' means that on the basis of historical exceedance levels at existing shoreline monitoring locations, including a local reference beach within Santa Monica Bay, a certain number of daily exceedances of the single sample bacteria objectives are permitted. The allowable number of exceedance days is set such that (1) bacteriological water quality at any site is at least as good as at a designated reference site within the watershed and (2) there is no degradation of existing shoreline bacteriological water quality. This approach recognizes that there are natural sources of bacteria that may cause or contribute to exceedances of the single sample objectives and that it is not the intent of the Regional Board to require treatment or diversion of natural coastal creeks or to require treatment of natural sources of bacteria from undeveloped areas. The geometric mean targets may not be exceeded at any time. The rolling 30-day geometric means will be calculated on each day. If weekly sampling is conducted, the weekly sample result will be assigned to the remaining days of the week in order to calculate the daily rolling 30-day geometric mean. For the single sample targets, each existing shoreline monitoring site is assigned an allowable number of exceedance days during wet weather, defined as days with 0.1 inch of rain or greater and the three days following the rain event. (A separate amendment incorporating the Santa Monica Bay Beaches Dry-Weather Bacteria TMDL addressed the allowable number of summer and winter dry-weather exceedance days.)
Source Analysis	With the exception of isolated sewage spills, storm water runoff conveyed by storm drains and creeks is the primary source of elevated bacterial indicator densities to SMB beaches during wet weather. Because the bacterial indicators used as targets in the TMDL are not specific to human sewage, storm water runoff from undeveloped areas may also be a source of elevated bacterial indicator densities. For example, storm water runoff from natural areas may convey fecal matter from wildlife and birds or bacteria from soil. This is supported by the finding that, at the reference beach, the probability of exceedance of the single sample targets during wet weather is 0.22.
Loading Capacity	Studies show that bacterial degradation and dilution during transport from the watershed to the beach do not significantly affect bacterial indicator densities at SMB beaches. Therefore, the loading capacity is defined in terms of bacterial indicator densities, which is the most appropriate for addressing public health risk, and is equivalent to the numeric targets, listed above. As the numeric targets must be met in the wave wash and throughout the day, no degradation allowance is provided.
Waste Load Allocations *(for point sources)*	Waste load allocations are expressed as the number of sample days at a shoreline monitoring site that may exceed the single sample targets identified under "Numeric Target." Waste load allocations are expressed as allowable exceedance days because the bacterial density and frequency of single sample exceedances are the most relevant to public health protection.

Element	Key Findings and Regulatory Provisions
	For each shoreline monitoring site and corresponding subwatershed, an allowable number of exceedance days is set for wet weather. The allowable number of exceedance days for a shoreline monitoring site for each time period is based on the lesser of two criteria (1) exceedance days in the designated reference system and (2) exceedance days based on historical bacteriological data at the monitoring site. This ensures that shoreline bacteriological water quality is at least as good as that of a largely undeveloped system and that there is no degradation of existing shoreline bacteriological water quality. All responsible jurisdictions and responsible agencies[3] within a subwatershed are jointly responsible for complying with the allowable number of exceedance days for each associated shoreline monitoring site identified in Table 7-4.5 below. The three Publicly Owned Treatment Works (POTWs), the City of Los Angeles' Hyperion Wastewater Treatment Plant, Los Angeles County Sanitation Districts' Joint Water Pollution Control Plant, and the Las Virgenes Municipal Water Districts' Tapia Wastewater Reclamation Facility, discharging to Santa Monica Bay are each given individual WLAs of zero (0) days of exceedance during wet weather.

[3] For the purposes of this TMDL, "responsible jurisdictions and responsible agencies" are defined as: (1) local agencies that are responsible for discharges from a publicly owned treatment works to the Santa Monica Bay watershed or directly to the Bay, (2) local agencies that are permittees or co-permittees on a municipal storm water permit, (3) local or state agencies that have jurisdiction over a beach adjacent to Santa Monica Bay, and (4) the California Department of Transportation pursuant to its storm water permit.

