California Regional Water Quality Control Board
San Diego Region

Total Maximum Daily Loads for Indicator Bacteria Baby Beach in Dana Point Harbor and Shelter Island Shoreline Park in San Diego Bay

Technical Report
June 11, 2008

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To request copies of the Basin Plan Amendment and Technical Report for Total Maximum Daily Loads for Indicator Bacteria, Baby Beach in Dana Point Harbor and Shelter Island Shoreline Park in San Diego Bay, please contact Mr. Wayne Chiu at (858) 637-5558, or by email at wchiu@waterboards.ca.gov.

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Adopted by the
California Regional Water Quality Control Board
San Diego Region
on June 11, 2008

Approved by the
State Water Resources Control Board
on _______________, 200 x
and the
Office of Administrative Law
on _______________,200 x
and the
United States Environmental Protection Agency
on _________________, 200 x.

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Table of Contents

Table of Contents (Cont'd)

Table of Contents (Cont'd)

Appendices

Table of Contents (Cont'd)

Figures

Tables

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Acronyms and Abbreviations

ALERT	Automatic Local Evaluation in Real-Time
Bacteria TMDL Project I	Total Maximum Daily Loads for Indicator Bacteria Project I - Beaches and Creeks in the San Diego Region
Basin Plan	Water Quality Control Plan for the San Diego Basin (9)
BASINS	Better Assessment Science Integrating Point and Nonpoint Sources
BB	Baby Beach
BCS	Bacteria Compliance Schedule
BLRP	Bacteria Load Reduction Plan
BMP	best management practice
CALWTR	Calwater
CASQA	California Stormwater Quality Association
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
COOPS	Center for Operational Oceanographic Products and Services
DPH	Dana Point Harbor
DWR	California Department of Water Resources
E. Coli	*Escherichia coli*
EFDC	Environmental Fluid Dynamics Code model
EIR	Environmental Impact Report
ENT	*Enterococcus* indicator bacteria
FC	fecal coliform indicator bacteria
HA	Hydrologic Area
HSA	Hydrologic Subarea
HSPF	Hydrologic Simulation Program – FORTRAN model
LA	load allocation
$LA_{Homeless}$	load allocation for illegal discharges from homeless encampments
$LA_{Natural/Background}$	load allocation for natural and background sources of bacteria
List	Clean Water Action section 303(d) List of Water Quality Limited Segments
Los Angeles Water Board	Regional Water Quality Control Board, Los Angeles Region
LSPC	Loading Simulation Program in C++ model

Acronyms and Abbreviations (Cont'd)

mL	milliliter
MOS	margin of safety
MPN	most probable number [of bacteria colonies]
MS4	municipal separate storm sewer system
NAVFAC-SW	Naval Facilities Engineering Command, Southwest Division
NCDC	National Climatic Data Center
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NSEA	natural sources exclusion approach
OAL	Office of Administrative Law
POTW	publicly owned treatment works
REC-1	water contact recreation beneficial use
REC-2	non-water contact recreation beneficial use
RoWD	report of waste discharge
RSAA	reference system and antidegradation approach
SAG	Stakeholder Advisory Group
San Diego Water Board	Regional Water Quality Control Board, San Diego Region
SANDAG	San Diego Association of Governments
SANGIS	San Diego Graphical Information Source
SCAG	Southern California Association of Governments
SCCWRP	Southern California Coastal Research Project
SDB	San Diego Bay
SHELL	shellfish harvesting beneficial use
SISP	Shelter Island Shoreline Park
SPAWAR	Space and Naval Warfare Systems
State Water Board	State Water Resource Control Board
STATSGO	State Soil Geographic database
STORET	Storage and Retrieval (USEPA environmental data system)
TBEL	technology based effluent limitation
TC	total coliform indicator bacteria
TMDL	total maximum daily load
USACE	United States Army Corps of Engineers
USDA	United State Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United State Geological Survey

Acronyms and Abbreviations (Cont'd)

WDR	waste discharge requirement
WLA	wasteload allocation
WLA_{Boats}	wasteload allocation for illegal sewage discharges from boats
$WLA_{Municipal\ MS4}$	wasteload allocation for discharges from Phase I municipal separate storm sewer systems
WLA_{WWTP}	wasteload allocation for illegal sewage discharges from wastewater collection systems and treatment plants
WQBEL	water quality based effluent limitation
WQO	water quality objective

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Executive Summary

The purpose of this technical report is to present the development of the Total Maximum Daily Loads (TMDLs) for the shorelines of Baby Beach (BB) within Dana Point Harbor (DPH) and Shelter Island Shoreline Park (SISP) within San Diego Bay (SDB) impaired by indicator bacteria. Baby Beach and Dana Point Harbor are located in southern Orange County and Shelter Island Shoreline Park and San Diego Bay are located within San Diego County. Bacteria densities at these locations have historically exceeded the numeric water quality objectives (WQOs) for total coliform (TC), fecal coliform (FC), and/or *Enterococcus* (ENT) indicator bacteria as defined in the San Diego Water Board's *Water Quality Control Plan for the San Diego Basin (9)* (Basin Plan). These exceedances threaten or impair the water contact (REC-1) and non-water contact (REC-2) beneficial uses of these waterbodies.

Fecal bacteria originate from the intestinal biota of warm-blooded animals, and their presence in surface water is currently used as an indicator of human pathogens. Pathogens may cause illness in recreational water users. Bacteria have been historically used as indicators of human pathogens because bacteria are easier and less costly to measure than the pathogens themselves. As required by Clean Water Act section 303(d), TMDLs for indicator bacteria were developed to address the bacteria-impaired shoreline segments of BB and SISP.

A TMDL represents the maximum amount of the pollutant of concern that the waterbody can receive and still attain water quality standards. For this indicator bacteria TMDL analysis, mathematical models were used to calculate the TMDLs and potential bacteria loads from different sources. In this analysis, only the REC-1 beneficial use was evaluated. Waters that can meet the REC-1 WQOs will also meet the REC-2 WQOs.

Because the climate in southern California has two distinct hydrological patterns, for the BB and SISP shoreline segments of this project, separate modeling approaches and TMDLs were developed for wet weather and dry weather conditions. For wet weather TMDL calculations, single sample maximum REC-1 WQOs were used as numeric targets because wet weather conditions, or storm events with precipitation runoff, are episodic and short in duration, and characterized by rapid wash-off and transport of high bacteria loads, with short residence times, from all land use types to receiving waters. For dry weather TMDL calculations, geometric mean or median REC-1 WQOs were used as numeric targets, because dry weather runoff is not generated from precipitation runoff, is not uniformly linked to every land use, and is more uniform than precipitation runoff, with lower flows, lower loads, and slower transport, making die-off and/or amplification processes more important. Once calculated, the TMDL is set equal to the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for nonpoint sources and natural or background sources.

The only allowable point sources identified to affect the shoreline segments of BB and SISP were municipal separate storm sewer systems (MS4s), although illegal point

sources of bacteria (e.g., sewage from boats and wastewater collection systems and treatment plants) may exist. The USEPA's stormwater regulations require municipalities to obtain permits for all stormwater discharges from MS4s. The existing loads calculated with the modeling approaches were solely the result of watershed runoff, and did not include other types of point sources. Only MS4s were assigned a WLA for each shoreline segment. Illegal sources and any other unidentified point sources were assigned WLAs of zero.

Nonpoint sources identified were primarily associated with natural or background sources such as direct inputs from birds, terrestrial and aquatic wildlife, wrack line and aquatic plants, sediments, or other unidentified and unquantified sources within the receiving waters. No controllable nonpoint sources were identified within the watersheds contributing to the receiving waters. Until more information is obtained through further study to provide identification of the relative loading from each of these potential nonpoint sources, they were combined into a single existing load and LA for each shoreline segment.

Because loads from nonpoint sources are not controllable, no load reduction is required from nonpoint sources. However, wasteloads from MS4s are considered controllable and therefore a wasteload reduction was calculated for point sources. Wasteload reductions were calculated for each shoreline segment as the difference between the existing wasteload and WLA divided by the existing wasteload. Table E-1 summarizes the percent wasteload reductions calculated for each shoreline segment of BB and SISP.

Table E-1. Percent Wasteload Reductions for Impaired Shoreline Segments at Baby Beach and Shelter Island Shoreline Park

Waterbody	Shoreline Segment	Percent Wasteload Reduction					
		ENT REC-1		FC REC-1		TC REC-1	
		Wet[1]	Dry[2]	Wet[1]	Dry[2]	Wet[1]	Dry[2]
Dana Point Harbor	Baby Beach	62.2%	96.2%	0%	82.7%	0%	90.4%
San Diego Bay	Shelter Island Shoreline Park	0%	0%	0%	0%	0%	0%

Notes:
[1] Percent wasteload reduction for wet weather conditions.
[2] Percent wasteload reduction for dry weather conditions.

Abbreviations:
ENT REC-1: *Enterococcus* reduction for water contact beneficial use
FC REC-1: Fecal coliform reduction for water contact beneficial use
TC REC-1: Total coliform reduction for water contact beneficial use

In order to ensure that the TMDL requirements are met, and as required under state law, an Implementation Plan was developed and describes the regulatory and/or enforcement actions that the San Diego Water Board can take to reduce pollutant loading and monitor effluent and/or receiving water. The TMDLs will be implemented primarily by reissuing or revising the existing NPDES requirements for MS4 discharges to include WQBELs that are consistent with the assumptions and requirements of the bacteria WLAs for MS4 discharges. WQBELs for MS4 stormwater discharges can be either numeric or non-numeric. Non-numeric WQBELs typically are a program of best management practices (BMPs). The USEPA expects that most WQBELs for NPDES-regulated MS4 discharges will be in the form of BMPs. Additionally, a compliance schedule for meeting the required pollutant reductions is included in the Implementation Plan. The Implementation Plan also identifies several special studies that the dischargers can conduct to fill data gaps, which can be used to refine the TMDLs and required load reductions, and/or modify compliance requirements. The Implementation Plan requires the dischargers to continue monitoring to assess the effectiveness of the implementation measures in achieving the wasteload reductions.

According to the modeling calculations, natural and background sources contribute a significant portion of the bacteria load at both BB and SISP. If the REC-1 WQOs cannot be met in the receiving waters, and if natural and background sources appear to be the sole source of continued impairment, the natural sources exclusion approach (NSEA) may be applied.[1] The NSEA includes guidelines for recalculation of the TMDLs if it can be demonstrated that all anthropogenic sources of indicator bacteria have been controlled and that the remaining indicator bacteria densities do not cause a health risk.

[1] After approval of the Basin Plan amendment (Resolution No. R9-2008-0028) authorizing the use of the Natural Sources Exclusion Approach by the Office of Administrative Law, anticipated by the end of 2008 or early 2009..

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1 Introduction

Fecal bacteria originate from the intestinal biota of warm-blooded animals, and their presence in surface water is currently used as an indicator of human pathogens. Pathogens may cause illness in recreational water users. The purpose of this technical report is to present the development of the Total Maximum Daily Loads (TMDLs) for the shorelines at Baby Beach (BB) within Dana Point Harbor (DPH) and Shelter Island Shoreline Park (SISP) within San Diego Bay (SDB) impaired by indicator bacteria.

Section 303(d) of the Clean Water Act requires that each State identify waterbodies within its boundaries for which the effluent limitations are not stringent enough to meet applicable water quality standards, which are based on beneficial uses and water quality objectives (WQOs). The Clean Water Act also requires states to establish a priority ranking for these impaired waters, known as the *Clean Water Act Section 303(d) List of Water Quality Limited Segments* (List), and to establish TMDLs for the identified waterbodies.

Disease-causing pathogens include bacteria, viruses, and protozoa. Most disease-causing pathogens exist in very small amounts and are very difficult and expensive to detect in water samples. However, the presence of disease-causing pathogens in water can be often be correlated to "indicator organisms." Therefore, indicator organisms are used to help detect the presence of these disease-causing pathogens in water.

Indicator organisms have been used for more than a century to help identify where disease-causing pathogens may be present. These indicator organisms generally do not cause illness themselves, but they have characteristics that make them good indicators that harmful pathogens may present be in the water. Fecal bacteria are often used as indictors for the presence of pathogens. When fecal bacteria are present in surface water in high quantities, this indicates a higher risk of pathogens being present in the water. Total coliform (TC), fecal coliform (FC), *Enterococcus* (ENT), and *Escherichia coli* (*E. coli)*, which are fecal bacteria indicators, are often used as indicator organisms, or indicator bacteria, when evaluating the quality of water.

To protect the health of human recreational water users, the Basin Plan contains numeric WQOs for indicator bacteria for water contact recreation (REC-1), non-water contact recreation (REC-2), and shellfish harvesting (SHELL) beneficial uses. For coastal waters, including bays and estuaries, the Basin Plan includes numeric WQOs for TC, FC, and ENT. For saline waters, there are no WQOs for *E. coli*. Exceedances of the bacteria WQOs are common in waters throughout the San Diego Region coastal area. For a complete discussion of WQOs for each beneficial use, see Appendix A.

TMDLs are being developed to meet the WQOs and protect recreational beneficial uses in the bacteria-impaired waterbodies for the San Diego Region. In a previous analysis reported in *Total Maximum Daily Loads for Indicator Bacteria Project I - Beaches and Creeks in the San Diego Region* (Bacteria TMDL Project I) (San Diego Water Board, 2007), the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) developed TMDLs to address 19 of the 38 bacteria-impaired waterbodies in the San Diego Region, as identified on the *2002 Clean Water Act Section 303(d) List of Water Quality Limited Segments*. Regional watershed models were developed to calculate of TMDLs for multiple beaches and creeks in the region.

The present analysis, *Total Maximum Daily Loads for Indicator Bacteria, Baby Beach and Shelter Island Shoreline Park Shorelines,* is based on this previous work, and includes an expansion of the regional modeling approach to represent bacteria loads from the watersheds draining to the impaired BB and SISP shorelines. The bacteria loads calculated by the watershed model were used as inputs into a second model used to calculate the assimilative capacity of receiving waters at the impaired BB and SISP shorelines. As in Bacteria TMDLs Project I, TMDLs were calculated for each receiving waterbody included in this report for both wet and dry weather conditions.

The purpose of a TMDL is to attain WQOs that support beneficial uses in the waterbody. A TMDL is defined as the sum of the individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background such that the capacity of the waterbody to assimilate pollutant loading (i.e., the loading capacity) is not exceeded.[2] Therefore, a TMDL represents the maximum amount of the pollutant of concern that the waterbody can receive and still attain water quality standards. Additionally, a TMDL represents a strategy for meeting WQOs by allocating quantitative limits for point and nonpoint pollution sources. Once this total maximum pollutant load has been calculated, it is divided up and allocated among all of the contributing sources in the watershed.

The TMDL process begins with the development of a technical analysis which includes the following 7 components:

(1) **Problem Statement** - describes which WQOs are not being attained and which beneficial uses are threatened or impaired (section 2);
(2) **Numeric Targets –** identifies numeric targets for densities of indicator bacteria which will result in attainment of the WQOs and protection of beneficial uses (section 3);
(3) **Source Analysis** - identifies all of the point sources and nonpoint sources of the impairing pollutant (section 5);
(4) **Linkage Analysis -** calculates the **Loading Capacity** (i.e., the maximum load of the pollutant that may be discharged to the waterbody without causing exceedances of WQOs and impairment of beneficial uses) of the waterbody for the pollutant (sections 6 and 7);
(5) **Margin of Safety** (MOS) - accounts for uncertainties in the analysis (section 7);
(6) **Seasonal Variation and Critical Conditions –** describes how these factors are accounted for in the TMDL determination (section 7); and

[2] Code of Federal Regulations Title 40 section 1302.

(7) **Allocation of the TMDL –** division of the TMDL among each of the contributing sources in the watershed; wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint and background sources (sections 7 and 8).

The write-up of the above components is generally referred to as the technical TMDL analysis. The scientific basis of this TMDL has undergone external peer review pursuant to Health and Safety Code section 57-004. The San Diego Water Board has considered and responded to all comments submitted by the peer review panel. The peer reviewer's comments and the San Diego Water Board's responses to comments are contained in Appendix B.

This technical report also includes an **Implementation Plan** (section 10). In order to meet the TMDL, an Implementation Plan is developed that describes the regulatory and/or enforcement actions the San Diego Water Board can take to reduce pollutant loading and monitor effluent and/or receiving water. The TMDLs will be implemented primarily by reissuing or revising the existing NPDES requirements for MS4 discharges to include WQBELs that are consistent with the assumptions and requirements of the bacteria WLAs for MS4 discharges. WQBELs for municipal stormwater discharges can be either numeric or non-numeric. Non-numeric WQBELs typically are a program of expanded or better-tailored BMPs. The USEPA expects that most WQBELs for NPDES-regulated municipal discharges will be in the form of BMPs. Additionally, a compliance schedule for meeting the required pollutant reductions is included in the Implementation Plan. The Implementation Plan also identifies several special studies that the dischargers can conduct to fill data gaps, which can be used to refine the TMDLs and required load reductions, and/or modify compliance requirements. The Implementation Plan requires the dischargers to conduct monitoring to assess the effectiveness of the implementation measures in achieving the load and wasteload reductions.

Once established, the regulatory provisions of the TMDLs are incorporated into the *Water Quality Control Plan for the San Diego Basin (9)* (Basin Plan). Typically, the San Diego Water Board, following a public comment period and hearing process, adopts a resolution amending the Basin Plan to incorporate the TMDLs, allocations, reductions, compliance schedule, and Implementation Plan. Basin Plan amendments, including TMDL amendments, must also undergo an evaluation of the environmental impacts of complying with the amendment, and an evaluation of the costs of complying with the amendment. As with any Basin Plan amendment involving surface waters, a TMDL amendment will not take effect until it has undergone subsequent agency approvals by the State Water Resources Control Board (State Water Board) and the Office of Administrative Law (OAL). The U.S. Environmental Protection Agency (USEPA) must also approve the amendment; however, it will take effect following approval by the OAL. The tentative Resolution and draft Basin Plan amendment associated with this project are contained in Appendix C.

Following these approvals, the San Diego Water Board is required to incorporate the regulatory provisions of the TMDL into all applicable orders prescribing waste discharge requirements (WDRs), or other regulatory or enforcement mechanisms. For point sources, the San Diego Water Board will issue, reissue or amend existing WDRs that implement National Pollutant Discharge Elimination System (NPDES) regulations. For nonpoint sources, the San Diego Water Board will issue, reissue, amend, or enforce WDRs, waivers of WDRs, or adopt discharge prohibitions. Water Quality Based Effluent Limitations (WQBELs) for the impairing pollutant in the applicable watersheds are incorporated in the appropriate WDRs to implement and make the TMDLs enforceable. WQBELs can consist of either numeric effluent limitations, or a Best Management Practice (BMP) approach of expanded or better-tailored BMPs.

The final and most important step in the process is the implementation of the TMDLs by the dischargers. Per the governing WDR order (or other regulatory or enforcement mechanism), each discharger must reduce its current loading of the pollutant to its assigned allocation in accordance with the time schedule specified in the TMDL. When each discharger has achieved its required load reduction, water quality standards for the impairing pollutants should be restored in the receiving waters.

Public participation is a key element of the TMDL process, and stakeholder involvement is encouraged and required. The San Diego Water Board formed a Stakeholder Advisory Group (SAG), made up of key stakeholders to assist in the development of this TMDL report. The SAG was comprised of representatives from Municipal Separate Storm Sewer System (MS4) owners/operators discharging to BB and SISP, environmental groups, and business and industry interests, including Orange County, San Diego County, the City of Dana Point, the City of San Diego, San Diego Coastkeeper, Sierra Club and the San Diego Unified Port District.

1.1 Technical Approach

The San Diego Water Board and the USEPA coordinated a watershed and receiving water assessment and modeling study to support the development of TMDLs. In order to assist the San Diego Water Board in the development of the technical analysis, the USEPA used Clean Water Act section 106 funds to contract the environmental consulting firm, Tetra Tech, Inc. (Tetra Tech). Tetra Tech provided the San Diego Water Board with technical assistance in calculating the TMDLs for the impaired waterbodies through the development of region-wide watershed models.

The general approach utilized a watershed model and a receiving water model. The watershed model simulated the pollutant loads draining from the watersheds into the receiving waters. The receiving water model uses the output of the watershed model as a boundary condition, or bacteria load input into the receiving water. The receiving water model was used to calculate the assimilative capacity of the receiving waters at the impaired shorelines. For these TMDLs, the receiving waters are Dana Point Harbor and San Diego Bay, and the watersheds are the areas of the watershed that are conservatively assumed to have a potential impact on the impaired shorelines of those receiving waters.

Because the climate in southern California has two distinct hydrological patterns, two watershed models were developed for estimating bacteria loads. One watershed model was developed to specifically quantify loading from a watershed during wet weather conditions (storm events), which tend to be episodic and short in duration, and characterized by rapid wash-off and transport of very high pollutant loads from all land use types. The wet weather modeling approach is consistent with the methodologies used for bacteria TMDL development for impaired coastal areas of the Los Angeles Region, specifically Santa Monica Bay beaches (Los Angeles Water Board, 2002) and also Malibu Creek (Los Angeles Water Board, 2003), as well as for the bacteria impaired beaches and creeks in the San Diego Region (San Diego Water Board, 2007). A dynamic modeling system that simulates the build-up and wash-off of bacteria and the hydrologic and hydraulic processes that affect delivery was used to model bacteria loads from precipitation-based runoff (stormwater runoff) during wet weather events.

A separate dry weather watershed model was developed to quantify bacteria loading from a watershed during dry weather conditions. Dry weather loading is expected to be much smaller in magnitude, does not occur from all land use types, and exhibits less variability over time. A low-flow, steady-state model was used to estimate bacteria loads during dry weather conditions. The steady-state aspect of the model resulted in estimation of a constant bacteria load from each watershed. This load is representative of the average flow and bacteria loading conditions resulting from various urban land use practices (e.g., runoff from lawn irrigation or sidewalk washing).

The modeled wet weather and dry weather runoff flows and bacteria levels from the watersheds were used in a receiving water model that was developed to include the diurnal effects of tidal flushing, and bacterial die-off during wet and dry weather conditions, and ultimately to simulate the assimilative capacity of the receiving waters of the impaired shoreline segments.

The assimilative capacity, or TMDL that was calculated by the receiving water model was allocated to point sources as WLAs and nonpoint sources as LAs.

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2 Problem Statement

The presence of high quantities of bacteria in surface waters can pose a risk to human health. Sources of bacteria under all conditions vary widely and include natural sources such as feces from aquatic and terrestrial wildlife, and anthropogenic sources such as sewer line breaks, illegal sewage disposal from boats along the coastline, trash, and pet waste. Once in the environment, bacteria can also re-grow and multiply.

Of particular concern are disease-causing pathogens. Disease-causing pathogens are a risk to human health in surface waters. When the risk to human health from pathogens in the water is so great that beaches are posted with health advisories or closure signs the quality and beneficial uses of the water are impaired.

At present, analyzing water for specific disease-causing pathogens directly is very difficult and expensive. However, the presence of disease-causing pathogens in water can be often correlated to indicator bacteria, such as TC, FC, and ENT. When these indicator bacteria are present in surface waters in high quantities, this indicates a higher risk of pathogens being present in the water.

Bacteria quantities, written in terms of densities of bacteria colonies (most probable number per 100 milliliters of water [MPN/100 mL]), within specific shoreline segments of BB and SISP reportedly have exceeded the numeric WQOs for TC, FC, and/or ENT indicator bacteria. These exceedances threaten and/or impair the water contact recreation (REC-1), non-water contact recreation (REC-2), and shellfish harvesting (SHELL) beneficial uses of these shorelines. A discussion of WQOs for each beneficial use is provided in Appendix A.

All coastal waters in the Region are designated with REC-1, REC-2, and SHELL beneficial uses. REC-1 includes uses of water for recreational activities involving body contact with water (such as swimming or other water sports) where ingestion of water is reasonably possible. REC-2 includes the uses of water for recreational activities involving proximity to water, but not normally involving body contact with water (such as picnicking and sunbathing), and where ingestion of water is reasonably possible. SHELL includes uses of water that support habitats suitable for the collection of filter-feeding shellfish for human consumption, commercial, or sport purposes.

For this TMDL analysis, only the REC-1 beneficial use was evaluated. Waters that can meet the REC-1 WQOs will also meet the REC-2 WQOs. Waterbodies that are impaired for the SHELL beneficial use will be addressed in a separate SHELL TMDL and/or standards action pending the outcome of the work of the statewide task force involving the Ocean Planning Unit of the State Water Board, the California Department of Public Health, the USEPA, and the coastal Regional Water Boards. The following sub-sections provide additional information about the environmental settings, the beneficial uses and WQOs, and overview of the reported impairments of the waterbodies evaluated in this technical report.

2.1 Project Area Description

When this project was initiated in 2004, there were six bacteria-impaired shoreline segments on the 2002 List which were to be addressed in this TMDL project: Shelter Island Shoreline Park, B Street Pier, G Street, Chula Vista Marina, and Tidelands Park within SDB, and Baby Beach within DPH. However, since then, additional information provided to the San Diego Water Board resulted in the removal of four shoreline segments from this TMDL project.

The shoreline segments at Chula Vista Marina and Tidelands Park were removed from the 2006 List for indicator bacteria. According to the Chula Vista Marina fact sheet for the 2006 List, the area initially placed on the 1998 List was actually south of the Chula Vista Marina, rather than within the marina itself. The area south of the marina was placed on the 1998 List due to posting by the San Diego County Department of Public Health. According to fact sheet, the San Diego County Department of Public Health posted warning signs in the area as a precaution because of a nearby storm drain outlet, not because they had data showing elevated bacteria levels. There are no known data that have been collected to support the listing. Therefore, due to the inaccuracy of the area listed and the lack of data to support the listing, the shoreline segment at Chula Vista Marina within SDB was removed from the 2006 List as impaired for indicator bacteria based on REC-1 beneficial use. The shoreline segment at Chula Vista Marina within SDB was subsequently removed from this TMDL project.

Tidelands Park was also removed from the 2006 List. According to the Tidelands Park fact sheet for the 2006 List, the number of exceedances of the REC-1 WQOs for indicator bacteria from the data collected by the City of San Diego from 1999 to 2003 did not surpass the allowable number of exceedances. Because the available data indicate that the exceedance frequency of the applicable REC-1 WQOs are acceptable, the shoreline segment at Tidelands Park within SDB was removed from the 2006 List as impaired for indicator bacteria based on REC-1 beneficial use. The shoreline segment at Tidelands Park within SDB was subsequently removed from this TMDL project.

In 2007, the San Diego Unified Port District provided analytical data for evaluation to support removing the shoreline segments at B Street Pier and G Street within SDB from the 2008 List based on the WQOs for REC-1 beneficial use. Samples collected from four locations at B Street Pier and four locations at G Street between March 2006 and January 2007 were analyzed. During that sampling period, there were 48 samples collected from each shoreline segment. Of the samples collected between March 2006 and January 2007, the number of exceedances of the REC-1 WQOs for indicator bacteria did not surpass the allowable number of exceedances. Based on these data and findings, the San Diego Water Board will recommend removal of B Street Pier and G Street from the 2008 List for indicator bacteria for REC-1 beneficial use. Therefore, the shoreline segments at B Street Pier and G Street within SDB were removed from this TMDL project.

The remaining two shoreline segments are addressed in this technical report. They are located in Orange and San Diego Counties in southern California. Shelter Island Shoreline Park (SISP) is located within SDB, which is located in southern San Diego County (Figure 2-1). SISP is a mile-long park and promenade that spans the bayside length of Shelter Island within SDB. The beach is owned and operated by the San Diego Unified Port District. Baby Beach (BB) is located within DPH, which is located in southern Orange County, just north of San Diego County (Figure 2-2). BB is a small artificial beach located in the inner northwestern back corner of DPH. The beach is about 700 feet wide and is owned and operated by the County of Orange.

Although a significant portion of the bacteria loads may be attributed to natural and background sources, impairment of these shorelines is likely due to local sources of bacteria such as humans, domestic animals, and urban runoff. However, because these are coastal shorelines, the assimilative capacity of BB and SISP is increased due to tidal flushing and the likelihood of bacteria die-off is increased due to salinity.

The climate in the region is generally mild with annual temperatures averaging around 65 degrees Fahrenheit near the coastal regions. Annual average rainfall ranges from 9 to 11 inches along the coast to more than 30 inches in the eastern mountains. There are two distinct climatic periods: a dry period from late April to mid-October and a wet period from mid-October through late April. The wet period provides 85 to 90 percent of the annual rainfall in the region (County of San Diego, 2000).

The land use of the region is highly variable. Table 2-1 lists the total areas of each modeled watershed draining to the impaired shoreline segments, as well as their distribution of land uses (Appendix D, No. 14).

Table 2-1. Watershed Areas and Land Use

Watershed		Total Area (Acres)	Land Use Percentages (%)												
			Low Density Residential	High Density Residential	Commercial/ Institutional	Industrial/ Transportation	Military	Parks/ Recreation	Open Recreation	Agriculture	Dairy/ Intensive Livestock	Horse Ranches	Open Space	Water	Transitional
Dana Point Harbor	Baby Beach	522.6	37.1	31.7	15.8	0.7	0.0	3.3	5.7	0.0	0.0	0.0	5.8	0.0	0.0
San Diego Bay	Shelter Island Shoreline Park	10.2	0.0	0.0	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The area around BB consists primarily of residential and commercial properties. The areas immediately adjacent to the beach are parking lots and grass picnic areas. The area of the watershed that drains directly to the BB shoreline area of DPH, approximately 43 acres, consists of undeveloped hillside, park and recreation facilities, commercial properties, and some residential land uses. Water quality monitoring data and a circulation study suggest that impairment is confined to the BB shoreline and that circulation appears somewhat limited between the waters near BB and the waters further in the harbor channel. However, because DPH is a relatively small and enclosed harbor and other areas of the harbor may have an influence on bacteria levels at BB, the entire watershed area that drains into DPH (approximately 523 acres) was considered in the models developed for this TMDL project.

In contrast, SISP is a very small shoreline segment in a very large bay. The watershed area that drains to the SISP shoreline area of SDB consists entirely of park and recreational land use. Because exceedances in REC-1 WQOs for indicator bacteria are not observed in the open channel areas of SDB and adjacent to SISP, only the watershed area that drains directly to the impaired beach segment of SISP, confined to 10.2 acres of Shelter Island, was considered in the models developed for this TMDL project.

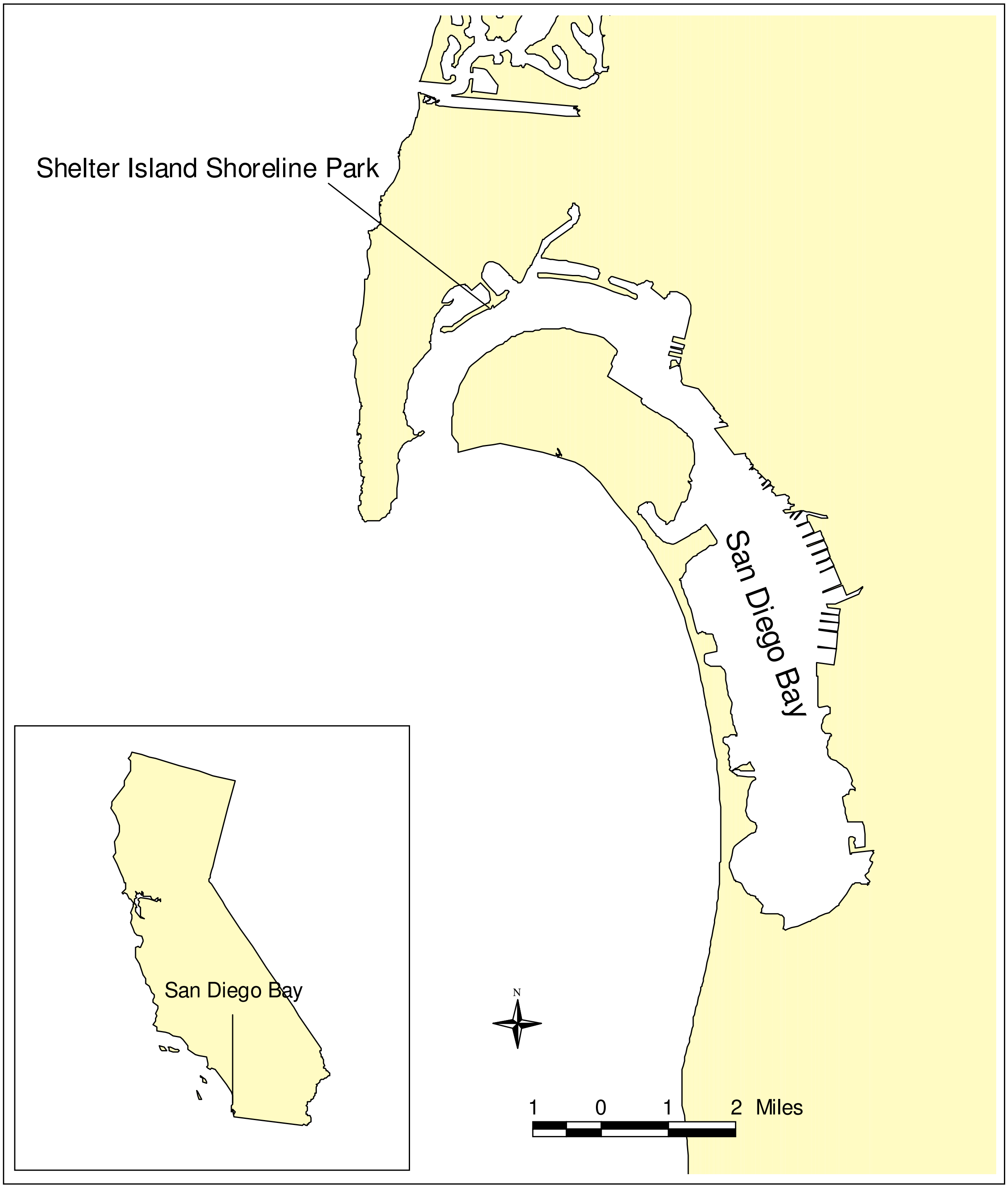

Figure 2-1. Location of Shelter Island Shoreline Park within San Diego Bay

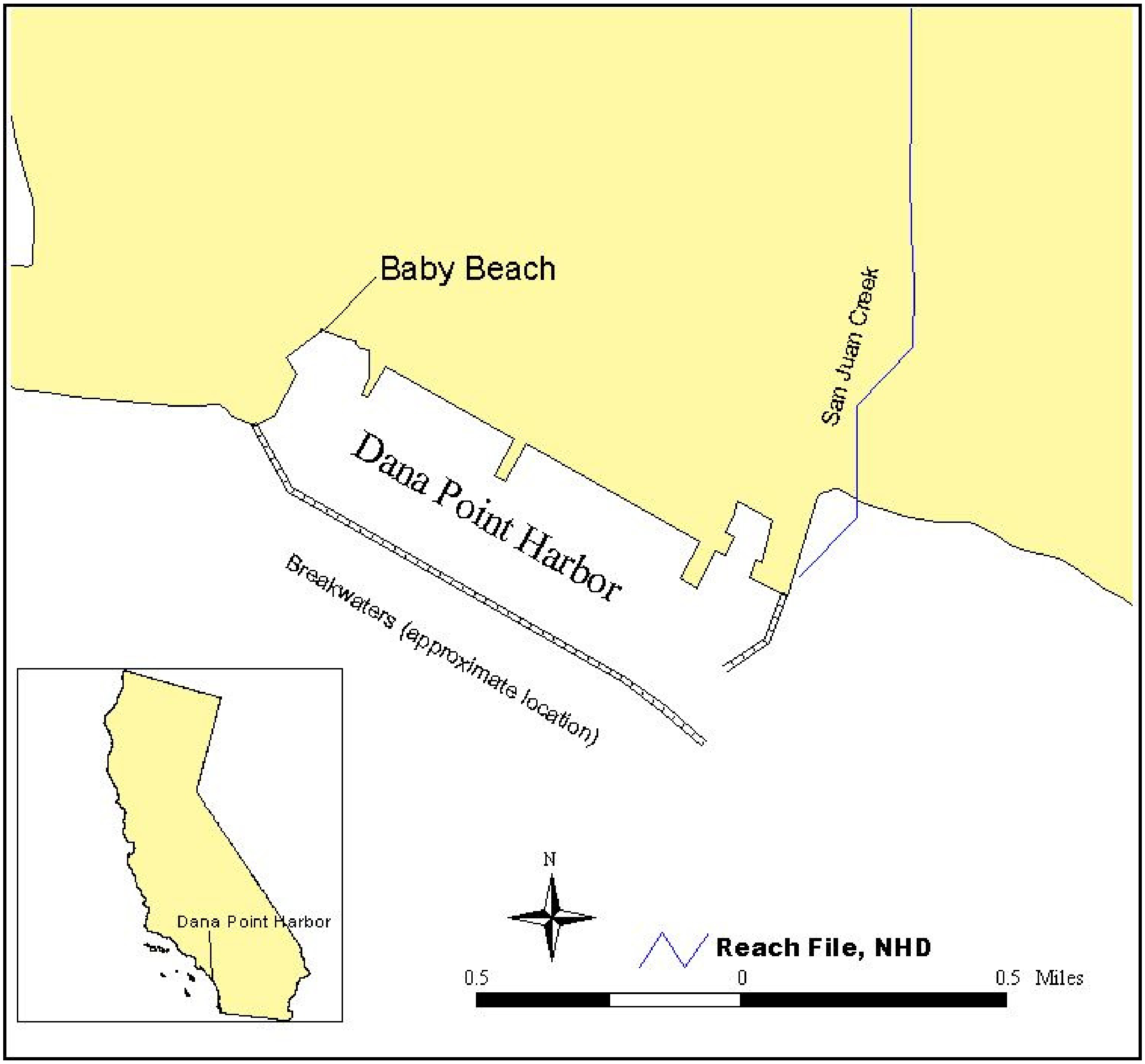

Figure 2-2. Location of Baby Beach within Dana Point Harbor

2.2 Applicable Water Quality Standards

Water quality standards consist of beneficial uses, water quality objectives (WQOs), and an antidegradation policy. WQOs are defined under Water Code section 13050(h) as "limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water." Under section 304(a)(1) of the Clean Water Act, the USEPA is required to publish water quality criteria that incorporate ecological and human health assessments based on current scientific information. WQOs must be based on scientifically sound water quality criteria, and be at least as stringent as those Clean Water Act criteria.

The Basin Plan identifies beneficial uses and WQOs for each waterbody type. Table 2-2 lists the beneficial uses for each of the shoreline segments evaluated in this technical report.

Table 2-2. Beneficial Uses of Shoreline Segments Evaluated

Waterbody Type	Waterbody	Shoreline Segment Evaluated	Beneficial Uses*
Coastal Water	Dana Point Harbor	Baby Beach	IND, NAV, REC-1, REC-2, COMM, WILD, RARE, MAR, MIGR, SPWN, SHELL
Coastal Water	San Diego Bay	Shelter Island Shoreline Park	IND, NAV, REC-1, REC-2, COMM, BIOL, EST, WILD, RARE, MAR, MIGR, SPWN, SHELL

* Beneficial uses defined in the Basin Plan (San Diego Water Board, 1994)

Only REC-1, REC-2, and SHELL beneficial uses have WQOs for bacteria, which are defined in the Basin Plan. For coastal waters, including bays and estuaries, the Basin Plan contains REC-1 WQOs for TC, FC, and ENT, REC-2 WQOs for FC,[3] and a SHELL WQO for TC. The objectives are derived from water quality criteria promulgated by the USEPA in 1986. Compliance to numeric WQOs must be assessed and maintained throughout a waterbody to protect beneficial uses, including the shorelines. For a complete discussion of WQOs for each beneficial use, see Appendix A.

As discussed previously, only the REC-1 beneficial use is evaluated in this TMDL project. Waters that can meet the REC-1 WQOs will also meet the REC-2 WQOs. Waterbodies that are impaired for the SHELL beneficial use will be addressed in a separate SHELL TMDL and/or standards action pending the outcome of the work of the statewide task force involving the Ocean Planning Unit of the State Water Board, the California Department of Public Health, the USEPA, and the coastal Regional Water Boards. The numeric WQOs selected as numeric targets for TC, FC, and ENT to calculate TMDLs under wet weather and dry weather conditions are discussed further in section 3.

[3] Where REC-1 use is not designated.