Element	Key Findings and Regulatory Provisions
Load Allocations *(for nonpoint sources)*	Because all storm water runoff to SMB beaches is regulated as a point source, load allocations of zero days of exceedance are set in this TMDL. If a nonpoint source is directly impacting shoreline bacteriological quality and causing an exceedance of the numeric target(s), the permittee(s) under the Municipal Storm Water NPDES Permits are not responsible through these permits. However, the jurisdiction or agency adjacent to the shoreline monitoring location may have further obligations as described under "Compliance Monitoring" below.
Implementation	The regulatory mechanisms used to implement the TMDL will include primarily the Los Angeles County Municipal Storm Water NPDES Permit (MS4 Permit), the Caltrans Storm Water Permit, the three NPDES permits for the POTWs, the authority contained in sections 13267 and 13263 of the Water Code, and regulations to be adopted pursuant to section 13291 of the Water Code. Each NPDES permit assigned a waste load allocation shall be reopened or amended at reissuance, in accordance with applicable laws, to incorporate the applicable waste load allocation(s) as a permit requirement. The implementation schedule will be determined on the basis of the implementation plan(s), which must be submitted to the Regional Board by responsible jurisdictions and agencies within two years of the effective date of the TMDL (see Table 7-4.7). After considering the implementation plan(s), the Regional Board shall amend the TMDL at a public hearing and, in doing so, will adopt an individual implementation schedule for each jurisdictional group (described in paragraph 3 below) that is as short as possible taking into account the implementation approach being undertaken. Responsible jurisdictions and agencies must clearly demonstrate in the above-mentioned plan whether they intend to pursue an integrated water resources approach.[4] If an integrated water resources approach is pursued, responsible jurisdictions and agencies may be allotted up to an 18-year implementation timeframe, based on a clear demonstration of the need for a longer schedule in the implementation plan, in recognition of the additional planning and time needed to achieve the multiple benefits of this approach. Otherwise, at most a 10-year implementation timeframe will be allotted, depending upon a clear demonstration of the time needed in the implementation plan. The subwatersheds associated with each beach monitoring location may

[4] An integrated water resources approach is one that takes a holistic view of regional water resources management by integrating planning for future wastewater, storm water, recycled water, and potable water needs and systems; focuses on beneficial re-use of storm water, including groundwater infiltration, at multiple points throughout a watershed; and addresses multiple pollutants for which Santa Monica Bay or its watershed are listed on the CWA section 303(d) List as impaired. Because an integrated water resources approach will address multiple pollutants, responsible jurisdictions can recognize cost-savings because capital expenses for the integrated approach will implement several TMDLs that address pollutants in storm water. An integrated water resources approach shall not only provide water quality benefits to the people of the Los Angeles Region, but it is also anticipated that an integrated approach will incorporate and enhance other public goals. These may include, but are not limited to, water supply, recycling and storage; environmental justice; parks, greenways and open space; and active and passive recreational and environmental education opportunities.

Element	Key Findings and Regulatory Provisions
	include multiple responsible jurisdictions and responsible agencies. Therefore, a "primary jurisdiction," defined as the jurisdiction comprising greater than fifty percent of the subwatershed land area, is identified for each subwatershed (see Table 7-4.6).[5] Seven primary jurisdictions are identified within the Santa Monica Bay watershed, each with a group of associated subwatersheds and beach monitoring locations. These are identified as "jurisdictional groups" (see Table 7-4.6). The primary jurisdiction of each "jurisdictional group" shall be responsible for submitting the implementation plan described above, which will determine the implementation timeframe for the subwatershed. A jurisdictional group may change its primary jurisdiction by submitting a joint, written request, submitted by the current primary jurisdiction and the proposed primary jurisdiction, to the Executive Officer requesting a reassignment of primary responsibility. Two jurisdictional groups may also choose to change the assignment of monitoring locations between the two groups by submitting a joint, written request, submitted by the current primary jurisdiction and the proposed primary jurisdiction, to the Executive Officer requesting a reassignment of the monitoring location. If an integrated water resources approach is pursued, the jurisdictional group(s) must achieve a 10% cumulative percentage reduction from the total exceedance-day reduction required for the group of beach monitoring locations within 6 years, a 25% reduction within 10 years, and a 50% reduction within 15 years of the effective date of the TMDL. These interim milestones for the jurisdictional group(s) will be re-evaluated, considering planning, engineering and construction tasks, based on the written implementation plan submitted to the Regional Board two years after the effective date of the TMDL (see Table 7-4.7). If an integrated water resources approach is not pursued, the jurisdictional group(s) must achieve a 25% cumulative percentage reduction from the total exceedance-day reduction required for the group of beach monitoring locations within 6 years, and a 50% reduction within 8 years of the effective date of the TMDL (see Table 7-4.7). For those beach monitoring locations subject to the antidegradation provision, there shall be no increase in exceedance days during the implementation period above that estimated for the beach monitoring location in the critical year as identified in Table 7-4.5. The final implementation targets in terms of allowable wet-weather exceedance days must be achieved at each individual beach location no later than 18 years after the TMDL's effective date if an integrated water resources approach is pursued, or no later than 10 years after the TMDL's effective date if an integrated water resources approach is not pursued. In addition, the geometric mean targets must be achieved for each individual beach location no later than 18 years or 10 years after the effective date, respectively, depending on whether a integrated