2.3 Impairment Overview

As discussed in section 2.1, of the six shoreline segments initially considered for this TMDL project, only two segments are now included. These two segments were initially placed on the 303(d) List in 2002. For the 2002 List, coastal waterbodies were evaluated based on the number of days health advisory and closure postings were placed at coastal areas by county health departments. These postings, based on weekly analytical data collected by the county health departments, indicated when waters along a shoreline segment could not be used for recreational purposes, and were thus impaired for REC-1 beneficial use. Beaches with health advisory and/or beach closure signs posted 10 or more days per year were placed on the 2002 List as impaired for REC-1 beneficial use due to indicator bacteria. The raw analytical data were not evaluated during the assembly of the 2002 List.

For this project, the most recent water quality data provided at the time of model development in 2004 were used to develop the models. However, because a significant amount of time has elapsed since then, more recent water quality data were also evaluated against REC-1 WQOs to confirm that the impairments continue to exist. Guidance provided in the State Water Board's *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List* was used to confirm impairment of a water body. According to the *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List* (Listing Policy), a minimum sample size of 26 samples, with no more than 4 exceedances of the applicable WQOs is needed for recommending the removal of a water body from the 303(d) List. Additionally, there must be enough samples to be temporally and spatially representative.

Table 2-3 lists the impaired waterbodies addressed in this report.

Table 2-3. Impaired Waterbodies Addressed in this Analysis

Waterbody	Hydrologic Descriptor	Segment / Area	Pollutant / Stressor	Extent of Impairment	Year Listed
Dana Point Harbor	Dana Point HSA (901.14)	Baby Beach	Indicator bacteria*	0.4 miles	2002
San Diego Bay	Point Loma HA (908.10)	Shelter Island Shoreline Park	Indicator bacteria*	0.4 miles	2002

* Placed on the 2002 Section 303(d) List based on reported exceedances of TC, FC, and/or ENT REC-1 water quality objectives.

An overview of the rationale for confirming each shoreline segment addressed in this technical report as impaired is provided in the following sub-sections.

2.3.1 Baby Beach Overview

In 2000, the Orange County Environmental Health Care Agency reported that beach closure and/or health risk advisory signs were posted at BB for 54 days. Based on this information, the shoreline segment at BB was placed on the 2002 List as impaired by indicator bacteria for REC-1 beneficial use.

In response, the County of Orange conducted numerous studies and implemented a variety of BMPs in an effort to reduce bacteria levels at BB. These efforts have included installing seasonal plugs in storm drains, increased street sweeping efforts, expedited trash collection to control birds, the installation of bird netting under the pier, public education efforts against bird-feeding at the beach, artificial circulation of water at BB, a dry weather flow diversion structure and media filter system on the west end of the beach, catch basin filters, and the collection and disposal of bird fecal droppings from the exposed intertidal areas of the beach.

Analytical data were available from the Orange County Environmental Health Care Agency for evaluation. Samples collected from four locations at BB between January 2002 and December 2006 were analyzed. During that sampling period, there were 1,160 samples collected, of which 1,160 samples were analyzed for TC and ENT, and 1,159 samples were analyzed for FC. According to the Listing Policy, to remove a water body from the 303(d) List based on a sample size of 1,159 or 1,160, the number of exceedances allowed is equal to or less than 193.

Of the samples collected between January 2002 and December 2006, indicator bacteria densities exceeded the single sample maximum numeric WQOs for REC-1 beneficial use in 11 of 1,160 samples analyzed for TC, 131 of 1,159 samples analyzed for FC, and 283 of 1,160 samples analyzed for ENT. The number of exceedances for TC and FC are within the number of allowed exceedances to delist for REC-1 beneficial use. However, the number of exceedances for ENT is greater than the number of allowed exceedances to recommend removal from the 303(d) List. These data indicate that there have been significant improvements in water quality since 2002. This improvement is believed to be attributed to the efforts described above. However, this analysis also confirms that BB is still impaired by indicator bacteria for REC-1 beneficial use and should remain on the 303(d) List.

2.3.2 Shelter Island Shoreline Park Overview

In 2000, the San Diego County Department of Environmental Health reported that beach closure and/or health risk advisory signs were posted at SISP for 24 days. Based on this information, SISP was placed on the 2002 List as impaired for REC-1 by indicator bacteria. In response, the San Diego Unified Port District implemented a variety of BMPs in an effort to reduce bacteria levels at SISP.

Analytical data were available from the San Diego Unified Port District and San Diego County Department of Environmental Health for evaluation. Samples collected at SISP between January 2003 and November 2006 were analyzed. During that sampling period, there were 143 samples collected, of which 143 samples were analyzed for TC and ENT, and 105 samples were analyzed for FC. According to the Listing Policy, to remove a water body from the 303(d) List based on a sample size of 105 or 143, the number of exceedances allowed is equal to or less than 17 or 23, respectively.

Of the samples collected between January 2003 and November 2006, indicator bacteria densities exceeded the single sample maximum numeric WQOs for REC-1 beneficial use in 1 of 143 samples analyzed for TC, 16 of 105 samples analyzed for FC, and 24 of 143 samples analyzed for ENT. The number of exceedances for TC and FC are within the number of allowed exceedances to delist for REC-1 beneficial use; however, the number of exceedances for ENT is greater than the number of allowed exceedances to recommend removal from the 303(d) List. These data indicate that there have been significant improvements in water quality since 2002. However, this analysis also confirms that SISP is still impaired by indicator bacteria for REC-1 beneficial use and should remain on the 303(d) List.

3 Numeric Target Selection

When calculating TMDLs, numeric targets are selected to meet WQOs for a waterbody and subsequently ensure the restoration and/or protection of beneficial uses. TMDLs were calculated for each impaired waterbody. The numeric targets used in the TMDL calculations were selected from the single sample maximum and geometric mean WQOs for REC-1 beneficial uses, as applicable, for TC, FC, and/or ENT indicator bacteria. Because these are coastal (i.e., saline) waterbodies, there are no applicable WQOs for *E. coli* indicator bacteria.

The basis for the indicator bacteria WQOs were developed, in part, with epidemiological studies in waters with sewage inputs. However, urban runoff from the BB and SISP watersheds is not known to include sewage. The San Diego Water Board recognizes that there are potential problems associated with using indicator bacteria WQOs to indicate the presence of human pathogens in receiving waters free of sewage discharges. The risk of contracting a water-born illness from contact with urban runoff devoid of sewage has not been established. Research is currently being conducted examining the relationship between water contact associated illness and recreational waters impacted by urban runoff devoid of sewage. In addition, new methods are being tested to better and more quickly characterize health risks for water contact recreation. Based upon the results of this research, revisions to the indicator bacteria WQOs in the Basin Plan and the TMDLs developed in this project may be appropriate in the future. However, until then, the numeric WQOs for indicator bacteria currently in the Basin Plan are the most appropriate numeric targets for the development of these TMDLs.

The selected numeric targets were different for wet and dry weather[4] because the bacteria transport mechanisms are different under each weather condition. Wet weather runoff, or stormflow runoff, occurs in episodic events that are short in duration, and characterized by rapid wash-off and transport of high bacteria loads, with short residence times, from all land use types to receiving waters. Bacteria densities from a wet weather event are best represented by the single sample maximum WQOs. These WQOs also apply when evaluating shorelines.

During dry weather conditions, dry weather runoff is not generated from stormflows. In contrast, flow during dry weather is typically more uniform than wet weather stormflow, is not uniformly linked to every land use, and has lower flows, lower loads, and slower transport, making bacteria die-off and/or amplification processes more important. Therefore, bacteria densities are usually best represented by the geometric mean WQOs.

[4] Wet weather is defined as any day when rainfall results in stormwater runoff, typically the days that precipitation occurs and the 72 hours following the end of the precipitation event. Dry weather is any day of no rainfall and therefore no stormwater runoff. However, runoff may occur during dry periods as a result of urban runoff resulting from irrigation practices or other water uses (e.g., car or sidewalk washing).

However, the bacteria densities along the impaired shoreline segments of BB and SISP are not influenced solely by bacteria loads from watershed runoff flows. Tidal effects for some shorelines have been observed to result in extreme diurnal variations in bacteria densities that can range by orders of magnitude. So, even if the shoreline bacteria densities are in compliance with the 30-day geometric mean, in some cases the maximum hourly concentration predicted in a model could regularly exceed the single sample maximum WQO. Therefore, the single sample maximum WQOs were used in addition to the geometric mean WQOs to set maximum daily bacteria densities allowed under dry weather conditions.

The selected wet and dry weather numeric targets used for calculating TMDLs for the shoreline segments evaluated in this technical report are discussed in the following sub-sections.

3.1 Wet-Weather Targets

All shorelines of SDB and DPH are designated with the REC-1 and REC-2 beneficial uses. Therefore, the shoreline segments evaluated in this technical report are subject to the applicable REC-1 and REC-2 WQOs for TC, FC, and ENT. Waters that can meet the REC-1 WQOs will also meet the REC-2 WQOs. The REC-1 single sample maximum WQOs were selected as numeric targets for wet weather.

The goal of establishing TMDLs is to restore and/or protect the quality and beneficial uses of a waterbody. For REC-1 beneficial use, WQOs have been established in the Basin Plan for TC, FC, and ENT in saline waters. The numeric targets selected for FC, ENT, and TC to calculate wet weather TMDLs are listed in Table 3-1.

Table 3-1. Wet Weather Numeric Targets

Basis for Numeric Target	Total Coliform (TC) (MPN/100mL)	Fecal Coliform (FC) (MPN/100mL)	*Enterococcus* (ENT) (MPN/100mL)
Beneficial Use	**REC-1**	**REC-1**	**REC-1**
Single sample maximum	10,000	400	104

Abbreviations:
ml: milliliter
MPN: most probable number
REC-1: Contact Water Recreation beneficial use, defined in the Basin Plan (San Diego Water Board, 1994)

3.2 Dry-Weather Targets

As with the numeric targets selected for wet weather, numeric targets for dry weather were selected to be protective of REC-1 and REC-2 beneficial uses. As discussed above, dry weather numeric targets are typically best represented by geometric mean WQOs. However, due to extreme diurnal variations in bacteria densities resulting from tidal effects, in some cases the maximum hourly concentration predicted in the receiving water model could regularly exceed the single sample maximum WQOs. Therefore, both the REC-1 30-day geometric mean and single sample maximum WQOs were selected as numeric targets for dry weather.

The numeric targets selected for FC, ENT, and TC to calculate dry weather TMDLs are listed in Table 3-2.

Table 3-2. Dry Weather Numeric Targets

Basis for Numeric Target	Total Coliform (TC) (MPN/100mL)	Fecal Coliform (FC) (MPN/100mL)	*Enterococcus* (ENT) (MPN/100mL)
Beneficial Use	**REC-1**	**REC-1**	**REC-1**
30-day geometric mean	1,000	200	35
Single sample maximum	10,000	400	104

Abbreviations:
ml: milliliter
MPN: most probable number
REC-1: Contact Water Recreation beneficial use, defined in the Basin Plan (San Diego Water Board, 1994)

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4 Data Inventory and Analysis

For the development of the wet weather and dry weather models, data from numerous sources (Appendix D) were used to characterize the watersheds and water quality conditions, identify sources of bacteria, and support the TMDL calculations. There were no new data collected as part of this data analysis effort. The data analysis provided an understanding of the conditions that resulted in the reported impairments (Appendix E).

4.1 Data Inventory

The categories of data used in developing these TMDLs include physiographic data that describe the physical conditions of the watershed, and environmental monitoring data that support the identification of potential pollutant sources. Table 4-1 presents the various data types and data sources used in the development of these TMDLs. The following sub-sections describe the key data sets used for TMDL development.

Table 4-1. Inventory of Data and Information Used for the Source Assessment of Bacteria

Data Set	Type of Information	Data Source(s)
Watershed physiographic data	Location of dams	USEPA BASINS
	Stream network	USEPA BASINS (Reach File, Versions 1 and 3); USGS NHD reach file; special studies of Aliso Creek, Tecolote Creek, and Rose Creek; SANGIS
	Land use	2000 land use coverage for San Diego County (SANDAG); 1993 land use coverage of Orange and portions of Riverside Counties (SCAG)
	Counties	USEPA BASINS
	Cities/populated places	USEPA BASINS, U.S. Census Bureau's Tiger Data
	Soils	USEPA BASINS (USDA-NRCS STATSGO)
	Watershed boundaries	USEPA BASINS (8-digit hydrologic cataloguing unit); CALWTR 2.2 (1995)
	Topographic and digital elevation models (DEMs)	USEPA BASINS; USGS

Table 4-1. Inventory of Data and Information Used for the Source Assessment of Bacteria (Cont'd)

Data Set	Type of Information	Data Source(s)
Environmental monitoring data	Water quality monitoring data	USEPA STORET; California Department of Environmental Health; County of San Diego Department of Environmental Health; Orange County Pubic Facilities and Resources Department; City of San Diego; Orange County Public Health Laboratory, San Diego Water Board; NAVFAC-SW; SPAWAR; San Diego Unified Port District
	Streamflow data	USGS; Orange County Public Facilities and Resources Department; City of San Diego
	Meteorological station locations	BASINS; NOAA-NCDC; CIMIS; ALERT Flood Warning System; California DWR, Division of Flood Management

Abbreviations/Acronyms:
ALERT: Automatic Local Evaluation in Real-Time
BASINS: Better Assessment Science Integrating Point and Nonpoint Sources System
CALWTR: Calwater
CIMIS: California Irrigation Management Information System
DWR: Department of Water Resources
NAVFAC-SW: Naval Facilities Engineering Command, Southwest Division
NCDC: National Climatic Data Center
NHD: National Hydrography Dataset
NOAA: National Oceanic and Atmospheric Administration
NRCS: Natural Resources Conservation Service
SANDAG: San Diego Association of Governments
SANGIS: San Diego Geographic Information Source
SCAG: Southern California Association of Governments
SPAWAR: Space and Naval Warfare Systems
STATSGO: State Soil Geographic database
STORET: Storage and Retrieval environmental data system
USDA: United States Department of Agriculture
USEPA: United States Environmental Protection Agency
USGS: United States Geological Survey

4.1.1 Water Quality Data

For the development of the wet weather and dry weather models, water quality data provided when the model development was initiated for the shoreline segments of SDB and DPH were obtained from the County of San Diego and the Orange County Public Health Laboratory, respectively (Appendix D, No. 3-4), for use in wet weather and dry weather model calibration and validation processes. At the time the model development was initiated, analytical data were available for SISP (one sampling location) and BB (four sampling locations). See Figures 4-1 and 4-2 for sampling locations. Bacteria data from these shoreline segments (including FC, TC, and ENT) used in the development of the models were collected at various times from 1996 through 2004, and the amount of data varied among sampling locations.

4.1.2 Waterbody Characteristics

The assessment of waterbody characteristics involved the evaluation of physical data such as bathymetry and water surface elevations and hydrodynamic data including currents, tidal velocities, and BB and SISP outflows. This information was used to determine the volume and hydrodynamic features of the waterbodies, which were included in the calculation of the assimilative capacity and identification of the physical processes that affect bacteria loading.

No recorded streamflow data were identified for the watersheds draining to the impaired shorelines. However, regionally calibrated hydrologic models developed in Bacteria TMDL Project I were able to be used to provide much information regarding the hydrologic characteristics in these watersheds.

Bathymetry data for BB and SISP were based on data obtained from the US Army Corp of Engineers (USACE) and Space and Naval Warfare Systems (SPAWAR), respectively (Appendix D, No. 12). A complete discussion of the data is provided in the modeling report in Appendix F.

Hydraulic data, such as water surface elevations, used for the hydrodynamic model were obtained from the National Oceanic and Atmospheric Administration (NOAA) Center for Operational Oceanographic Products and Services (COOPS) (Appendix D, No. 2).

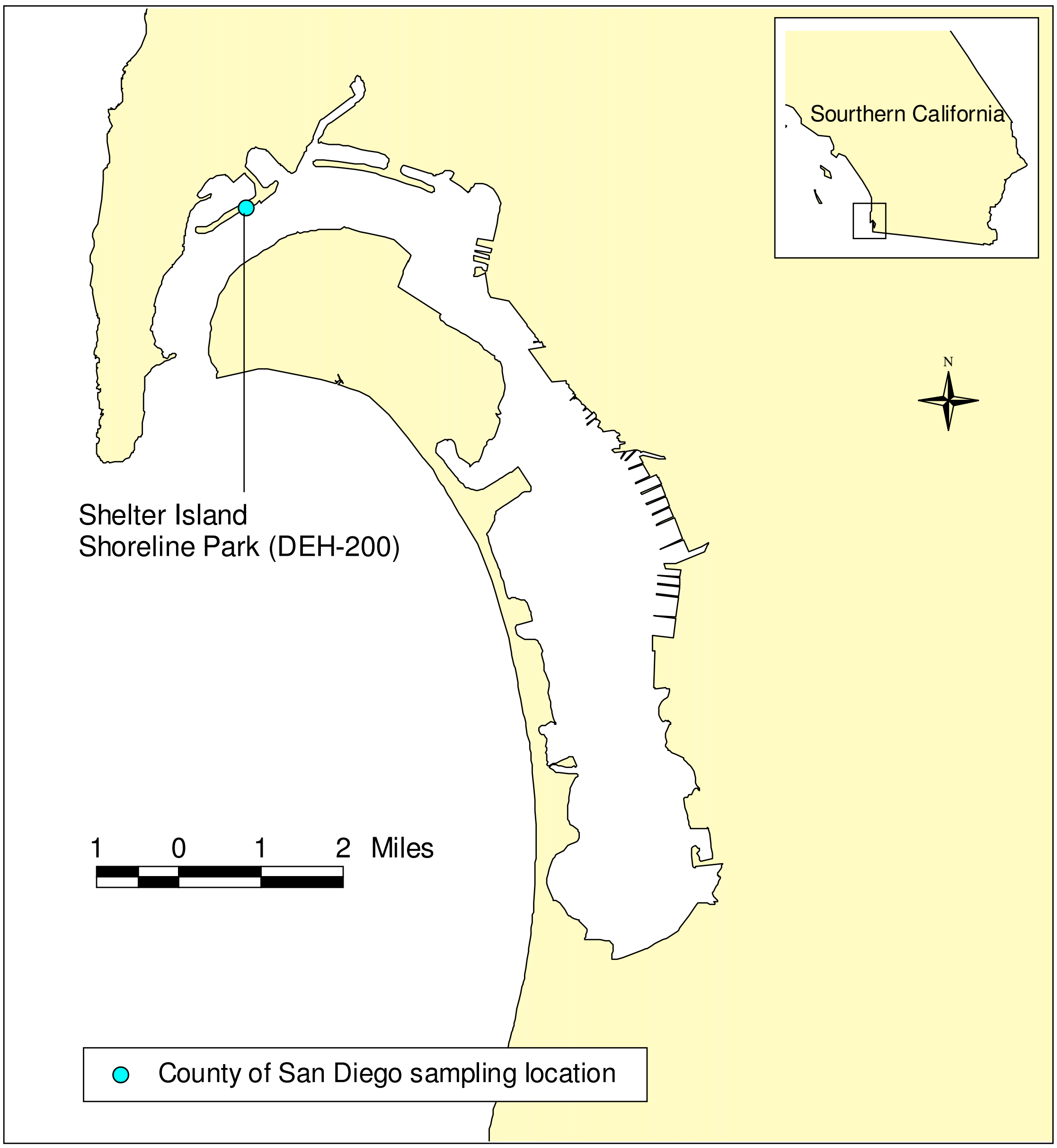

Figure 4-1. Shelter Island Shoreline Park Bacteria Monitoring Station

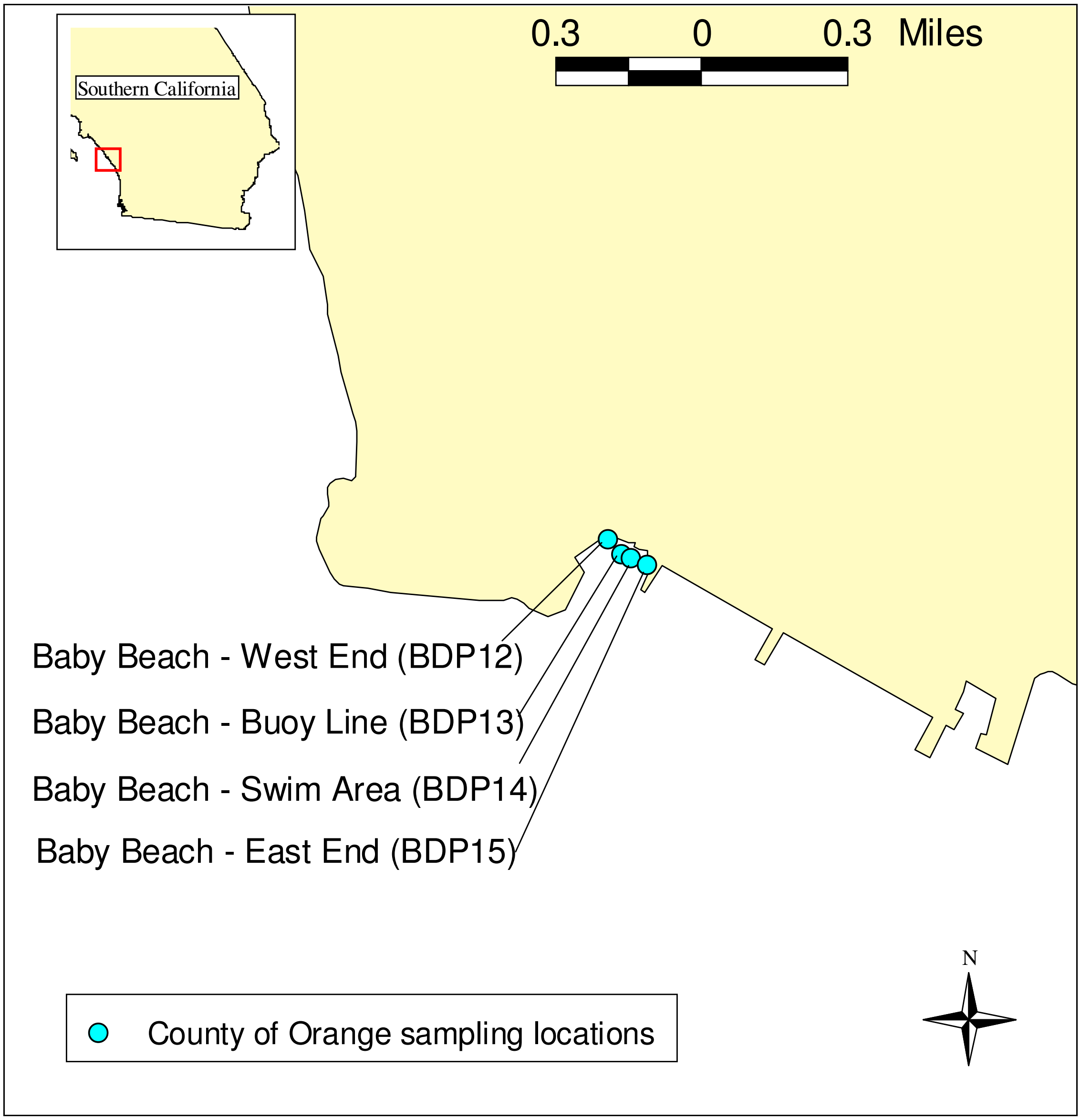

Figure 4-2. Baby Beach Bacteria Monitoring Stations

4.1.3 Meteorological Data

Hourly rainfall data were obtained from the National Climatic Data Center (NCDC) of the NOAA. To augment the NCDC data, hourly rainfall data were obtained from the Automatic Local Evaluation in Real-Time (ALERT) Flood Warning System. In addition, hourly evapotranspiration data were obtained from the California Irrigation Management Information System (CIMIS) (Appendix D, No. 9-11).

Apart from rainfall and evapotranspiration data, other meteorological data such as temperature, humidity, wind speed, wind direction, atmospheric pressure and cloud cover data were obtained from NOAA-NCDC (Appendix D, No. 9). These data were used to drive the hydrodynamic receiving water models.

4.1.4 Land Characteristic Data

Available land use data to support this study included the San Diego Association of Governments (SANDAG) Regional Planning Agency's land use data set that covers San Diego County, and the Southern California Association of Governments (SCAG) land use data set for Orange County. A combination of SANDAG and SCAG data was used to provide the most complete and up-to-date land use representation of the region at the time of model development (Appendix D, No. 14).

In addition, soil data were obtained from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) State Soil Geographic (STATSGO) database and topographic information was obtained from the USEPA's Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) system (Appendix D, No. 15-16).

4.2 Review of Shoreline Water Quality

Bacteria water quality data for BB and SISP shorelines provided at the time of model development (Appendix D, No. 3-4) were analyzed to provide insight into the spatial extent of impairment and the timing of any exceedances of WQOs. Results of this analysis were also used in the source assessment to identify the proximity of listed coastal segments to tributaries, outfalls, and other potential sources (see section 5).

The timing of exceedances of WQOs and the relationship to wet and dry conditions are important considerations for evaluation of impairments. Monitoring data from both BB and SISP shorelines were reviewed based on their association with wet or dry periods to better understand variability during periods when transport methods differ (wet weather runoff versus dry weather runoff). For each monitoring station, sampling dates were compared to rainfall data collected at the closest rainfall gage to determine whether bacteria water quality samples had been collected during wet or dry weather periods. Once the data for all sampling stations were identified as wet or dry, they were evaluated against the associated single sample maximum and/or 30-day geometric mean WQOs.

Results of analyses at SISP and four locations at BB are illustrated in Appendix E. These results show multiple exceedances of WQOs during both wet and dry weather periods. Typically, higher levels of indicator bacteria appear correlated with wet weather periods, although peak concentrations during dry weather also exceeded WQOs. Specific results of the data analysis for BB and SISP are discussed in the following sub-sections.

4.2.1 Baby Beach Water Quality

At the time of model development, water quality data collected during 1996 to 2002 were provided from four locations along BB (Figure 4-2). Both wet weather and dry weather conditions appeared to be well represented and trends were found for bacteria densities with relation to weather. Exceedances of both the single sample maximum and 30-day geometric mean REC-1 WQOs were observed at all four sampling locations and for all indicator bacteria.

Results of the water quality data analysis show that, with the exception of geometric means calculated for TC bacteria densities at BB-West End, the percentage of wet weather samples in exceedance of wet weather WQOs was consistently greater than the percentage of dry samples in exceedance at all sampling locations along BB and for all measured indicator bacteria (Appendix E). This was true for indicator bacteria densities compared to both the single sample maximum and the 30-day geometric mean REC-1 WQOs. In addition, spatial trends show that percent exceedances of both the single sample maximum and 30-day geometric mean REC-1 WQOs tend to be higher at the western locations of BB than in the eastern locations.

4.2.2 Shelter Island Shoreline Park Water Quality

At the time of model development, water quality data collected during 1999 to 2004 were provided from one location for SISP (Figure 4-1). Most water quality samples were collected during dry weather conditions at SISP. A small number (approximately 1.5 percent) of the samples were collected during wet weather conditions (Appendix E).

With regards to wet weather, water quality data collected at SISP were limited. Those samples collected during wet weather and the geometric means that were calculated over a wet weather period tended to be higher than many of the dry weather samples and geometric means calculated over a dry weather period (Appendix E). Wet weather bacteria densities were not well represented, making it difficult to document the trends in bacteria densities with regards to wet weather periods at the SISP location.

Exceedances of the single sample maximum REC-1 WQOs were observed for all indicator bacteria under both wet and dry weather conditions. Also for both weather conditions, exceedances of the 30-day geometric mean REC-1 WQOs for TC and/or ENT were observed. However, no exceedances of the 30-day geometric mean REC-1 WQOs were observed for FC under wet or dry weather conditions.

5 Source Analysis

This section presents the approach used to identify and quantify the sources of bacteria that can contribute to the bacteria loading along the BB and SISP shorelines. Bacteria can enter surface waters from both nonpoint and point sources. Nonpoint sources are typically diffuse sources that have multiple routes of entry into surface waters. Nonpoint sources can include encampments of homeless persons, or direct input to waterbodies from birds, terrestrial and aquatic wildlife, wrack line and aquatic plants, sediments, or other unidentified sources within the receiving waters. Point sources typically discharge at a specific location from pipes, outfalls, and conveyance channels from municipal wastewater collection systems and treatment plants, industrial waste treatment facilities, or Municipal Separate Storm Sewer System (MS4) discharges. Point sources can include residential sewage disposal from illicit connections to stormwater conveyance systems and illegal discharge of sewage from boats along the coastline.

Sources of bacteria are the same under both wet weather and dry weather conditions. For both wet weather and dry weather conditions, there are natural and background sources of bacteria within the receiving waters at the impaired shoreline segments. However, for sources of bacteria that originate from the watersheds draining into the receiving waters, the method of transport for the two conditions is very different. Wet weather loading originating from the watersheds is dominated by episodic storm flows that wash off bacteria that build up on the surface of all land use types in a watershed during dry periods. Dry weather loading originating from the watersheds is dominated by nuisance flows from urban land use activities such as car washing, sidewalk washing, and lawn over-irrigation, which pick up bacteria and deposit it into receiving waters. These types of nuisance flows are generally referred to as urban runoff. Because the relative loads from bacteria sources vary significantly between wet weather events and dry weather conditions, load assessment required separate wet and dry weather analyses. For this reason, two distinct modeling approaches were used to assess bacteria loading and TMDLs. These modeling approaches are described in the Linkage Analysis in section 6.

The following sub-sections discuss nonpoint and point sources and their relative significance as contributors of bacteria to surface waters during wet and dry weather conditions as they were incorporated into the TMDL calculations.

5.1 Nonpoint Sources

The primary nonpoint sources identified for the BB and SISP shorelines were associated with natural sources (such as birds, terrestrial and aquatic wildlife, or other sources within the water), as well as the potential contribution from encampments of homeless persons. These nonpoint sources are discussed below.

5.1.1 Natural Sources

Direct input of waste from birds, terrestrial and aquatic wildlife, and other sources within the water to the waterbodies can be a significant source of bacteria during both wet and dry weather conditions. Studies have shown that waterfowl can potentially contribute significant loads of bacteria directly to coastal waters (Fleming and Fraser, 2001; Grant et al., 2001; City of San Diego, 2004). In a study of bacteria levels in Mission Bay during dry weather conditions conducted by the City of San Diego (2004), results of DNA typing showed that waterfowl were the main source of indicator bacteria in the bay and stormwater conveyance system discharge. Although birds were the primary type of wildlife observed in Mission Bay, the results also showed that marine mammals contribute at least 5 percent of indicator bacteria found in the bay. This percentage likely would be higher if the marine mammal population density is higher.

In the San Diego Region, shorelines are frequented by large populations of waterfowl that can contribute fecal matter directly to the shoreline areas. Bacteria loads from this fecal matter can be transported to the coastal waters from tidal fluctuations during dry weather conditions, as well as during wet weather stormflows. In addition, marine mammals (such as seals) have been observed at impaired shorelines in numbers that suggest they could also be a significant source of bacteria.

For dry weather TMDL calculations, when incoming flows from the watershed are relatively low, impacts to the BB and SISP shorelines were considered to be primarily due to direct contribution of fecal bacteria from waterfowl on to the shorelines, which are washed into the shoreline surface water by tidal fluctuations. For wet weather TMDL calculations, in addition to the bacteria that have accumulated in the watershed and are washed off with stormflow runoff, the contribution of fecal bacteria from waterfowl on to the shorelines would also be a relatively significant source.

Other natural sources of bacteria within the water (such as aquatic plants and wildlife, or sediments) may contribute to the bacteria levels within the waterbodies during both wet and dry weather conditions. All of these natural sources of bacteria discussed above can be significant, but are largely uncontrollable.

5.1.2 Encampments (Homeless Persons)

Encampments of homeless persons were identified as a potential nonpoint source of bacteria in the watersheds of BB and SISP. Bacteria loads from homeless encampment populations are usually inland and not right on the shore, where tidal fluctuations can wash human fecal matter into the shoreline surface water. Therefore, this nonpoint source was not included in the dry weather TMDL calculations.

However, during wet weather (storm) periods, wash-off from encampments of homeless persons can potentially contribute elevated bacteria loads to waterbodies due to improper disposal of human waste. Such bacteria contributions are extremely difficult to quantify from analysis of homeless encampment populations. Instead, bacteria loads from homeless encampments were considered to be included within the urban runoff characterized through the watershed modeling analysis of wet weather conditions (Appendix F). Urban runoff from these areas was considered along with stormwater runoff and was categorized as point source discharges through National Pollutant Discharge Elimination System (NPDES) requirements for MS4 discharges, as discussed in section 5.2.

Direct discharges of fecal matter from homeless encampments were not included explicitly in wet weather TMDL calculations. If bacteria loads from encampments of homeless persons result from direct discharge of human fecal matter to the shoreline waterbodies, a 100 percent reduction would be required for implementation of the dry and wet weather TMDLs.

5.1.3 Other Background Sources

Illegal discharges of sewage from boats and wastewater collection systems and treatment plants were identified as a potential point source of bacteria in the receiving waters of BB and SISP. Illegal discharges from boats and wastewater collection systems and treatment plants do not appear to be occurring in areas directly adjacent to the impaired shorelines, but may contribute to the background levels of bacteria. While these sources are generally considered illegal and should not be occurring, the reality is that they occur frequently enough to potentially influence the “ambient” or background levels of bacteria in the receiving waters.

In addition to influence that illegal discharges from boats and wastewater collection systems and treatment plants may have on background levels of bacteria, there may be other unnatural or anthropogenic sources of bacteria that may also have an influence on background levels of bacteria. For example, shedding of bacteria from human (especially infants and children) can be a source of anthropogenic bacteria.

Anthropogenic sources are generally considered controllable. However, there may be some anthropogenic sources that are infeasible or impractical to control, such as shedding from human bathers. When humans enter water they may shed bacteria from their bodies (e.g., bacteria on clothing, skin and hair, or bacteria in bodily excretions). Shedding from humans may be controllable (e.g., banning infants from swimming or requiring humans to take a shower before entering the water), but implementing such control measures are impractical and infeasible and would take away the beneficial uses (i.e., REC-1) that the TMDL is supposed to restore. However, anthropogenic sources that are feasible to eliminate, such as discharges from boats and wastewater collection systems and treatment plants, should be identified and quantified, and reduction requirements should be calculated and implemented.

At this time, there are not enough data to identify and quantify the exact potential contribution from these other background sources. Direct illegal discharges from boats and wastewater collection systems and treatment plants are considered point sources and discussed below in sections 5.2.1 and 5.2.2, respectively. However, the potential background bacteria loads attributed to these sources and other unidentified anthropogenic sources, along with the natural sources discussed in section 5.1.1 were lumped together into one "natural and background" nonpoint source that exists in the receiving waters. Until more information is obtained through further study to provide identification and quantification of the relative loading from these potential anthropogenic sources, "natural and background" sources are generally considered uncontrollable.

5.2 Point Sources

A point source, according to federal regulations [Code of Federal Regulations Title 40 section 122.3], is defined as "any discernable, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged." Potential point sources identified for the BB and SISP shorelines are discussed below.

5.2.1 Wastewater Collection Systems and Treatment Plants

There are no direct point source discharges of bacteria from wastewater treatment plants to areas directly adjacent to the BB and SISP shorelines. However, bacteria loads periodically occur as a result of sewage spills, or may be occurring due to illegal cross connections or sanitary sewer leaks. Although these loads potentially result in contamination of the waterbodies and bacterial concentrations that exceed WQOs, the loads attributed to these sources were not quantified for TMDL development. Bacteria loads attributed to sewage spills were not quantified because sewage spills are typically accidental and intermittent. Bacteria loads attributed to sewage from illegal cross connections or sewage leaks were not quantified because no data were available. Because the Basin Plan includes waste discharge prohibitions specifically for the unauthorized discharge of treated or untreated sewage to waters of the state, 100 percent reduction of bacteria loads from sewage spills is required for implementation of the dry and wet weather TMDLs.

5.2.2 Illegal Sewage Discharge from Boats

Illegal discharge of sewage from boats has been identified as a potential point source of bacteria in the receiving waters of the BB and SISP shorelines. While these bacteria loads may potentially be a large source of the existing bacteria in these waterbodies, there were not enough data available to specifically quantify the loads attributed to these sources for TMDL development. Because the Basin Plan includes waste discharge prohibitions specifically for the discharge of treated or untreated sewage from vessels to Dana Point Harbor and San Diego Bay, 100 percent reduction of bacteria loads from boats is required for implementation of the dry and wet weather TMDLs.

5.2.3 Municipal Separate Storm Sewer Systems (Urban Runoff)

Urban runoff discharges from MS4s are a leading cause of receiving water quality impairments in the San Diego Region. The County of Orange confirms that storm drains are a significant contributor of bacteria in a study performed at Baby Beach in Dana Point Harbor (County of Orange, 2003). A direct linkage has also been established between human illness and recreating near the outfalls of urban stormwater conveyance systems (Haile et al, 1999).

For the San Diego Region, all discharges of urban runoff are covered by MS4 NPDES waste discharge requirements. For the watersheds of San Diego County, the incorporated cities of San Diego County (18 cities), the San Diego Unified Port District, and the San Diego County Regional Airport Authority, Order No. R9-2007-0001 defines the NPDES waste discharge requirements for MS4s. For the watersheds of Orange County, the incorporated cities of Orange County (11 cities), and the Orange County Flood Control District, Order No. R9-2002-0001 defines the NPDES waste discharge requirements for MS4s.

The watersheds draining into the impaired shoreline segments addressed in this TMDL discharge directly from the MS4 storm drain systems into BB and SISP, and not via any streams or creeks. Urban runoff discharged by MS4s is different depending on wet or dry weather conditions. Runoff under these weather conditions are discussed below.

5.2.3.1 Wet Weather Urban Runoff

During wet weather conditions (storm events), wash-off of bacteria from various land uses is considered to be the primary mechanism for transport of bacteria. After bacteria build up on the land surface as a result of various land use sources and associated management practices (e.g., pet waste in residential areas), much of the bacteria is washed off of the land surface during storm events into the MS4 storm drain systems. The amount of runoff and associated bacteria densities are therefore highly dependent on land use.

5.2.3.2 Dry Weather Urban Runoff

During dry weather conditions, many streams in the San Diego Region exhibit a sustained flow even if no rainfall has occurred for a significant period to provide precipitation-based runoff or groundwater flows. These dry weather flows are generally understood to result from various urban land use practices that cause water to enter MS4s. Such land use practices include landscape irrigation, car washing, sidewalk washing, and the like. As these urban runoff flows travel across lawns and urban surfaces, bacteria are carried from these areas to the receiving waterbody.

Studies performed at other waterbodies (Aliso Creek, San Juan Creek, Tecolote Creek, and Rose Creek) for Bacteria TMDLs Project I (San Diego Water Board, 2007) found that urban runoff and associated bacteria levels during dry weather conditions could be estimated from land use information in a given watershed. This observance was validated in Bacteria TMDLs Project I through an analysis of dry weather data collected throughout the San Diego Region that led to development of a regional model for estimation of dry weather flows and bacteria levels.

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6 Linkage Analysis

The analysis of the relationship between bacteria loading and the waterbody response to this loading is referred to as the linkage analysis. The linkage analysis results in the calculation of a numeric value for the total amount of loading of a pollutant that a waterbody can receive and still meet water quality standards. This numeric value becomes the TMDL of a pollutant for a waterbody. The TMDL is typically calculated under critical conditions (i.e., worst case scenario). If the waterbody can meet WQOs under these conditions, it should be able to meet WQOs under any conditions.

Because the TMDL calculations are based on critical conditions and numeric WQOs that support the beneficial uses, attainment of the TMDL numeric values will result in attainment of water quality standards under any conditions. Likewise, attainment of the water quality standards, specifically WQOs that support the beneficial uses, will result in attainment of the TMDL. Ultimately, the goal of a TMDL is to restore the water quality of a waterbody so it can support its beneficial uses by meeting the WQOs at all times.

After the TMDL for a waterbody is calculated, the pollutant loading is allocated among the allowable sources that have been identified as potentially contributing a pollutant load to the waterbody. The TMDL is allocated to nonpoint sources and point sources. The pollutant loads that are attributed and allocated to nonpoint sources are known as load allocations (LAs). The pollutant loads that are attributed and allocated to point sources are known as wasteload allocations (WLAs).