[5] Primary jurisdictions are not defined for the Ballona Creek subwatershed or the Malibu Creek subwatershed, since separate bacteria TMDLs are being developed for these subwatersheds.

Element	Key Findings and Regulatory Provisions
	water resources approach is pursued or not.

Element	Key Findings and Regulatory Provisions
Margin of Safety	The TMDL is set at levels that are exactly equivalent to the applicable water quality standards along with the proposed reference system/antidegradation implementation procedure. An implicit margin of safety is included in the supporting water quality model by assuming no dilution between the storm drain and the wave wash, the point of compliance. This is a conservative assumption since studies have shown that there is a high degree of variability in the amount of dilution between the storm drain and wave wash temporally, spatially and among indicators, ranging from 100% to 0%.
Seasonal Variations and Critical Conditions	Seasonal variations are addressed by developing separate waste load allocations for three time periods (wet weather, summer dry weather and winter dry weather) based on public health concerns and observed natural background levels of exceedance of bacterial indicators. (The two dry-weather periods are addressed in the Santa Monica Bay Beaches Dry-Weather Bacteria TMDL.) The critical condition for this bacteria TMDL is wet weather generally, when historic shoreline monitoring data for the reference beach indicate that the single sample bacteria objectives are exceeded on 22% of the wet-weather days sampled. To more specifically identify a critical condition within wet weather in order to set the allowable exceedance days shown in Tables 7-4.5 and 7-4.6, the 90th percentile 'storm year'[6] in terms of wet days is used as the reference year. Selecting the 90th percentile year avoids a situation where the reference beach is frequently out of compliance. It is expected that because responsible jurisdictions and agencies will be planning for this 'worst-case' scenario, there will be fewer exceedance days than the maximum allowed in drier years. Conversely, in the 10% of wetter years, it is expected that there may be more than the allowable number of exceedance days.
Compliance Monitoring	Responsible jurisdictions and agencies as defined in Footnote 2 shall conduct daily or systematic weekly sampling in the wave wash at all major drains[7] and creeks or at existing monitoring stations at beaches without storm drains or freshwater outlets to determine compliance.[8] At all locations, samples shall be taken at ankle depth and on an incoming wave. At locations where there is a freshwater outlet, during wet weather, samples should be taken as close as possible to the wave wash, and no further away than 10 meters down current of the storm drain or outlet.[9] At locations where there is a freshwater outlet, samples shall be taken when the freshwater outlet is flowing into the surf zone. If the number of exceedance days is greater than the allowable number of exceedance days for any jurisdictional group at the interim implementation milestones the responsible jurisdictions and agencies

[6] For purposes of this TMDL, a 'storm year' means November 1 to October 31. The 90th percentile storm year was 1993 with 75 wet days at the LAX meteorological station.
[7] Major drains are those that are publicly owned and have measurable flow to the beach during dry weather.
[8] The frequency of sampling (i.e., daily versus weekly) will be at the discretion of the implementing agencies. However, the number of sample days that may exceed the objectives will be scaled accordingly.
[9] Safety considerations during wet weather may preclude taking a sample in the wave wash.

Element	Key Findings and Regulatory Provisions
	shall be considered out-of-compliance with the TMDL. If the number of exceedance days exceeds the allowable number of exceedance days for a target beach at the final implementation deadline, the responsible jurisdictions and agencies within the contributing subwatershed shall be considered out-of-compliance with the TMDL. Responsible jurisdictions or agencies shall not be deemed out of compliance with the TMDL if the investigation described in the paragraph below demonstrates that bacterial sources originating within the jurisdiction of the responsible agency have not caused or contributed to the exceedance. If a single sample shows the discharge or contributing area to be out of compliance, the Regional Board may require, through permit requirements or the authority contained in Water Code section 13267, daily sampling in the wave wash or at the existing open shoreline monitoring location (if it is not already) until all single sample events meet bacteria water quality objectives. Furthermore, if a beach location is out-of-compliance as determined in the previous paragraph, the Regional Board shall require responsible agencies to initiate an investigation, which at a minimum shall include daily sampling in the wave wash or at the existing open shoreline monitoring location until all single sample events meet bacteria water quality objectives. If bacteriological water quality objectives are exceeded in any three weeks of a four-week period when weekly sampling is performed, or, for areas where testing is done more than once a week, 75% of testing days produce an exceedence of bacteria water quality objectives, the responsible agencies shall conduct a source investigation of the subwatershed(s) pursuant to protocols established under Water Code 13178. If a beach location without a freshwater outlet is out-of-compliance or if the outlet is diverted or being treated, the adjacent municipality, County agency(s), or State or federal agency(s) shall be responsible for conducting the investigation and shall submit its findings to the Regional Board to facilitate the Regional Board exercising further authority to regulate the source of the exceedance in conformance with the Porter-Cologne Water Quality Control Act.

Note: The complete staff report for the TMDL is available for review upon request.

Attachment A to Resolution No. 2002-022

Table 7-4.5. Final Allowable Wet-Weather Exceedance Days by Beach Location

Beach Monitoring Location	Estimated no. of wet weather exceedance days in critical year (90th percentile)*	Final allowable no. of wet weather exceedance days (daily sampling)*
DHS 010 - Leo Carrillo Beach, at 35000 PCH	17	17
DHS 009 - Nicholas Beach- 100 feet west of lifeguard tower	14	14
DHS 010a - Broad Beach	15	15
DHS 008 - Trancas Beach entrance, 50 yards east of Trancas Bridge	19	17
DHS 007 - Westward Beach, east of Zuma Creek	17	17
DHS 006 - Paradise Cove, adjacent to west side of Pier	23	17
DHS 005 - Latigo Canyon Creek entrance	33	17
DHS 005a - Corral State Beach	17	17
DHS 001a - Las Flores Beach	29	17
DHS 001 - Big Rock Beach, at 19900 PCH	30	17
DHS 003 - Malibu Point	18	17
DHS 003a - Surfrider Beach (second point)- weekly	45	17
S1 - Surfrider Beach (breach point)- daily	47	17
DHS 002 - Malibu Pier- 50 yards east	45	17
S2 - Topanga State Beach	26	17
DHS 101 - PCH and Sunset Bl.- 400 yards east	25	17
DHS 102 - 16801 Pacific Coast Highway, Bel Air Bay Club (chain fence)	28	17
S3 - Pulga Canyon storm drain- 50 yards east	23	17
DHS 103 - Will Rogers State Beach- Temescal Canyon (25 yrds. so. of drain)	31	17
S4 - Santa Monica Canyon, Will Rogers State Beach	25	17
DHS 104a - Santa Monica Beach at San Vicente Bl.	34	17
DHS 104 - Santa Monica at Montana Av. (25 yrds. so. of drain)	31	17
DHS 105 - Santa Monica at Arizona (in front of the drain)	31	17
S5 - Santa Monica Municipal Pier- 50 yards southeast	35	17
S6 - Santa Monica Beach at Pico/Kenter storm drain	42	17
DHS 106 - Santa Monica Beach at Strand St. (in front of the restrooms)	36	17
DHS 106a - Ashland Av. storm drain- 50 yards north	39	17
S7 - Ashland Av. storm drain- 50 yards south	22	17
DHS 107 - Venice City Beach at Brooks Av. (in front of the drain)	40	17