“Existing” pollutant loads from all the identified allowable sources are also calculated under critical conditions. The calculation of the exiting pollutant loads can be used to identify which sources may need to be reduced so the TMDL may be achieved. Existing pollutant loads from each source are compared to the WLAs and LAs of the TMDL. If the existing pollutant loading from a source exceeds the LA or WLA, load reductions are required to meet the water quality standards. Controllable sources of pollutants are identified, and load reductions are calculated in order to meet the LA or WLA for each controllable pollutant source.

Due to the complex interactions that bacteria can have with the environment, a model is typically required to perform the linkage analysis and TMDL calculation. A model mathematically represents environmental processes, which can be used to evaluate the way pollutants interact with the environment.

A model can be very simple or extremely complex, requiring more time and resources as more parameters are included in the model. The simpler a model is the fewer model parameters and the higher the uncertainty in the results, which means a larger explicit margin of safety is required to account for the uncertainties. As more parameters are included in the model, the uncertainty may be reduced and the explicit margin of safety required may be reduced or eliminated. Unfortunately, uncertainty in a model can never be completely removed, just like in reality. However, models can be developed with enough parameters to approximate a system and provide results that can help in the management of a system. Therefore a model must include enough parameters that can be meaningfully used in the management of a system.

Models require some parameter data to develop a modeling system. For TMDL calculation, the model parameters are used in mathematical equations that provide the instructions for how the pollutants and environmental processes interact with each other. The model is used to simulate reality as well as possible. How well a model simulates reality is assessed by comparing the output the model produces to actual measurements.

Actual measurements are used to calibrate the model, meaning setting up the model to have an output that closely approximates the actual measurements. Then another set of actual measurements is used to validate the model, meaning the results of the calibrated model are examined to see how well the calibrated model output compares to actual measurements. The more actual data available for model calibration and validation, the better a model can be used to predict and represent reality. So, a model can be developed and compared to available hydrologic and water quality data to calibrate and validate it for use in calculating the "existing" loading under critical conditions and a TMDL for a waterbody.

For the BB and SISP shoreline segments, modeling approaches were evaluated for calculating the bacteria loading from nonpoint and point sources, and simulating the effects on the receiving waterbody. As discussed in section 5, the bacteria loading from nonpoint and point sources to the BB and SISP shorelines can vary significantly depending on wet weather or dry weather conditions. Therefore, for the calculation of these TMDLs, a distinction is made between wet weather and dry weather periods, because bacteria density and implementation measures will vary between the two conditions. As a result, separate modeling approaches were used for calculating bacteria loads and TMDLs under each weather condition. The criteria considered for model selection, and the wet weather and dry weather models selected for TMDL calculations are discussed in the following sub-sections.

6.1 Model Selection Criteria

In selecting an appropriate modeling approach for TMDL calculation, technical and regulatory criteria were considered. Technical criteria include the physical system in question (watershed and receiving water characteristics and processes) and the pollutant or constituent of interest (bacteria). Regulatory criteria include water quality standards (beneficial uses and numeric WQOs). Based on these criteria, modeling approaches were identified for both wet weather and dry weather conditions to be used in the TMDL calculations for the BB and SISP shorelines. These criteria are discussed in detail below.

6.1.1 Technical Criteria

There are four main criteria considered when selecting a model for TMDL calculation: 1) physical domain, 2) source contributions, 3) critical conditions, and 4) model variables. Consideration of each criterion is critical in selecting the most appropriate modeling approach to address the types of sources and the numeric targets associated with the listed waters.

6.1.1.1 Physical Domain

Representation of the physical domain is perhaps the most important consideration in model selection. The physical domain is the focus of the modeling effort. The physical domain typically consists of either the receiving water itself or a combination of the contributing watershed and the receiving water. Selection of the appropriate physical domain for modeling depends on the constituents and the conditions under which the waterbody exhibits impairment.

In the environmental setting found in the San Diego Region, two physical domains have been recognized that require specific model requirements to address key physical and environmental conditions. As discussed above, sources of pollutant loading can vary significantly depending on wet weather or dry weather conditions. The physical domain and processes differ significantly between wet weather and dry weather conditions.

Under dry weather conditions, pollutant loads are typically generated by discharges from specific land uses with low-flow conditions. Under this setting, a steady-state approach is typically used, which assumes a constant or average flow and pollutant load. If a system also includes tidal influences, a quasi-steady-state approach may be used, which includes the variability in hydrodynamics due to tidal effects in addition to the steady-state point source inputs. The steady-state and quasi-steady-state modeling approaches primarily focus on receiving water processes during a user-specified condition.

Under wet weather conditions (storm events), most of the pollutant loads are generated by stormwater runoff discharges from all land uses that can vary over the course of a storm. Under this setting, a dynamic modeling approach is typically most appropriate. Dynamic models can consider time-variable pollutant contributions from a watershed surface and/or subsurface, as well as the hydrodynamic response of the receiving water. Some dynamic models consider monthly or seasonal variability, while others enable assessment of conditions immediately before, during, and after individual rainfall events. Dynamic models require a substantial amount of information regarding input parameters and data for calibration and validation processes.

6.1.1.2 Source Contributions

Primary pollutant sources must be considered in the model selection process. Representing contributions from nonpoint and point sources as accurately as possible is critical in properly representing the system and assigning LAs and WLAs.

6.1.1.3 Critical Conditions

The goal of a TMDL analysis is to determine the loading capacity, or assimilative capacity, of a waterbody and to identify potential allocation scenarios that will enable that waterbody to achieve water quality standards (numeric WQOs that support applicable beneficial uses). The TMDL must be conservative enough to be protective of water quality under the most critical conditions. In other words, a TMDL must be protective of the period of time and location in which the waterbody exhibits the most vulnerability.

For dry weather conditions, dry weather models typically are assumed to have a steady-state flow and pollutant load. Therefore, a dry weather model may not have a specific period of time in which a waterbody is most vulnerable. However, there may be a location where the pollutant loading may be expected to be the most concentrated, thus most vulnerable to violating water quality standards. Additionally, with tidally influenced systems, there may be a tidal period when a waterbody is most vulnerable.

For wet weather conditions, critical conditions are typically associated with extreme rainfall conditions, when the highest pollutant loads may be washed off of land surfaces to the receiving water and the receiving water is most vulnerable to violating water quality standards. Critical conditions under wet weather conditions will also have a location where the pollutant loading may be expected to be the most concentrated and most vulnerable to violating water quality standards. Therefore, for our modeling purposes, critical conditions include a critical period of time and a critical location when and where a modeled system is most vulnerable to violating the water quality standards.

6.1.1.4 Model Variables

Another important consideration in model selection and application are the model variables required to assess and simulate the fate and transport of pollutant(s) in the watershed and/or waterbody. Selection of the model state variables is a critical part of developing the model. A state variable is any variable which represents the state of an object or system. The more state variables included, the more complex the model becomes, and the more difficult the model will be to apply and calibrate. However, if key state variables are omitted from the model, the simulation might not include all the necessary aspects of the modeled system and might produce unrealistic results. A delicate balance must be met between minimal number of variables and maximum applicability of the model.

The focus of this TMDL analysis is on indicator bacteria. Receiving water bacteria dynamics can be extremely complex, and accurate estimation of bacteria densities relies on a host of interrelated environmental variables. Environmental variables that can affect the survival of bacteria include soil moisture content, pH, solar radiation, available nutrients, and salinity, among others. Bacteria densities in the water column are also influenced by die-off, regrowth, partitioning of bacteria between water and sediment during transport, as well as bacteria and sediment settling and resuspension of bottom materials.

First-order die-off is likely the most important dynamic to simulate in the watersheds and receiving waters. Salinity in the tidally influenced BB and SISP shoreline segments would also require simulation to represent the impact of salinity on bacterial die-off rates. The impact of temperature on bacterial die-off rates can also be considered. However, the limited available data provide few insights into which of the other environmental variables mentioned above might be most influential on bacterial behavior for the models. To account for these other environmental variables, certain assumptions were made for the model. A description of assumptions regarding these environmental variables is described in Appendix G.

6.1.2 Regulatory Criteria

The Basin Plan establishes, for all waters in the San Diego Region, the beneficial uses for each waterbody to be protected, the numeric WQOs that are considered protective of those beneficial uses, and an implementation plan that accomplishes those objectives. A properly designed and applied model provides the source-response linkage component of the TMDL calculation, and enables an accurate assessment of the assimilative capacity of a waterbody. The assimilative capacity, or TMDL, of a receiving water is based on the assumption that the numeric WQOs are met.

The selected modeling approach must enable direct comparison of model results to actual measurements of receiving water bacteria densities and allow for the analysis of the duration of those densities. For the watershed loading analysis and implementation of measures required to reduce pollutant loads, it is also important that the modeling approach enable examination of gross land use loading as well as urban runoff bacteria densities.

6.2 Receiving Water Modeling Approach

Based on the criteria discussed above, separate modeling systems were selected to simulate pollutant loading to the receiving waters during dry weather and wet weather conditions. Different watershed models were selected and developed to simulate the pollutant loads discharging from the watershed under wet weather and dry weather conditions to the receiving waters of the impaired shorelines. The watershed model outputs were used as inputs to a receiving water model.

For the receiving water model, the Environmental Fluid Dynamics Code (EFDC) model (Hamrick, 1992 and 1996) was selected for both wet weather and dry weather conditions to simulate the assimilative capacity of the receiving waters at the impaired shorelines of BB and SISP. The EFDC model can be used to conduct a dynamic or quasi-steady-state simulation of flushing and intrusion of waters high in salinity resulting from tidal hydrodynamics. The EFDC model can also include assumptions for influence of salinity and temperature on bacteria die-off rate formulations.

Sufficient water quality data were available for BB and SISP to perform model calibration and validation and analyses of loading conditions to the receiving waters. Appendix F provides more details regarding model formulations and assumptions.

For the present study, the EFDC models were used for estimation of the assimilative capacity of the shoreline segments evaluated and the resulting TMDLs based on numeric WQOs, simulation of the response of the receiving waters to varying external loading scenarios, and estimation of loads from sources not associated with watershed runoff. As more hydrology and/or water quality data are collected, the EFDC model formulations for each of the shoreline segments can be refined through additional model calibration and validation. In addition, further study regarding relative sources of bacteria from within the receiving waters (e.g., waterfowl) can be quantified and configured into the EFDC models for simulation of water quality, comparison to observed data, and refined calculation of load allocations and load reductions (discussed in section 7). The wet weather and dry weather watershed modeling approaches selected for simulating the pollutant loads in the receiving waters are discussed in more detail below.

6.2.1 Wet Weather Modeling Approach

During wet weather conditions, sources of bacteria are usually associated with wash-off of bacteria accumulated, or built up, on the land surface. Specifically, during rainy periods, or storm events, the bacteria are washed off the land surface and delivered to the waterbody through creeks and/or stormwater collection systems. Once the bacteria loads reach the receiving waters of the shoreline, tidal flushing and water conditions can influence the die-off rates of the bacteria loads and assimilative capacity of the receiving waters. Therefore, to assess the linkage between sources of bacteria and the effect on receiving waters at BB and SISP, a modeling approach was needed that could simulate the build-up and wash-off of bacteria from land surfaces, the hydrologic and hydraulic processes that affect delivery of the bacteria load to the waterbody, the assimilative capacity of the waterbody, and the effects of tidal flushing.

Understanding and modeling of these processes provided the necessary decision support for the calculated TMDLs and the allocation of the bacteria loads to the identified nonpoint and point sources. The wet weather modeling approach assumed the following:

- All sources can be represented through build-up/wash-off of bacteria from specific land use types.
- The discharge of sewage is zero. Sewage spill information was reserved for use during the calibration process to account for observed spikes in bacteria, as applicable; however, the calibration process did not necessitate removal of any wet weather data considered to be affected by sewage spill information. In other words, data from wet weather conditions used for calibration were not indicative of sewage spills.

- For numeric TMDL target assessment, the critical locations were assumed to be along the length of each shoreline segment.

The wet weather modeling approach selected for use in this project is based on the application of two separate models: 1) the USEPA's Loading Simulation Program in C++ (LSPC) model (USEPA, 2003a) to estimate bacteria loading in the watersheds that are delivered to the receiving waterbodies, and 2) the EFDC model (USEPA, 2003b), to simulate the assimilative capacity of the receiving waterbodies, as described in section 6.2. Both models are included in the USEPA's TMDL Modeling Toolbox recommended by the USEPA for use in development of TMDLs.

LSPC is a recoded C++ version of the USEPA's Hydrological Simulation Program–FORTRAN (HSPF) that relies on fundamental (and USEPA-endorsed) algorithms. Insufficient hydrology and water quality data were available for the BB and SISP watersheds to perform site-specific LSPC model calibration and validation. However, LSPC has been successfully applied and calibrated in multiple watersheds in the San Diego Region for Bacteria TMDL Project I (San Diego Water Board, 2007). These regionally calibrated modeling parameters were transferred and applied to the watersheds that deliver bacteria loads to the BB and SISP shoreline segments. For a complete discussion of the LSPC model configuration, validation, and application refer to Appendix F.

Wet weather watershed flows and bacteria levels based on the LSPC model output from the watersheds of the respective shoreline segments modeled were used as boundary conditions to the receiving waters of the impaired shoreline segments in the EFDC model. Assumptions for the wet weather modeling approach can be found in Appendix G.

6.2.2 Dry Weather Modeling Approach

Bacteria densities during dry weather conditions are extremely variable in nature. For modeling of dry weather watershed sources of bacteria for the shoreline segments of BB and SISP, the approach for Bacteria TMDLs Project I was used. This approach relied on detailed analysis of available data to better identify and characterize sources. Data collected from dry weather samples were used to develop empirical relationships that represent water quantity and water quality associated with dry weather runoff from various land uses. For each monitoring station, a watershed was delineated and the land use was related to flow and bacteria concentrations. A statistical relationship was established between flow, bacteria densities, and area of each land use. A complete discussion of the statistical analysis of data and development of the empirical framework for estimating watershed bacterial loads is provided in Appendix F.

To represent the linkage between source contributions and effect on receiving waters, steady-state mass balance models were developed to simulate transport of bacteria from the watershed to the streams and stormdrains flowing to the BB and SISP shorelines; and the EFDC model (USEPA, 2003b) was used to simulate the assimilative capacity of the receiving waterbodies, as described in section 6.2.

The steady-state mass balance models were used to represent the streams/stormdrains as a series of plug-flow reactors, with each reactor having a constant, steady-state flow and bacteria load. Bacteria concentrations in each segment were simulated based on regionally calibrated values for a first-order die-off rate and stream infiltration. A complete description of configuration and calibration of the transport modeling network is provided in Appendix F.

Dry weather receiving water models of BB and SISP were consistent with EFDC models developed for wet weather model analyses (section 6.2.1). Dry weather flows and bacteria levels based on the output from the steady-state mass balance models used for the watersheds of the respective shoreline segments modeled were used as boundary conditions to the EFDC model. Assumptions for the dry weather modeling approach can be found in Appendix G.

7 Identification of Load Allocations and Reductions

The models selected for wet and dry weather analysis provided the first step in developing the tools for a framework to assist in regulatory and management decisions for the BB and SISP shoreline segments and their respective watersheds. Estimated current existing loads were compared to the TMDLs. The comparison was used to identify controllable sources requiring load reductions. Methodologies for determining load reductions to the identified controllable nonpoint and point sources are described in the following sub-sections.

7.1 Wet Weather Loading Analysis

After calibrating and validating the LSPC and EFDC models with existing flow and water quality data, the models were used to calculate existing wet weather bacteria loading and TMDLs under critical conditions. The LSPC model was used to calculate existing bacteria loads for each watershed that delivers bacteria loads to the impaired shoreline segments of BB and SISP during critical wet weather conditions. The EFDC model was used to calculate the existing bacteria loads and TMDLs for the receiving waters under critical tidal conditions at a critical location. The difference between the existing wet weather bacteria loads and TMDLs for the impaired shoreline segments was used to determine the load reductions required. The wet weather loading analysis is discussed in the following sub-sections.

7.1.1 Identification of the Critical Wet Weather and Tidal Conditions

To ensure the receiving waters are protected during extremely wet periods of weather, a critical wet weather period associated with extreme wet conditions was selected for loading analysis and TMDL calculations. This extreme wet period, or critical wet weather condition, was selected by reviewing data from multiple rainfall gages in the San Diego Region over a recent 14-year period (1990 through 2004) (Appendix D, No.9).

The wettest year, 1993, was selected as the critical wet year for assessment of wet weather loading conditions. Statistically, 1993 is in the 92nd percentile of annual rainfalls observed from 1990 to 2004. This observation is consistent with studies performed by the Southern California Coastal Research Project (SCCWRP), where a 90th percentile year was selected based on rainfall data for the Los Angeles Airport (LAX) from 1947 to 2000, also resulting in selection of 1993 as the critical wet year (Los Angeles Water Board, 2002).

To assess the response of the receiving waters to variable critical watershed loads, a critical 30-day period of the critical wet year was selected for detailed assessment by the LSPC model to calculate bacteria loads delivered from the watersheds to the shoreline segments of BB and SISP. This shortened period facilitated detailed analyses of the hourly or diurnal conditions that impact the water quality, rather than a longer-term, daily evaluation of loads. January 7 through February 5 was identified as the

30-day critical wet weather period in 1993. During this 30-day critical wet weather period, five to ten of the top 1st percentile of flow magnitudes (daily averages) were observed in the flow data collected between January 1, 1990 and May 31, 2004, depending on location. Additionally, of these higher flows, all the bacteria levels within the top 10th percentile of magnitude were simulated by the LSPC model over that same period.

Besides bacteria loading from the watersheds calculated by the LSPC model during the 30-day critical wet weather period, assessment of the assimilative capacities of the receiving waters at the shoreline segments by the EFDC model was also highly dependent on tidal effects. The degree of variation between high and low tides impacts the amount of flushing that occurs along the shorelines. Lower tides are associated with reduced assimilative capacities, and higher tides, in turn, are associated with increased assimilative capacities. Because the variation of tide elevations are so important to the assimilative capacities of the shorelines, a period of tidal fluctuation dominated by lower tide elevations, which are associated with reduced assimilative capacities, was also considered in the assessment of critical conditions for wet weather TMDL development. Tidal elevation data were available for the period from 2001 to 2002. Within that period, March 7 to April 7, 2001 was identified as the 30-day period with the lowest tide elevation. Therefore, March 7 to April 7, 2001 was selected as the 30-day critical tidal period.

The 30-day critical wet weather period and the 30-day critical tidal period do not fall within the same time period. However, the rainfall and tidal elevation data from these two periods were used together in the wet weather model analysis to represent the most conservative potential critical condition for the wet weather loading conditions and TMDL calculations.

7.1.2 Critical Locations for Wet Weather Load Calculations

Bacteria loading during critical wet weather and tidal conditions is calculated at a critical location in the physical domain of the model. The critical location is the point or area in the waterbody that is most vulnerable to bacteria loading under the critical wet weather and tidal conditions. This critical location is selected based on high bacteria levels predicted at that location and considered to be a conservative assumption for the assessment of water quality conditions. If the water quality at the critical location is protective of beneficial uses under critical conditions, the water quality in the rest of the waterbody is expected to be protective of beneficial uses as well. Although water quality is predicted only at this critical location in the wet weather model, in reality, water quality must be assessed and maintained throughout a waterbody to support beneficial uses.

For the BB and SISP shoreline segments, the critical location is the entire length of each impaired shoreline segment. For the development of the wet weather model, receiving waters at these shoreline segments were represented in the model with multiple grid cells (see Appendix F). For each shoreline segment evaluated, a weighted average of bacteria density was calculated based on the respective length of shoreline of each model grid cell located adjacent to that shoreline. This resulted in a single representative bacteria density for each shoreline segment addressed in this TMDL. The representative bacteria density is calculated by the following equation:

$$\text{(Avg. Dens.} = \sum \text{[Length*Dens.]} / \sum \text{Length)}$$

Where:	Avg. Dens.	= weighted average bacteria density
	Length	= length of the shoreline segment
	Dens.	= bacteria density of each grid cell

7.1.3 Wet Weather Load Calculations

Calculations of bacteria loading from the watersheds to the receiving shoreline segments under wet weather conditions required the use of the LSPC model to predict watershed flows and bacteria densities. The dynamic model-simulated watershed processes, based on observed rainfall data as model input, provided temporally variable load estimates for the 30-day critical wet weather period. These bacteria loads from the watersheds were simulated using calibrated, land use-specific processes associated with hydrology and build-up and wash-off of bacteria from the land surface. Transport processes of bacteria loads from the watershed sources to the receiving waterbodies were also simulated in the LSPC model with a first-order loss rate based on values taken from literature sources (see Appendix F).

In addition to bacteria loads from the watershed sources delivered to the receiving waterbodies, additional sources within the receiving waters were quantified. Limited data were available for identification of non-urban runoff sources at the receiving waters and their relative load contributions. These non-urban runoff sources include waterfowl or other local sources within the receiving waters and at the shoreline, which will impact water quality during wet and dry weather conditions.

No available data were identified regarding waterfowl populations or other non-urban runoff sources at the BB and SISP shorelines to directly estimate associated bacteria loads. However, if the loads from these sources are assumed to be constant in both wet weather and dry weather conditions, allowable loads attributed to these sources may be inversely-derived, or back-calculated. The EFDC model of the receiving waters developed for the dry weather modeling analysis was used to back-calculate the allowable loads from these non-urban runoff sources, which is discussed in section 7.2.5, and Appendix F.

The total calculated loads to the receiving waters is the sum of the bacteria loads attributed to non-urban runoff sources back-calculated using the dry weather EFDC model and the bacteria loads attributed to the watershed that were calculated based on the LSPC model for the 30-day critical wet weather period.

7.1.4 Application of Wet Weather Numeric Targets

As discussed in section 3, the wet weather numeric targets are based on the single sample maximum WQOs which are given in the Basin Plan. For REC-1 beneficial uses, single sample maximum WQOs were established in the Basin Plan for TC, FC, and ENT. The wet weather numeric targets for the indicator bacteria evaluated for this project are provided in Table 3-1.

7.1.5 Calculation of Existing Wet Weather Bacteria Loads and TMDLs

For each LSPC-modeled watershed discharging to a shoreline segment of BB or SISP (watersheds and proximity to impaired shorelines are shown in Appendix J), wet weather watershed flows and bacteria loads were calculated for the 30-day critical wet weather period. Bacteria from non-urban runoff sources (e.g., waterfowl and other local sources) were back-calculated for the 30-day critical tidal period using the dry weather EFDC model (see section 7.2.5).

Hourly bacteria densities within critical locations of the wet weather model were simulated with the EFDC model over the combined 30-day critical wet weather and tidal period. Using the hourly EFDC model-predicted bacteria densities, daily arithmetic means for existing bacteria loads were calculated and compared to the wet weather numeric targets for each indicator bacteria at each shoreline segment evaluated. Graphical comparisons of the calculated daily arithmetic means for existing bacteria loads under critical conditions with the wet weather numeric target are shown in Appendix H.

As shown in Appendix H, there were some cases where the existing bacteria loads modeled using the combined 30-day critical wet weather and tidal period showed no exceedances of the wet weather numeric targets. For these cases, no load reductions are expected to be required from any allowable sources of bacteria to meet the REC-1 WQOs, and the existing bacteria load was set as the TMDL.

For the other cases, where the model shows that the wet weather numeric targets have been exceeded one or more days under critical conditions, the wet weather model was also used to calculate the loading capacity, or TMDL, of the receiving water. Because the bacteria loads from non-urban runoff sources (e.g., waterfowl and other local sources) back-calculated for the 30-day critical tidal period are assumed to be constant, only the bacteria loads from the watershed could be adjusted. The wet weather LSPC and EFDC models were used to determine the maximum bacteria density that can be discharged in the 30-day critical wet weather period runoff to the receiving water and not result in any exceedances of wet weather numeric targets at the critical locations. This bacteria density was then assigned to all the stormwater runoff flows in the watershed discharging to an impaired shoreline segment over the 30-day critical wet weather period. This analysis resulted in a bacteria load that was added to the bacteria loads from non-urban runoff sources to represent the TMDL of the receiving water. The loading capacities, or TMDLs, calculated for each modeled shoreline segment are graphically shown in Appendix H.

7.1.6 Allocation of Wet Weather TMDLs and Calculation of Load Reductions for WLAs

Because the bacteria loads from non-urban runoff sources (e.g., waterfowl and other local sources within the receiving waters) are assumed uncontrollable nonpoint sources and constant, only the bacteria loads from the watershed, which are assumed to be from controllable point sources, can be reduced. To determine load reductions to meet the TMDLs, analyses were performed for each indicator bacteria and shoreline segment based on the following steps:

1. Calculate the existing wet weather watershed bacteria load for each day of the 30-day critical wet weather period (represented as bars in loading curves in Appendix K);
2. Determine the daily loads attributed to non-urban runoff sources of bacteria (e.g., waterfowl and other local sources within the receiving water) based on dry weather EFDC modeling analyses (see sections 7.2.3 and 7.2.5) and set as load allocation (LA) for uncontrollable natural or background sources;
3. Calculate the wet weather TMDL – the loading capacities of the receiving waters for each day were calculated using the daily flows multiplied by maximum allowable watershed bacteria densities determined through modeling analyses described above (section 7.1.5), plus the daily bacteria load attributed to the non-urban runoff sources (from step 2);
4. Calculate wasteload allocation (WLA) for controllable point sources as the difference between the wet weather TMDL (from step 3) and the LA for uncontrollable natural or background sources (from step 2); and;
5. Calculate load reductions required to meet WLA for controllable point sources, represented by the portion of the bars above loading capacity curves in Appendix K (i.e., the difference between step 1 and step 4). Load reduction calculations are discussed in more detail in section 8.

7.1.7 Margin of Safety

There are two ways to incorporate the margin of safety, or MOS (USEPA, 1991): (1) implicitly incorporate the MOS using conservative model assumptions to develop allocations; and/or, (2) explicitly specify a portion of the total TMDL as the MOS and use the remainder for allocations. For the wet weather bacteria TMDL calculations, only an implicit MOS was incorporated.

Throughout the wet weather TMDL development process, conservative assumptions were employed. For example, the critical conditions included the combination of a critical wet weather period and a critical tidal period that resulted in a scenario that assumes maximum bacteria loading will occur when the assimilative capacity of the receiving waterbody is at its lowest. Also, the critical location for TMDL calculation was at the shallow shoreline within the model's physical domain where volumes are lower and the resulting assimilative capacities are therefore reduced. Additional conservative assumptions are listed in Appendix G.

Based on the incorporation of all these conservative assumptions, no explicit MOS was necessary.

7.1.8 Seasonality

Seasonal analyses of bacteria levels in the receiving waters at the BB and SISP shorelines were specific to wet and dry seasons, when loadings to the receiving waters can vary considerably. For the wet season, a 30-day critical wet weather period was selected and assessed to determine conditions that can occur for high watershed flows during rainfall events. This 30-day critical wet weather period can occur during any month throughout the wet season (mid-October to early April).

For estimating bacteria loads during dry weather conditions, a separate dry weather modeling approach was used (see section 7.2).

7.2 Dry Weather Loading Analysis

After calibrating and validating the dry weather steady-state watershed model and EFDC receiving water model with existing flow and water quality data, the models were used to calculate existing dry weather bacteria loading and TMDLs under critical conditions. A steady-state model (see Appendix F) was used to calculate existing dry weather bacteria loads for each watershed that delivers bacteria loads to the impaired shoreline segments of BB and SISP during dry weather conditions. As with the wet weather loading analysis, the EFDC model (see Appendix F) was used to calculate the existing bacteria loads and TMDLs for the receiving waters under critical tidal conditions at a critical location. The difference between the existing dry weather bacteria loads and TMDLs for the impaired shoreline segments was used to determine the load reductions required. The dry weather loading analysis is discussed in the following sub-sections.

7.2.1 Identification of the Critical Dry Weather and Tidal Conditions

Because the dry weather watershed model assumes steady-state conditions for bacteria loading to the receiving waterbody, there is no critical dry weather period. However, as with the wet weather modeling approach, assessment of the assimilative capacities of the shoreline segments by the EFDC model was highly dependent on tidal effects (see section 7.1.1). The same 30-day critical tidal period, March 7 to April 7, 2001, was identified. This critical tidal period was used as the 30-day critical tidal period in the dry weather model analysis.

7.2.2 Critical Locations for Dry Weather Load Calculations

As was the case with the wet weather load calculations (see section 7.1.2), the critical location selected is the entire length of each impaired shoreline segment of BB and SISP. For the development of the dry weather model, receiving waters at these shoreline segments were represented in the model with multiple grid cells (see Appendix F). For each shoreline segment evaluated, a weighted average of bacteria density was calculated as in the wet weather analysis based on respective length of shoreline (Avg. Dens. = ∑ [Length*Dens.] / ∑ Length) of each model grid cell located adjacent to that shoreline. This resulted in a single representative bacteria density for each shoreline segment addressed in this TMDL.

7.2.3 Dry Weather Load Calculations

Calculation of bacteria loading from the watershed to the receiving shoreline segments under dry weather conditions was based on empirical relationships established between both flow and bacteria densities and land use distribution in the watershed. Transport of bacteria loads was simulated using standard plug-flow equations to describe steady-state losses resulting from first-order die-off and stream infiltration (Appendix F). Steady-state estimates of bacteria loads were assumed constant for all dry weather days. Assumptions incorporated in the dry weather loading analysis are described in Appendix G.

In addition to bacteria loads from the watershed sources delivered to the receiving waterbodies, additional sources within the receiving waters needed to be quantified. As discussed in section 7.1.2, no available data were identified regarding waterfowl populations or other non-urban runoff sources at the BB and SISP shorelines to directly estimate associated bacteria loads. However, if the loads from these sources are assumed to be constant in both wet weather and dry weather conditions, allowable loads attributed to these sources may be inversely-derived, or back-calculated.

BB and SISP had sufficient bacteria water quality data collected from the receiving waters for EFDC models to be set up using bacteria loads from the dry weather steady-state watershed model as the only load input to the receiving waterbodies. The EFDC modeling analyses of those receiving waters determined that loads predicted from the dry weather steady-state watershed models were generally too low to result in the observed bacteria levels in the receiving waters without additional non-urban runoff source loads considered.

This discrepancy could be due to the under-prediction of bacteria loading from dry weather urban runoff, or additional non-urban runoff sources at the shoreline, such as waterfowl or other sources within the receiving water. Further analyses using the EFDC models were performed to calculate loads from non-urban runoff sources of bacteria that could have theoretically resulted in the water quality observed in the receiving waters. These analyses determined that such additional non-urban runoff sources varied considerably over time, and this variation could not be predicted with accuracy for other periods when data were not available. A complete discussion of these modeling analyses is provided in Appendix F.

The above analyses were used to try and verify and predict the additional loading from non-urban runoff sources that was not accounted for in the steady-state model-predicted dry weather urban runoff from the watershed. However, the observed data varied significantly, both temporally and spatially, and the model could not predict the additional loading from non-urban runoff sources with any accuracy. Thus, these estimates were not used directly in TMDL analyses.

Instead, the dry weather EFDC model was used to back-calculate the allowable loads of dry weather non-urban runoff sources that can be assimilated by the receiving waters and still meet dry weather numeric targets. A full discussion of this back-calculation is provided in section 7.2.5.

7.2.4 Application of Dry Weather Numeric Targets

As discussed in section 3, the dry weather numeric targets are based on the 30-day geometric mean as well as the single sample maximum WQOs established in the Basin Plan. The application of both the 30-day geometric mean and single sample maximum WQOs is due to the fact that tidal effects for some shorelines have been observed to result in extreme diurnal variations in bacteria densities that can range by orders of magnitude. So, even if the shoreline bacteria densities are in compliance with the 30-day geometric mean, in some cases the daily arithmetic mean predicted in a model could exceed the single sample maximum WQO. Therefore, the single sample maximum WQOs were also used to set maximum daily bacteria densities allowed under dry weather conditions.

For comparison to the 30-day geometric mean WQOs, the hourly EFDC model-predicted bacteria densities occurring within critical locations (see section 7.2.2) for all days during the 30-day critical period were used to calculate a geometric mean. Including all the hourly EFDC model-predicted bacteria densities in the calculation of the 30-day geometric mean for each shoreline segment allowed consideration of diurnal variations in water quality resulting from tidal fluctuations. For comparison to the single sample maximum WQOs, the hourly EFDC model-predicted bacteria densities occurring within critical locations were used to calculate daily arithmetic averages for each day in the 30-day critical tidal period. Use of the 30-day geometric mean and single sample maximum WQOs in calculating dry weather TMDLs is discussed further is section 7.2.5.

For REC-1 beneficial uses, 30-day geometric mean and single sample maximum WQOs have been established in the Basin Plan for TC, FC, and ENT. The dry weather numeric targets for the indicator bacteria evaluated for this project are provided in Table 3-2.

7.2.5 Calculation of Existing Dry Weather Bacteria Loads and TMDLs

As discussed in section 7.2.3, due to lack of available data, sources of bacteria during dry periods are difficult to quantify and require further study for complete identification. Modeling analyses that were performed and compared to available water quality data indicated that the bacteria loads predicted by the dry weather steady-state watershed model were generally too low to result in the observed bacteria levels in the receiving waters without additional bacteria source loads considered. These additional sources may include localized inputs such as waterfowl or other sources within the receiving waters, or could result from under-prediction of the watershed model on specific days when loadings are high (dry weather model-predicted loads are steady-state, and assumed constant for each day). Further study is recommended to identify and quantify these other sources that may be contributing to bacteria loads to the receiving waters. In the meantime, steady-state dry weather watershed flows and bacteria densities were used to calculate bacteria loading from the watershed, which are assumed to be from controllable point sources. Bacteria from non-urban runoff sources (e.g., waterfowl and other local sources within the receiving water) were lumped into a single load and assumed to be from natural and background uncontrollable nonpoint sources.

Because bacteria loads predicted by the watershed runoff models were generally too low to result in the observed bacteria levels in the receiving waters without bacteria loads from other sources present, and no information is currently available for quantification of existing loads attributed to non-urban runoff sources (e.g., waterfowl and other local sources), another approach was taken to account for loading from non-urban runoff sources. The receiving waters were modeled using the EFDC model to back-calculate the allowable loading from the nonpoint sources that would still meet the assimilative capacities of those waterbodies, while accounting for the allowable loading calculated using the dry weather steady-state watershed model.

The dry weather steady-state watershed model was used to calculate the allowable loading from dry weather urban runoff by calculating the dry weather flow and multiplying it by the dry weather 30-day geometric mean numeric targets. This allowable bacteria load from the watershed was used as a boundary condition in the receiving water (EFDC) model. Nonpoint, non-urban runoff sources of bacteria that may be attributed to waterfowl or other unidentified sources were added to the allowable load calculated from the dry weather steady-state watershed model. These loads were modeled on an hourly basis during the 30-day critical tidal period by the EFDC model. The hourly model-predicted bacteria densities allowed the consideration of diurnal variations in water quality resulting from tidal fluctuations, which may vary by orders of magnitude.

The hourly EFDC model-predicted bacteria densities were used to calculate a geometric mean bacteria density for the 30-day critical tidal period. Additionally, the hourly EFDC model-predicted bacteria densities were used to calculate daily arithmetic averages for each day of the 30-day critical tidal period. The 30-day critical tidal period geometric mean was compared to the 30-day geometric mean numeric target. The daily arithmetic averages were compared to the single sample maximum numeric target.

Bacteria loads attributed to non-urban runoff sources (e.g., waterfowl or other unidentified sources) were increased until either the 30-day critical tidal period geometric mean was equal to the 30-day geometric mean numeric target, or one or more daily arithmetic means was equal to the single sample maximum numeric target. This was considered the allowable load attributed to non-urban runoff sources that could still meet the assimilative capacity of the receiving water, while accounting for the allowable loads from urban runoff sources.

Results of these analyses are shown in Appendix L for the dry weather 30-day critical tidal period evaluated. Results show the hourly EFDC model-predicted bacteria densities and the calculated daily arithmetic means compared to dry weather numeric targets. The 30-day critical tidal period geometric means are not shown in Appendix L, but are less than or equal to the 30-day geometric mean numeric targets. For each shoreline segment evaluated, the EFDC model-predicted TC, FC and ENT bacteria densities were compared to REC-1 WQOs for development of TMDLs.

7.2.6 Allocation of Dry Weather TMDLs and Calculation of Load Reductions for WLAs

Because the bacteria loads from non-urban runoff sources (e.g., waterfowl and other local sources) are assumed uncontrollable nonpoint sources and constant, only the bacteria loads from the watershed, which are assumed to be from controllable point sources, can be reduced. To determine load reductions to meet the TMDLs, analyses were performed for each indicator bacteria and shoreline segment based on the following steps:

1. Calculate the existing dry weather watershed bacteria load using the steady-state modeled daily flow multiplied by the average observed bacteria densities;
2. Determine the daily loads attributed to non-urban runoff sources of bacteria (e.g., waterfowl and other local sources) based on dry weather EFDC modeling analyses (see sections 7.2.3 and 7.2.5) and set as LA for uncontrollable natural or background sources;
3. Calculate the dry weather TMDL – the daily loading capacities of the receiving waters were calculated using the steady-state modeled daily flow from the watersheds multiplied by the dry weather 30-day geometric mean numeric targets (section 7.2.5), plus the daily bacteria load attributed to the non-urban runoff sources (from step 2);
4. Calculate WLA for controllable point sources as the difference between the dry weather TMDL (from step 3) and the LA for uncontrollable natural or background sources (from step 2); and;
5. Calculate load reductions required to meet WLA for controllable point sources (i.e., the difference between step 1 and step 4). Load reduction calculations are discussed in more detail in section 8.

7.2.7 Margin of Safety

As was the case for the wet weather bacteria TMDL calculations, an implicit MOS was incorporated through application of conservative assumptions throughout the dry weather TMDL development. An important conservative assumption was the application of both the 30-day geometric mean and single sample maximum WQOs as numeric targets in the TMDL calculations. Compliance with both numeric targets for the 30-day critical tidal period ensured that diurnal variations of bacteria levels resulting from tidal fluctuations, and resulting impacts on receiving water assimilative capacities, would not result in potential detrimental effects to designated beneficial uses. Additional conservative assumptions are listed in Appendix G.

Based on the incorporation of all these conservative assumptions, no explicit MOS was necessary.

7.2.8 Seasonality

Seasonal analyses of bacteria levels in the receiving waters at the BB and SISP shorelines were specific to wet and dry seasons, when loadings to the receiving waters can vary considerably. The dry weather modeling approach only included non-precipitation-based urban runoff from the watershed, because wet weather storm events are not expected during the dry season. Instead, the urban runoff modeled in the dry weather modeling approach was assumed to be steady-state. The steady-state aspect of the dry weather watershed model resulted in estimation of a constant load from each watershed to the receiving water model.

For estimating bacteria loads during wet weather conditions, a separate wet weather modeling approach was used (see section 7.1).

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8 Total Maximum Daily Loads and Allocations

The TMDL for a given pollutant within a waterbody is the total amount of the pollutant that can be assimilated by the receiving water while still achieving the WQOs for the designated beneficial uses. TMDLs can be expressed on a mass loading basis (e.g., number of bacteria colony forming units per year) or as a concentration in accordance with Code of Federal Regulations Title 40 section 130.2(i). Once calculated, the TMDL is equal to the sum of individual WLAs (for point sources) and LAs (for nonpoint and natural sources). In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving water. Conceptually, the definition of a TMDL is represented by the following equation:

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

When developing a TMDL, allowable loadings from pollutant sources must be established that do not cumulatively amount to more than the TMDL. This provides the basis for establishing and recommending water quality-based controls. Based on the source analysis in section 5 and the implicit MOS (i.e., MOS = 0), the TMDL equation is as follows:

$$TMDL = WLA_{WWTP} + WLA_{Boats} + WLA_{Municipal\ MS4} + LA_{Homeless} + LA_{Natural/Background}$$

TMDLs, WLAs, and LAs were developed separately for wet and dry weather conditions. These loads and allocations were reported differently to address the weather conditions used for their determination, as well as to provide guidance for implementation since the numeric targets selected differ between the two weather conditions.

8.1 Wasteload Allocations

Federal regulations[5] require TMDLs to include an individual WLA for each point source identified. The point sources identified to potentially affect the waterbodies addressed in this study were discharges from MS4s and illegal discharges from boats and/or wastewater collection systems and treatment plants, although other point sources may exist. Because the Basin Plan includes waste discharge prohibitions specifically for the discharge of treated or untreated sewage from vessels to Dana Point Harbor and San Diego Bay and the unauthroized discharge of treated or untreated sewage to waters of the state, illegal discharges from boats and wastewater collection systems and treatment plants were assigned WLAs of zero (i.e., $WLA_{WWTP} = 0$ and $WLA_{Boats} = 0$). Assignment of a zero WLA is the most stringent allocation possible and the only allocation that can be assigned to an illegal discharge in the context of a TMDL. Other point sources that may exist and were not identified were also assigned WLAs of zero. Discharges from MS4s were modeled and represented with the wet weather LSPC and

[5] Code of Federal Regulations Title 40 section 130.7

dry weather steady-state watershed models. The watershed and receiving water models were used to calculate and assign the WLAs for discharges from the MS4s.