Attachment A to Resolution No. 2002-022

Beach Monitoring Location	Estimated no. of wet weather exceedance days in critical year (90th percentile)*	Final allowable no. of wet weather exceedance days (daily sampling)*
S8 - Venice City Beach at Windward Av.- 50 yards north	13	13
DHS 108 - Venice Fishing Pier- 50 yards south	17	17
DHS 109 - Venice City Beach at Topsail St.	38	17
S11 - Dockweiler State Beach at Culver Bl.	23	17
DHS 110 - Dockweiler State Beach- south of D&W jetty	30	17
S12 - Imperial HWY storm drain- 50 yards north	17	17
DHS 111 - Hyperion Treatment Plant One Mile Outfall	18	17
DHS 112 - Dockweiler State Beach at Grand Av. (in front of the drain)	25	17
S10 - Ballona Creek entrance- 50 yards south	34	17
S13 - Manhattan State Beach at 40th Street	4	4
S14 - Manhattan Beach Pier- 50 yards south	5	5
DHS 114 - Hermosa City Beach at 26th St.	12	12
S15 - Hermosa Beach Pier- 50 yards south	8	8
DHS 115 - Herondo Street storm drain- (in front of the drain)	19	17
S16 - Redondo Municipal Pier- 50 yards south	14	14
DHS 116 - Redondo State Beach at Topaz St. - north of jetty	19	17
S17 - Redondo State Beach at Avenue I	6	6
S18 - Malaga Cove, Palos Verdes Estates-daily	3	3
LACSDM - Malaga Cove, Palos Verdes Estates-weekly	14	14
LACSDB - Palos Verdes (Bluff) Cove, Palos Verdes Estates	0	0
LACSD1 - Long Point, Rancho Palos Verdes	5	5
LACSD2 - Abalone Cove Shoreline Park	1	1
LACSD3 - Portuguese Bend Cove, Rancho Palos Verdes	2	2
LACSD5 - Royal Palms State Beach	6	6
LACSD6 - Wilder Annex, San Pedro	2	2
LACSD7 - Cabrillo Beach, oceanside	3	3

Notes: * The compliance targets are based on existing shoreline monitoring data and assume daily sampling. If systematic weekly sampling is conducted, the compliance targets will be scaled accordingly. These are the compliance targets until additional shoreline monitoring data are collected prior to revision of the TMDL. Once additional shoreline monitoring data are available, the following will be re-evaluated when the TMDL is revised 1) estimated number of wet-weather exceedance days in the critical year at all beach locations, including the reference system(s) and 2) final allowable wet-weather exceedance days for each beach location.

Table 7-4.6. Interim Compliance Targets by Jurisdictional Group

Jurisdiction Group	Primary Jurisdiction	Additional Responsible Jurisdictions & Agencies	Subwatershed(s)	Monitoring Site(s)***	Interim Compliance Targets as Maximum Allowable Exceedance Days during Wet Weather*,**		
					10% Reduction Milestone	25% Reduction Milestone	50% Reduction Milestone
1	County of Los Angeles	Caltrans Malibu City of Los Angeles (Topanga only) Calabasas (Topanga only)	Arroyo Sequit	DHS 010	221	212	197
			Carbon Canyon	none			
			Corral Canyon	DHS 005a			
			Encinal Canyon	DHS 010a#			
			Escondido Canyon	none			
			Las Flores Canyon	DHS 001a			
			Latigo Canyon	DHS 005			
			Los Alisos Canyon	none			
			Pena Canyon	none			
			Piedra Gorda Canyon	DHS 001			
			Ramirez Canyon	DHS 006			
			Solstice Canyon	none			
			Topanga Canyon	S2			
			Trancas Canyon	DHS 008			
			Tuna Canyon	none			
			Zuma Canyon	DHS 007			
2	City of Los Angeles	Caltrans County of Los Angeles El Segundo (DW only) Manhattan Beach (DW only) Culver City (MDR only) Santa Monica	Castlerock	none	342	324	294
			Dockweiler	S11, DHS 110, S12, DHS 111, DHS 112			
			Marina del Rey	DHS 107, S8#, DHS 108, DHS 109			
			Pulga Canyon	S3, DHS 103			
			Santa Monica Canyon	S4			
			Santa Ynez Canyon	DHS 101, DHS 102			

Jurisdiction Group	Primary Jurisdiction	Additional Responsible Jurisdictions & Agencies	Subwatershed(s)	Monitoring Site(s)***	Interim Compliance Targets as Maximum Allowable Exceedance Days during Wet Weather*,**		
					10% Reduction Milestone	25% Reduction Milestone	50% Reduction Milestone
3	Santa Monica	Caltrans City of Los Angeles County of Los Angeles	Santa Monica	DHS 104a, DHS 104, DHS 105, S5, S6, DHS 106, DHS 106a, S7	257	237	203
4	Malibu	Caltrans County of Los Angeles	Nicholas Canyon	DHS 009#	14	14	14
5	Manhattan Beach	Caltrans El Segundo Hermosa Beach Redondo Beach	Hermosa	S13#, S14#, DHS 114#, S15#	29	29	29
6	Redondo Beach	Caltrans Hermosa Beach Manhattan Beach Torrance County of Los Angeles	Redondo	DHS 115, S16#, DHS 116, S17#	58	57	56

Jurisdiction Group	Primary Jurisdiction	Additional Responsible Jurisdictions & Agencies	Subwatershed(s)	Monitoring Site(s)***	Interim Compliance Targets as Maximum Allowable Exceedance Days during Wet Weather*,**		
					10% Reduction Milestone	25% Reduction Milestone	50% Reduction Milestone
7	Rancho Palos Verdes	Caltrans City of Los Angeles Palos Verdes Estates Redondo Beach Rolling Hills Rolling Hills Estates Torrance County of Los Angeles	Palos Verdes Peninsula	S18#, LACSDM#, LACSDB#, LACSD1#, LACSD2#, LACSD3#, LACSD5#, LACSD6#, LACSD7#	36	36	36

Notes: *Interim milestones will be re-calculated during the revision of the TMDL based on shoreline monitoring data collected from the wave wash and a re-evaluation of the most appropriate reference system and reference year. Furthermore, if an integrated water resources approach is pursued, as demonstrated by the implementation plans to be submitted to the Regional Board by the primary jurisdictions within two years of the effective date of the TMDL, the interim milestones will be re-evaluated on the basis of the implementation plan, considering planning, engineering and construction tasks. **Interim milestones for the Malibu and Ballona shoreline monitoring locations will be identified in subsequent bacteria TMDLs to be developed for these two watersheds. ***Monitoring sites are those shoreline locations currently monitored by the City of Los Angeles, County Sanitation Districts of Los Angeles County, and the Los Angeles County Department of Health Services at the time of adoption of this TMDL by the Regional Board. This list does not preclude the establishment of additional monitoring stations. For those subwatersheds without an existing shoreline monitoring site, responsible jurisdictions and agencies must establish a shoreline monitoring site if there is measurable flow from a creek or publicly owned storm drain to the beach during dry weather. # For those beach monitoring locations subject to the antidegradation provision, there shall be no increase in exceedance days during the implementation period above that estimated for the beach monitoring location in the critical year as identified in Table 7-4.5.

Attachment A to Resolution No. 2002-022

Table 7-4.7. Santa Monica Bay Beaches Bacteria TMDL (Wet Weather Only): Significant Dates

Date	Action
120 days after the effective date of the TMDL	Pursuant to a request from the Regional Board, responsible jurisdictions and responsible agencies must submit coordinated shoreline monitoring plan(s) to be approved by the Executive Officer, including a list of new sites* and/or sites relocated to the wave wash at which time responsible jurisdictions and responsible agencies shall select between daily or systematic weekly shoreline sampling.
20 months after the effective date of the TMDL	Responsible jurisdictions and agencies shall provide a draft written report to the Regional Board outlining how each intends to cooperatively (through Jurisdictional Groups) achieve compliance with the TMDL. The report shall include implementation methods, an implementation schedule, and proposed milestones.
Two years after effective date of TMDL	Responsible jurisdictions and agencies shall provide a written report to the Regional Board outlining how each intends to cooperatively (through Jurisdictional Groups) achieve compliance with the TMDL. The report shall include implementation methods, an implementation schedule, and proposed milestones. Under no circumstances shall final compliance dates exceed 10 years for non-integrated approaches or 18 years for integrated water resources approaches. Regional Board staff shall bring to the Regional Board the aforementioned plans as soon as possible for consideration.
4 years after effective date of TMDL	The Regional Board shall reconsider the TMDL to: (1) refine allowable wet weather exceedance days based on additional data on bacterial indicator densities in the wave wash and an evaluation of site-specific variability in exceedance levels, (2) re-evaluate the reference system selected to set allowable exceedance levels, including a reconsideration of whether the allowable number of exceedance days should be adjusted annually dependent on the rainfall conditions and an evaluation of natural variability in exceedance levels in the reference system(s), (3) re-evaluate the reference year used in the calculation of allowable exceedance days, and (4) re-evaluate whether there is a need for further clarification or revision of the geometric mean implementation provision.