The USEPA's stormwater regulations require municipalities to obtain permits, or discharge requirements, for all stormwater discharges from MS4s.[6] The discharge requirements that regulate the existing MS4 apply to the watersheds identified as likely to contribute pollutant loads to the shoreline segments addressed in this study.

8.2 Load Allocations

For each nonpoint source identified, an LA is assigned. The only nonpoint sources identified to potentially affect the waterbodies addressed in this study were natural sources (e.g., waterfowl, terrestrial and aquatic animals, wrack line and aquatic plants, sediments), homeless encampments, or other background sources (e.g., "ambient" bacteria that may be a result of illegal discharges from boats). Because the homeless encampments are illegal, discharges from homeless encampments were assigned LAs of zero (i.e., $LA_{Homeless} = 0$). Due to lack of data, bacteria loads from natural sources or other background sources could not be specifically identified or quantified for TMDL development. Until more information is obtained through further study to provide identification of the relative loading from each of these potential sources, they were combined into a single LA for each shoreline segment (see section 7.2.5).

Because the loads from non-urban runoff sources (e.g., waterfowl and other unidentified sources) are attributed to uncontrollable sources, no reduction is required to meet the LA at this time. However, if more information is collected in future studies on non-urban runoff sources that indicate a higher loading can be attributed to these sources, load reductions to meet the LA can be recommended, if controllable.

No nonpoint sources were identified within the watersheds contributing to the receiving waters. Until better information is available that describes the spatial coverage of MS4s in the watersheds, no distinction can be made regarding those areas of the watersheds that are drained by the MS4s. If this information becomes available for the watersheds, the WLA assigned to MS4s can be redistributed to nonpoint source runoff, and LAs can be established for those nonpoint sources. Such nonpoint source runoff includes runoff attributed to natural areas not included within coverage of an MS4. The implementation strategy provides sufficient time for collection of information that better distinguishes areas covered by MS4s so that TMDL allocations can potentially be reassigned from WLAs to LAs for nonpoint source runoff from those natural areas.

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[6]In California, to avoid the issuance by the USEPA of separate and duplicative NPDES permits for discharges in California subject to the Clean Water Act, the State's WDRs (Water Code Chapter 5.5) for such discharges implement the NPDES regulations and entail enforcement provisions that reflect the penalties imposed by the Clean Water Act for violation of NPDES permits issued by the USEPA. These State WDRs that implement NPDES regulations serve in lieu of federal NPDES permits.

8.3 Wet Weather Results

TMDLs, LAs, and WLAs for wet weather were developed based on multiple wet days occurring within a 30-day critical wet weather period and compliance to single sample maximum REC-1 WQOs. Thus, the TMDLs, LAs, and WLAs are given in units of billion MPN per 30 days (Billion MPN/30 days). The loading analyses outlined in Appendix K evaluated these wet days to determine the critical loads resulting from the 30-day critical wet weather period.

As discussed in section 8.2, homeless encampments were assigned a LA of zero, and natural or background sources of bacteria were lumped into one LA. The LA for natural or background sources was based on the loads that were back-calculated for non-urban runoff sources by the dry weather load analysis (see section 7.2.5 and Tables 8-4 through 8-6). The remaining portion of the TMDL is allocated to point sources as WLAs. The portion of the TMDL that can be allocated to point sources as WLAs was calculated as the difference between the TMDL and LA for natural sources (i.e., $WLA_{Point\ Sources} = TMDL - LA_{Natural/Background}$).

As discussed in section 8.1 illegal discharges from boats and wastewater collection systems and treatment plants in the receiving water were assigned WLAs of zero. The only known point source identified by the source analysis in section 5 that can be assigned a WLA was urban runoff from MS4s. The principal MS4s contributing bacteria to receiving waters are owned or operated by the municipalities located within the watersheds. Therefore, only the municipal MS4s are assigned wet weather WLAs (i.e., $WLA_{Municipal\ MS4} = TMDL - LA_{Natural/Background}$).

“Existing” wasteloads for point sources and loads for nonpoint sources were calculated with the watershed and receiving water models under the critical conditions discussed in section 7.1. The existing loads calculated for natural and background sources were considered uncontrollable and were therefore assigned as the LA with zero reduction required. Because discharges by homeless persons, boats, and wastewater collection systems and treatment plants are illegal and prohibited, they were not calculated with the watershed and receiving water models and assumed to be zero and assigned LAs/WLAs of zero. Assignment of a zero LA/WLA is the most stringent allocation possible and the only allocation that can be assigned to an illegal discharge in the context of a TMDL. Therefore, if these discharges are occurring, they require 100 percent reduction.

Finally, existing wasteloads from the MS4s were calculated with the watershed model and the allowable wasteload, or MS4 WLA, was calculated at the shoreline with the receiving water model. If the existing municipal MS4 wasteload from the watershed calculated under the critical conditions was less than the WLA calculated for the municipal MS4, the existing municipal MS4 wasteload was set equal to the municipal MS4 WLA. If the existing municipal MS4 wasteload from the watershed calculated under the critical conditions was greater than the WLA calculated for the municipal MS4, a wasteload reduction (i.e., Existing Municipal MS4 Wasteload – Municipal MS4 WLA) and reduction percentage (i.e., [Existing Municipal MS4 Wasteload – Municipal MS4 WLA] ÷ [Existing Municipal MS4 Wasteload] x 100 percent) were calculated.

TMDLs were developed for the REC-1 beneficial use designation and associated WQOs. According to the Basin Plan, WQOs for TC, FC, and ENT indicator bacteria apply to the REC-1 beneficial use. Appendix K provides a graphical representation of the load reductions required to meet the TMDLs for REC-1 beneficial use for TC, FC, and ENT indicator bacteria. The wet weather TMDLs, WLAs, and LAs for TC, FC, and ENT are listed in Tables 8-1, 8-2, and 8-3, respectively.

Because the models used to calculate the TMDLs, WLAs, LAs, and existing wasteloads and loads were based on critical conditions (i.e., worst case loading scenario), the numbers in Table 8-1, 8-2, and 8-3 only represent conservative estimates and assume illegal discharges are not occurring. While the information in the tables does not provide absolute numeric values that must be met, it does provide a tool for identifying bacteria sources that may need to be controlled.

In some situations, the models predict that existing bacteria loads under critical conditions will not exceed the TMDL. This means that the bacteria loads from the MS4 in addition to the natural and background loads in the receiving water should not cause an exceedance in REC-1 WQOs and may not need to be controlled. However, if there is an exceedance, the cause may be due to an illegal discharge or some other unknown source that may need to be controlled.

However, in situations where a wasteload reduction is calculated for the MS4, this indicates that discharges from the MS4 are a likely source that is causing, or at least significantly contributing, to exceedances in REC-1 WQOs. This means that bacteria loads originating from the MS4 need to be controlled.

Table 8-1. REC-1 Wet Weather TMDLs for Total Coliform for BB and SISP Shoreline Segments

Waterbody	Shoreline Segment/Area	Hydrologic Descriptor	Model Sub-watershed	TMDL (Billion MPN/ 30 days)	Load Allocations (LAs) Natural/Background (Billion MPN/ 30 days)[1]	Wasteload Allocations (WLAs) Municipal MS4 (Billion MPN/ 30 days)	Existing Wasteloads Municipal MS4 (Billion MPN/ 30 days)	Percent Reduction of Municipal MS4 Existing Wasteload[2]
Dana Point Harbor	Baby Beach	Dana Point HSA (901.14)	2101,2102 2103,2104	166,111	162,857	3,254	3,254	0%
San Diego Bay	Shelter Island Shoreline Park	Point Loma HA (908.10)	2201	482,598	482,400	198	198	0%

Abbreviations/Acronyms:
TMDL: total maximum daily load
LA: load allocation for nonpoint source
WLA: wasteload allocation for point source
MS4: Municipal Separate Storm Sewer System
MPN: most probable number

Notes:
[1] Calculated by dry weather EFDC model analysis (Dry weather LA from Table 8-4 multiplied by 30 days). No reduction required for natural/background sources.
[2] Percent Reduction of Existing Municipal MS4 Wasteload = (Existing Municipal MS4 Wasteload – Municipal MS4 WLA) ÷ (Existing Municipal MS4 Wasteload) x 100%

Table 8-2. REC-1 Wet Weather TMDLs for Fecal Coliform for BB and SISP Shoreline Segments

Waterbody	Shoreline Segment/Area	Hydrologic Descriptor	Model Sub-watershed	TMDL (Billion MPN/ 30 days)	Load Allocations (LAs) Natural/Background (Billion MPN/ 30 days)[1]	Wasteload Allocations (WLAs) Municipal MS4 (Billion MPN/ 30 days)	Existing Wasteloads Municipal MS4 (Billion MPN/ 30 days)	Percent Reduction of Municipal MS4 Existing Wasteload[2]
Dana Point Harbor	Baby Beach	Dana Point HSA (901.14)	2101,2102 2103,2104	32,585	32,473	112	112	0%
San Diego Bay	Shelter Island Shoreline Park	Point Loma HA (908.10)	2201	41,408	41,400	8	8	0%

Abbreviations/Acronyms:
TMDL: total maximum daily load
LA: load allocation for nonpoint source
WLA: wasteload allocation for point source
MS4: Municipal Separate Storm Sewer System
MPN: most probable number

Notes:
[1] Calculated by dry weather EFDC model analysis (Dry weather LA from Table 8-5 multiplied by 30 days). No reduction required for natural/background sources.
[2] Percent Reduction of Existing Municipal MS4 Wasteload = (Existing Municipal MS4 Wasteload – Municipal MS4 WLA) ÷ (Existing Municipal MS4 Wasteload) x 100%

Table 8-3. REC-1 Wet Weather TMDLs for *Enterococcus* for BB and SISP Shoreline Segments

Waterbody	Shoreline Segment/Area	Hydrologic Descriptor	Model Sub-watershed	TMDL (Billion MPN/ 30 days)	Load Allocations (LAs) Natural/Background (Billion MPN/ 30 days)[1]	Wasteload Allocations (WLAs) Municipal MS4 (Billion MPN/ 30 days)	Existing Wasteloads Municipal MS4 (Billion MPN/ 30 days)	Percent Reduction of Municipal MS4 Existing Wasteload[2]
Dana Point Harbor	Baby Beach	Dana Point HSA (901.14)	2101,2102 2103,2104	5,730	5,616	114	301	62.2%
San Diego Bay	Shelter Island Shoreline Park	Point Loma HA (908.10)	2201	10,556	10,530	26	26	0%

Abbreviations/Acronyms:
TMDL: total maximum daily load
LA: load allocation for nonpoint source
WLA: wasteload allocation for point source
MS4: Municipal Separate Storm Sewer System
MPN: most probable number

Notes:
[1] Calculated by dry weather EFDC model analysis (Dry weather LA from Table 8-6 multiplied by 30 days). No reduction required for natural/background sources.
[2] Percent Reduction of Existing Municipal MS4 Wasteload = (Existing Municipal MS4 Wasteload – Municipal MS4 WLA) ÷ (Existing Municipal MS4 Wasteload) x 100%

8.4 Dry Weather Results

TMDLs, LAs, and WLAs for dry weather were calculated based on quasi-steady-state conditions and compliance with both the 30-day geometric mean and single sample maximum WQOs. Because the dry weather watershed modeling approach is based on average daily flows and loads, the TMDLs, LAs, and WLAs are given in units of billion MPN per day (Billion MPN/day).

As discussed in section 8.2, homeless encampments were assigned a LA of zero, and natural or background sources of bacteria were lumped into one LA. The LA for natural or background sources was based on the loads that were back-calculated for non-urban runoff sources by the dry weather load analysis (see section 7.2.5). The remaining portion of the TMDL is allocated to point sources as WLAs. The portion of the TMDL that can be allocated to point sources as WLAs was calculated as the difference between the TMDL and LA for natural or background sources (e.g., $WLA_{Point\ Sources} = TMDL - LA_{Natural/Background}$).

As discussed in section 8.1 illegal discharges from boats and wastewater collection systems and treatment plants in the receiving water were assigned WLAs of zero. The only known point source identified by the source analysis in section 5 that can be assigned a WLA was urban runoff from MS4s. The principal MS4s contributing bacteria to receiving waters are owned or operated by the municipalities located within the watersheds. Therefore, only the municipal MS4s are assigned dry weather WLAs (i.e., $WLA_{Municipal\ MS4} = TMDL - LA_{Natural/Background}$).

“Existing” wasteloads for point sources and loads for nonpoint sources were calculated with the watershed and receiving water models under the critical conditions discussed in section 7.2. The existing loads calculated for natural and background sources were considered uncontrollable and were therefore assigned as the LA with zero reduction required. Because discharges by homeless persons, boats, and wastewater collection systems and treatment plants are illegal and prohibited, they were not calculated with the watershed and receiving water models and assumed to be zero and assigned LAs/WLAs of zero. Assignment of a zero LA/WLA is the most stringent allocation possible and the only allocation that can be assigned to an illegal discharge in the context of a TMDL. Therefore, if these discharges are occurring, they require 100 percent reduction.

Finally, existing wasteloads from the MS4s were calculated with the watershed model and the allowable wasteload, or MS4 WLA, was calculated at the shoreline with the receiving water model. If the existing municipal MS4 wasteload from the watershed calculated under the critical conditions was less than the WLA calculated for the municipal MS4, the existing municipal MS4 wasteload was set equal to the municipal MS4 WLA. If the existing municipal MS4 wasteload from the watershed calculated under the critical conditions was greater than the WLA calculated for the municipal MS4, a wasteload reduction (i.e., Existing Municipal MS4 Wasteload – Municipal MS4 WLA) and reduction percentage (i.e., [Existing Municipal MS4 Wasteload – Municipal MS4 WLA] ÷ [Existing Municipal MS4 Wasteload] x 100 percent) were calculated.

TMDLs were developed for the REC-1 beneficial use designation and associated WQOs. According to the Basin Plan, WQOs for TC, FC, and ENT indicator bacteria apply to the REC-1 beneficial use. The dry weather TMDLs, WLAs, and LAs for TC, FC, and ENT are listed in Tables 8-4, 8-5, and 8-6, respectively.

Because the models used to calculate the TMDLs, WLAs, LAs, and existing wasteloads and loads were based on critical conditions (i.e., worst case loading scenario), the numbers in Table 8-4, 8-5, and 8-6 only represent conservative estimates and assume illegal discharges are not occurring. While the information in the tables does not provide absolute numeric values that must be met, it does provide a tool for identifying bacteria sources that may need to be controlled.

In some situations, the models predict that existing wasteloads and loads will not exceed the TMDL. This means that the bacteria loads from the MS4 in addition to the natural and background loads in the receiving water should not cause an exceedance in REC-1 WQOs and may not need to be controlled. However, if there is an exceedance, the cause may be due to an illegal discharge or some other unknown source that may need to be controlled.

However, in situations where a wasteload reduction is calculated for the MS4, this indicates that discharges from the MS4 are a likely source that is causing, or at least significantly contributing, to exceedances in REC-1 WQOs. This means that bacteria loads originating from the MS4 need to be controlled.

Table 8-4. REC-1 Dry Weather TMDLs for Total Coliform for BB and SISP Shoreline Segments

Waterbody	Shoreline Segment/Area	Hydrologic Descriptor	Model Sub-watershed	TMDL (Billion MPN/ day)	Load Allocations (LAs) Natural/Background (Billion MPN/ day)[1]	Wasteload Allocations (WLAs) Municipal MS4 (Billion MPN/ day)	Existing Wasteloads Municipal MS4 (Billion MPN/ day)	Percent Reduction of Municipal MS4 Existing Wasteload[2]
Dana Point Harbor	Baby Beach	Dana Point HSA (901.14)	2101,2102 2103,2104	5,430	5,429	0.86	9.0	90.4%
San Diego Bay	Shelter Island Shoreline Park	Point Loma HA (908.10)	2201	16,080	16,080	0	0	0%

Abbreviations/Acronyms:
TMDL: total maximum daily load
LA: load allocation for nonpoint source
WLA: wasteload allocation for point source
MS4: Municipal Separate Storm Sewer System
MPN: most probable number

Notes:
[1] Calculated by dry weather EFDC model analysis. No reduction required for natural/background sources.
[2] Percent Reduction of Existing Municipal MS4 Wasteload = (Existing Municipal MS4 Wasteload – Municipal MS4 WLA) ÷ (Existing Municipal MS4 Wasteload) x 100%

Table 8-5. REC-1 Dry Weather TMDLs for Fecal Coliform for BB and SISP Shoreline Segments

Waterbody	Shoreline Segment/Area	Hydrologic Descriptor	Model Sub-watershed	TMDL (Billion MPN/ day)	Load Allocations (LAs) Natural/Background (Billion MPN/ day)[1]	Wasteload Allocations (WLAs) Municipal MS4 (Billion MPN/ day)	Existing Wasteloads Municipal MS4 (Billion MPN/ day)	Percent Reduction of Municipal MS4 Existing Wasteload[2]
Dana Point Harbor	Baby Beach	Dana Point HSA (901.14)	2101,2102 2103,2104	1,083	1,082	0.17	1.0	82.7%
San Diego Bay	Shelter Island Shoreline Park	Point Loma HA (908.10)	2201	1,380	1,380	0	0	0%

Abbreviations/Acronyms:
TMDL: total maximum daily load
LA: load allocation for nonpoint source
WLA: wasteload allocation for point source
MS4: Municipal Separate Storm Sewer System
MPN: most probable number

Notes:
[1] Calculated by dry weather EFDC model analysis. No reduction required for natural/background sources.
[2] Percent Reduction of Existing Municipal MS4 Wasteload = (Existing Municipal MS4 Wasteload – Municipal MS4 WLA) ÷ (Existing Municipal MS4 Wasteload) x 100%

Table 8-6. REC-1 Dry Weather TMDLs for *Enterococcus* for BB and SISP Shoreline Segments

Waterbody	Shoreline Segment/Area	Hydrologic Descriptor	Model Sub-watershed	TMDL (Billion MPN/ day)	Load Allocations (LAs) Natural/Background (Billion MPN/ day)[1]	Wasteload Allocations (WLAs) Municipal MS4 (Billion MPN/ day)	Existing Wasteloads Municipal MS4 (Billion MPN/ day)	Percent Reduction of Municipal MS4 Existing Wasteload[2]
Dana Point Harbor	Baby Beach	Dana Point HSA (901.14)	2101,2102 2103,2104	187	187	0.03	0.8	96.2%
San Diego Bay	Shelter Island Shoreline Park	Point Loma HA (908.10)	2201	351	351	0	0	0%

Abbreviations/Acronyms:
TMDL: total maximum daily load
LA: load allocation for nonpoint source
WLA: wasteload allocation for point source
MS4: Municipal Separate Storm Sewer System
MPN: most probable number

Notes:
[1] Calculated by dry weather EFDC model analysis. No reduction required for natural/background sources.
[2] Percent Reduction of Existing Municipal MS4 Wasteload = (Existing Municipal MS4 Wasteload – Municipal MS4 WLA) ÷ (Existing Municipal MS4 Wasteload) x 100%

9 Legal Authority For TMDL Implementation Plan

This section presents the legal authority and regulatory framework used as a basis for assigning responsibilities to dischargers to implement and monitor compliance with the requirements set forth in these TMDLs. The laws and policies governing point source[7] and nonpoint source discharges are described below. A large portion of the bacteria loads generated in the receiving waters of the impaired shorelines comes from natural and background sources. These nonpoint sources are considered largely uncontrollable and therefore cannot be regulated.

Discharger accountability for attaining bacteria allocations is established in this section. The legal authority and regulatory framework are described in terms of the following:

- Controllable water quality factors;
- Regulatory background;
- Persons accountable for point source discharges; and
- Persons accountable for controllable nonpoint source discharges.