Date	Action
Significant Dates for Responsible Jurisdictions and Agencies *Not* Pursuing an Integrated Water Resources Approach	
6 years after effective date of the TMDL	Each defined jurisdictional group must achieve a 25% cumulative percentage reduction from the total exceedance-day reductions required for that jurisdictional group as identified in Table 7-4.6.
8 years after effective date of the TMDL	Each defined jurisdictional group must achieve a 50% cumulative percentage reduction from the total exceedance-day reductions required for that jurisdictional group as identified in Table 7-4.6.
10 years after effective date of the TMDL	Final implementation targets in terms of allowable wet-weather exceedance days must be achieved at each individual beach as identified in Table 7-4.5. In addition, the geometric mean targets must be achieved for each individual beach location.
Significant Dates for Responsible Jurisdictions and Agencies Pursuing an Integrated Water Resources Approach to Implementation	
6 years after effective date of the TMDL	Each defined jurisdictional group must achieve a 10% cumulative percentage reduction from the total exceedance-day reductions required for that jurisdictional group as identified in Table 7-4.6.
10 years after effective date of the TMDL	Each defined jurisdictional group must achieve a 25% cumulative percentage reduction from the total exceedance-day reductions required for that jurisdictional group as identified in Table 7-4.6.
15 years after effective date of the TMDL	Each defined jurisdictional group must achieve a 50% cumulative percentage reduction from the total exceedance-day reductions required for that jurisdictional group as identified in Table 7-4.6.
18 years after effective date of the TMDL	Final implementation targets in terms of allowable wet-weather exceedance days must be achieved at each individual beach as identified in Table 7-4.5. In addition, the geometric mean targets must be achieved for each individual beach location.

Notes: *For those subwatersheds without an existing shoreline monitoring site, responsible jurisdictions and agencies must establish a shoreline monitoring site if there is measurable flow from a creek or publicly owned storm drain to the beach during dry weather.

Attachment B to Resolution No. 2002-022

Amendment to the Water Quality Control Plan – Los Angeles Region to Revise the Santa Monica Bay Beaches Dry-Weather Bacteria TMDL

Adopted by the California Regional Water Quality Control Board, Los Angeles Region on December 12, 2002.

Amendments:

Chapter 7. Total Maximum Daily Loads (TMDLs) Summaries
Santa Monica Bay Beaches Bacteria TMDL (Dry Weather Only)*

Table 7-4.3. Santa Monica Bay Beaches Bacteria TMDL (Dry Weather Only): Significant Dates

Date	Action
120 days after the effective date of the TMDL	Responsible jurisdictions and responsible agencies must submit coordinated shoreline monitoring plan(s), including a list of new sites or sites relocated to the wave wash at which time responsible jurisdictions and responsible agencies will select between daily and weekly shoreline sampling.
120 days after the effective date of the TMDL	Responsible jurisdictions and responsible agencies must identify and provide documentation on 342 potential discharges to Santa Monica Bay beaches listed in Appendix C of the TMDL Staff Report dated January 11, 2002. Documentation must include a Report of Waste Discharge (ROWD) where necessary. Responsible jurisdictions and responsible agencies must identify and provide documentation on potential discharges to the Area of Special Biological Significance (ASBS) in northern Santa Monica Bay from Latigo Point to the County line. Cessation of the discharges into the ASBS shall be required in conformance with the California Ocean Plan.
~~2~~ 4 years after effective date of TMDL	Re-open TMDL to re-evaluate allowable winter dry weather exceedance days based on additional data on bacterial indicator densities in the wave wash, a re-evaluation of the reference system selected to set allowable exceedance levels, and a re-evaluation of the reference year used in the calculation of allowable exceedance days.
3 years after effective date of the TMDL	Achieve compliance with allowable exceedance days as set forth in Table 7-4.2a and rolling 30-day geometric mean targets during summer dry weather (April 1 to October 31).
6 years after effective date of the TMDL	Achieve compliance with allowable exceedance days as set forth in Table 7-4.2a and rolling 30-day geometric mean targets during winter dry weather (November 1 to March 31).