9.1 Controllable Water Quality Factors

The source and linkage analyses (sections 5, 6 and 7) found that a significant portion of the bacteria load to the shoreline segments can be attributed to natural and background sources (e.g., birds, terrestrial and aquatic animals, wrack line and aquatic plants, sediments, and other unidentified and unquantified sources within the waters). Natural and background sources of bacteria are most significant during dry weather conditions, though these sources are significant during wet weather conditions as well. Bacteria from these sources are largely considered uncontrollable.

The primary controllable source identified by the source analysis was urban runoff discharged from the watersheds by the MS4s. Illegal discharges from boats and wastewater collection systems and treatment plants, which are controllable sources, were also identified. These bacteria discharges result from controllable water quality factors which are defined as those actions, conditions, or circumstances resulting from human activity that may influence the quality of the waters of the state and that may be reasonably controlled. These TMDLs establish WLAs for controllable point sources and LAs for uncontrollable nonpoint sources.

9.2 Regulatory Framework

The regulatory framework for point sources of pollution differs from the regulatory framework for nonpoint sources. The different regulatory frameworks are described in the subsections below.

[7] The term ‘‘point source’’ is defined in Clean Water Act section 502(14) to mean any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.

9.2.1 Point Sources

Clean Water Act section 402 establishes the National Pollutant Discharge Elimination System (NPDES) program to regulate the "discharge of a pollutant," other than dredged or fill materials, from a "point source" into "waters of the U.S." Under section 402, discharges of pollutants to waters of the U.S. are authorized by obtaining and complying with NPDES discharge requirements. These discharge requirements commonly contain effluent limitations consisting of either Technology Based Effluent Limitations (TBELs) or Water Quality Based Effluent Limitation (WQBELs). TBELs represent the degree of control that can be achieved by point sources using various levels of pollution control technology that are defined by the USEPA for various categories of discharges and implemented on a nation-wide basis.

TBELs may not be sufficient to ensure that WQOs will be attained in receiving waters. In such cases, NPDES regulations require the San Diego Water Board to develop WQBELs that derive from and comply with all applicable water quality standards. If necessary to achieve compliance with the applicable water quality standards, NPDES requirements must contain WQBELs more stringent than the applicable TBELs.[8] WQBELs may be expressed as numeric effluent limitations or as BMP development, implementation, and revision requirements. Numeric effluent limitations require monitoring to assess load reductions while non-numeric provisions, such as BMP programs, require progress reports on BMP implementation and efficacy, and could also require monitoring of the waste stream for conformance with a numeric wasteload allocation requiring a mass load reduction.

In California, state Waste Discharge Requirements (WDRs) for discharges of pollutants from point sources to navigable waters of the U.S. that implement federal NPDES regulations and Clean Water Act requirements serve in lieu of federal NPDES permits. These are referred to as NPDES requirements. Such requirements are issued by the State pursuant to independent state authority described in California's Porter-Cologne Water Quality Control Act[9] (not authority delegated by the USEPA or derived from the Clean Water Act).

Within each TMDL, a WLA is determined which is the maximum amount of a pollutant that may be contributed to a waterbody by point source discharges of the pollutant in order to attain WQOs that support designated beneficial uses. NPDES requirements must include conditions that are consistent with the assumptions and requirements of the WLAs. The principal regulatory means of implementing TMDLs for point source discharges regulated under these types of NPDES requirements are:

1. Dividing up and distributing the WLAs for the pollutant entering the waterbody among all the point sources that discharge the pollutant;

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[8] Clean Water Act section 303(d)(1)(C) and Code of Federal Regulations Title 40 section 122.44(d)(1)
[9] Division 7 of the Water Code, commencing with section 13000

2. Evaluating whether the effluent limitations or conditions within the NPDES requirements are consistent with the WLAs. If not, incorporate WQBELs that are consistent with the WLAs into the NPDES requirements or otherwise revise the requirements[10] to make them consistent with the assumptions and requirements of the TMDL WLAs.[11] A time schedule to achieve compliance should also be incorporated into the NPDES requirements in instances where the discharger is unable to immediately comply with the required wasteload reductions;

3. Mandate discharger compliance with the WLAs in accordance with the terms and conditions of the new or revised NPDES requirements;

4. Implement a monitoring and/or modeling plan designed to measure the effectiveness of the controls implementing the WLAs and the progress the waterbodies are making toward attaining WQOs; and

5. Establish criteria to measure progress toward attaining WQOs and criteria for determining whether the TMDLs or WLAs need to be revised.

The only allowable point sources identified were MS4s, although illegal point sources of bacteria, such as discharges from boats and wastewater collection systems and treatment plants, may exist. Because bacteria loading within urbanized areas were largely determined to be from urban runoff discharged from MS4s, the primary mechanism for TMDL attainment will be regulation of these discharges. For the illegal discharges, the Basin Plan includes waste discharge prohibitions specifically for the discharge of treated or untreated sewage from vessels to Dana Point Harbor and San Diego Bay, and for the unauthorized discharge of treated or untreated sewage to waters of the state. Enforcing the Basin Plan prohibitions and the mechanisms to impose regulations on these point source discharges are discussed in the Implementation Plan, section 10.

9.2.2 Nonpoint Sources

The TMDL analyses found that natural and background sources (e.g., birds, terrestrial and aquatic animals, wrack line and aquatic plants, sediments, and other unidentified and unquantified sources within the waters) are the only allowable and uncontrollable nonpoint sources of bacteria loading to the receiving waters. Bacteria loads from these sources are largely uncontrollable, and therefore cannot be regulated.

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[10] In the case of NPDES requirements, WQBELs may include best management practices that evidence shows are consistent with the WLAs.

[11] See federal regulations [40 CFR section 122.44(d)(1)(vii)(B)]. NPDES water quality-based effluent limitations must be consistent with the assumptions and requirements of any available TMDL wasteload allocation. The regulations do not require the WQBELs to be identical to the WLAs. The regulations leave open the possibility that the San Diego Water Board could determine that fact-specific circumstances render something other than literal incorporation of the wasteload allocation to be consistent with the TMDL assumptions and requirements. The rationale for such a finding could include a trade amongst dischargers of portions of their LAs or WLAs, performance of an offset program that is approved by the San Diego Water Board, or any number of other considerations bearing on facts applicable to the circumstances of the specific discharger.

9.3 Persons Responsible for Point Source Discharges

Persons responsible for point source discharges of bacteria include municipal Phase I urban runoff dischargers, and potentially boat dischargers, and publicly owned treatment works (POTWs). Each class of discharger is described in the following subsections.

9.3.1 Municipal Phase I Dischargers of Urban Runoff

Since the shoreline segments evaluated in this project are in urbanized areas, significant bacteria loads enter these waterbodies through the MS4s within the watersheds. MS4 discharges are point source discharges because they are released from channelized, discrete conveyance pipe systems and outfalls. Discharges from MS4s to navigable waters of the U.S. are considered to be point source discharges and are regulated in California through the issuance of NPDES requirements. Persons owning and/or operating MS4s (herein referred to as Municipal Dischargers) that discharge to shorelines have specific roles and responsibilities assigned to them for achieving compliance with the bacteria WLAs described in section 8.

9.3.2 Illicit Discharges from Boats

Boats that dock along any of the shoreline segments evaluated in this project could potentially discharge sewage waste into the waters. At this time, the San Diego Water Board has not issued NPDES requirements or waste discharge requirements to regulate discharges from boats. Thus, there is no regulatory mechanism in place that can be used by the San Diego Water Board to specifically regulate discharges from boats. However, the Basin Plan includes waste discharge prohibitions specifically for the discharge of treated or untreated sewage from boats to Dana Point Harbor and San Diego Bay. Because of this prohibition, these discharges are expressly prohibited and illegal and should not occur. Therefore, the WLA for this type of discharge is zero. If discharges from boats are shown to be a significant source of bacteria contributing to exceedances of water quality objectives, actions may be taken by marina and harbor operators, the muncipalities, and/or the San Diego Water Board to enforce the prohibition of these types of illegal discharge.

9.3.3 Publicly Owned Treatment Works and Sewage Collection Systems

Wastewater treatment plants, or POTWs are regulated under various San Diego Water Board orders that contain effluent limitations for point source discharges of bacteria from these facilities. Most effluent from these facilities is discharged to the Pacific Ocean through offshore ocean outfalls. All POTWs are subject to NPDES requirements with effluent limits for various pollutants, including bacteria. Since POTW discharges do not pose a known bacteria threat to surface waters, the WLA for POTW discharges is zero.

Sewage discharges to surface and groundwaters are subject to enforcement actions including fines. Typically surface spills are detected and mitigated quickly, however leaking underground sewer pipes, or sewer pipes that become cross-connected with stormwater pipes, may go undetected for long periods of time. Therefore, both wet and dry weather may bring sewage in contact with MS4s and beaches.

Bacteria levels in sewage spills from sanitary sewer systems are subject to regulation under State Water Board Order No. 2006-0003-DWQ and San Diego Water Board Order No. R9-2007-0005, which establish waste discharge requirements prohibiting sanitary sewer overflows by sewage collection agencies. Order Nos. 2006-0003-DWQ and R9-2007-0005 replace San Diego Water Board Order No. 96-04, which had been successful at reducing the number and volume of spills and protecting water quality, the environment, and public health. While Order No. 2006-0003-DWQ prohibits sanitary overflows to surface or ground waters in general, Order No. R9-2007-0005 is more stringent and prohibits “(t)he discharge of sewage from a sanitary sewer system at any point upstream of a sewage treatment plant…” Together, these orders prohibit most kinds of discharge, including but not limited to sewer overflows and leaking underground sewer pipes. Accordingly, the dry and wet weather WLA for discharges from all sanitary sewer systems is zero.

9.4 Persons Responsible for Controllable Nonpoint Source Discharges

Nonpoint sources identified during the source analysis were natural and background sources such as birds and other unidentified and unquantified sources within the waters. Nonpoint source discharges associated with natural and background sources are largely uncontrollable, and therefore cannot be regulated. Although an LA has been established for these nonpoint source discharges, no reductions are required.

Encampments of homeless persons were also identified during the source analysis as a potential nonpoint source of fecal bacteria. However, bacteria loads from homeless encampments were included within the urban runoff categorized as point source discharges regulated through NPDES requirements for MS4 discharges, as discussed in section 9.3. If an LA were to be assigned to homeless encampments, the LA would be zero.

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10 Implementation Plan

This section describes the actions necessary to implement the TMDLs that have been developed to attain the REC-1 WQOs for indicator bacteria in the shoreline segments evaluated for this project. The plan describes implementation responsibilities assigned to point source dischargers and describes the schedule and key milestones for the actions to be taken.

The goal of the Implementation Plan is to ensure that WQOs[12] for indicator bacteria for the shoreline segments at BB and SISP are attained and maintained throughout the waterbody and in all seasons of the year. WQOs are considered "attained" when the waterbody can be removed from the Clean Water Act Section 303(d) List of Water Quality Limited Segments (List). WQOs are considered "maintained" when, upon subsequent listing cycles, the waterbody has not returned to an impaired condition and been put back on the List. The expectation is that attaining and maintaining WQOs will be accomplished by achieving wasteload allocations (WLAs) for point sources. However, according to the TMDL analysis, natural and background sources contribute a significant portion of the bacteria load at both BB and SISP. If the REC-1 WQOs cannot be met in the receiving waters, and if natural and background sources appear to be the sole source of continued impairment, an allowance for exceedances of the REC-1 WQOs may be appropriate.

The San Diego Water Board strongly encourages the dischargers to identify and eliminate all anthropogenic sources (e.g., illegal sewer cross-connections, sewage leaks, pet waste, boat or recreational vehicle sewage dumping, hosing down restrooms and trash recepticles, homeless wastes, excessive landscape irrigation that can convey anthropogenic sources, etc.) before spending their limited resources on expensive structural treatment systems designed to sterilize and/or remove pollutants from runoff immediately before discharge into receiving waters. Prevention and control of anthropogenic sources are also generally more cost effective than structural treatment systems, which will treat both natural and anthropogenic sources. Generally speaking, natural sources of bacteria (e.g., waterfowl) need not, and should not, be eliminated, since elimination of natural sources may also result in the elimination f important beneficial uses.

The final goals for this plan are somewhat different than what was adopted for the San Diego Region beaches and creeks under *Total Maximum Daily Loads for Indicator Bacteria Project I - Beaches and Creeks in the San Diego Region* (Bacteria TMDL Project I). While many of the actions that may be taken by the San Diego Water Board are similar, the ways the dischargers can account for natural and background or uncontrollable sources and achieve the TMDLs are different.

[12] Code of Federal Regulations Title 40 section 131.38(b)(2)

Under *Total Maximum Daily Loads for Indicator Bacteria Project I - Beaches and Creeks in the San Diego Region* (Bacteria TMDL Project I), allowable exceedances of the REC-1 WQOs are determined by comparing the impaired beach and/or creek to a reference system. A reference system is a water body that is minimally impacted by anthropogenic activities that can affect bacterial densities in the water body. A reference system can be used to determine an allowable exceedance frequency to account for bacteria loads that may be attributed to natural or uncontrollable sources of bacteria. This allowable exceedance frequency is already included in the Bacteria TMDL Project I TMDL calculations and will be applied after approval of the Basin Plan amendment (Resolution No. R9-2008-0028) authorizing the use of the Reference System and Antidegradation Approach (RSAA) by the Office of Administrative Law.[13] However, the RSAA can only be used if there is an appropriate reference system that may be compared to the subject impaired waterbody.

For this project, the impaired waterbodies are the impaired shoreline segments of Dana Point Harbor and San Diego Bay. There are no harbors or bays in the San Diego Region that are of similar size or setting that do not have anthropogenic activities occurring within them. Therefore, there are no harbor or bay reference systems and the RSAA cannot be applied. However, the same Basin Plan amendment discussed above also authorizes the use of the Natural Sources Exclusion Approach (NSEA). Under the NSEA, all anthropogenic sources of indicator bacteria to the subject impaired waterbody must be controlled such that they do not cause or contribute to exceedances of the REC-1 indicator bacteria WQOs. Dischargers must also demonstrate that all anthropogenic sources of indicator bacteria to the target water body are controlled and that residual indicator bacteria densities do not indicate a health risk. After all anthropogenic sources of indicator bacteria have been controlled such that they do not cause exceedances of the REC-1 indicator bacteria WQOs, and natural or uncontrollable sources have been identified and quantified, exceedances of the REC-1 indicator bacteria WQOs may be allowed based on the residual exceedances in the subject impaired waterbody.

In the case for Bacteria TMDL Project I, the RSAA may be applied immediately if an appropriate reference system can be identified. However, for this project, the use of the NSEA is not expected to occur immediately. Rather, the NSEA is used to recalculate TMDLs at some point after their initial adoption, following demonstration of control of all anthropogenic sources.

Additionally, we recognize in this plan that the Municipal Dischargers have been implementing BMP programs prior to and throughout the development of these TMDLs. The water quality at these impaired shorelines has improved significantly in recent years and we believe they can be delisted from the 303(d) List in a relatively short time frame

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[13] Approval of the Basin Plan amendment (Resolution No. R9-2008-0028) authorizing the use of the Reference System and Atnidegradation Approach and Natural Sources Exclusion Approach by the Office of Administrative Law is anticipated by the end of 2008 or early 2009

compared to the beaches and creeks in Bacteria TMDL Project I. While these BMP programs have resulted in significant improvements in water quality, additional efforts may be required by the Municipal Dischargers to achieve the MS4 WLAs and the TMDLs. Therefore, this Implementation Plan provides general guidance on remaining issues that should be addressed for compliance with the TMDLs.

10.1 Regulatory Authority for Implementation Plans

TMDL implementation plans are not currently required under federal law; however, federal policy is that TMDLs should include implementation plans. Clean Water Act section 303 [and Code of Federal Regulations Title 40 section 130] authorizes the USEPA to require implementation plans for TMDLs. USEPA regulations implementing section 303 do not currently require states to include implementation plans for TMDLs but are likely to be revised in the future. USEPA regulations require states to incorporate TMDLs in the State Water Quality Management Plans (Basin Plans) along with adequate implementation measures to implement all aspects of the plan.[14] According to USEPA policy, states must include implementation plans as an element of TMDL Basin Plan amendments submitted to USEPA for approval.[15]

TMDL implementation plans are required under State law. Basin plans must have a program of implementation to achieve WQOs.[16] The implementation plan must include a description of actions that are necessary to achieve the objectives, a time schedule for these actions, and a description of surveillance to determine compliance with the WQOs.[17] State law requires that a TMDL include an implementation plan since a TMDL supplements, interprets, and/or refines existing WQOs. The TMDLs, LAs, and WLAs must be incorporated into the Basin Plan.[18]

10.2 Implementation Plan Objectives

The specific objectives of this Implementation Plan are as follows:

1. Identify the persons responsible for meeting the WLAs in discharges of bacteria to the impaired shoreline segments of BB and SISP.

2. Establish a time schedule for meeting the LAs and WLAs. The schedule will establish interim milestones that are to be achieved until the LAs and WLAs are achieved.

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[14] Code of Federal Regulations Title 40 section 130.6
[15] See *Guidance for Developing TMDLs in California,* USEPA Region 9, (January 7, 2000).
[16] See Water Code section 13050(j). A “Water Quality Control Plan” or “Basin Plan” consists of a designation or establishment for the waters within a specified area of all of the following: (1) Beneficial uses to be protected, (2) Water quality objectives and (3) A program of implementation needed for achieving water quality objectives.
[17] See Water Code section 13242.
[18] See Clean Water Act section 303(e).

3. Reissue or revise the various existing statewide and regional NPDES requirements that regulate urban runoff and other point source discharges to the shoreline segments of BB and SISP to implement WLAs set forth in section 8.

4. Establish mechanisms to document and track BMP implementation, monitor BMP effectiveness in achieving the allocations in bacteria discharges, assess success in achieving TMDL objectives and milestones, and report on TMDL program effectiveness in attaining WQOs for indicator bacteria in the receiving waters at the impaired shoreline segments of BB and SISP.

5. Enforce the Basin Plan waste discharge prohibitions for illegal discharges from vessels and wastewater collection systems and treatment plants where these discharges contribute significant bacteria loads to receiving waters.

6. Identify the conditions for applying the Natural Sources Exclusion Approach if the REC-1 WQOs cannot be met in the receiving waters, and if natural and background sources appear to be the sole source of continued impairment.

10.3 Allocations and Identification of Dischargers

Allocations for each watershed are described in Tables 8-1 thru 8-6 and are expressed as “loads” in terms of number of bacteria colonies per 30-day period (billion MPN/30 days) for wet weather loads, and number of bacteria colonies per day (billion MPN/day) for dry weather loads. Allocations are expressed as either WLAs for point sources, or LAs for nonpoint sources. The only persons identified that are responsible for allowable and controllable point source discharges include the owners and operators of Phase I MS4 systems within the affected watersheds. Illegal discharges from boats and wastewater collection systems and treatment plants were also identified as potential point source discharges. Because illegal discharges are not authorized and considered controllable, they are assigned WLAs of zero. Therefore, owners of marinas and harbors and boat owners are not assigned part of the TMDL and must eliminate their loads. There were no controllable nonpoint source discharges identified.

Although allocations are distributed to the identified discharges of bacteria, this is not to say that other potential sources do not exist. Any potential sources in the watersheds not receiving an explicit allocation described in this Technical Report is allowed a zero discharge of bacteria to the impair shoreline segments of BB and SISP.

10.3.1 Point Source Discharges

The point sources identified to potentially affect the waterbodies addressed in this study were discharges from MS4s, and illegal discharges from boats and/or wastewater collection systems and treatment plants. Regulation of these discharges is discussed below.

<u>Municipal Separate Storm Sewer Systems</u>

Bacteria loading within urbanized areas generally originate from urban runoff discharged from MS4s. The primary mechanism for TMDL attainment will be increased regulation of these discharges. The Municipal Dischargers whose point source discharges contribute to the exceedance of WQOs for indicator bacteria (as discussed in section 9) will be required to meet the WLAs in their urban runoff before it is discharged from MS4s to the receiving waters. Municipal Dischargers are responsible for reducing bacteria loads in their urban runoff prior to discharge to impaired receiving waters because they own or operate MS4s that contribute to the impairment of receiving waters. These discharges are identified in and regulated by NPDES requirements prescribed in the San Diego Water Board orders listed in Table 10-1 below.

Table 10-1. San Diego Water Board Orders Regulating Applicable MS4 Discharges

Order Number/Short Name	Order Title
San Diego Water Board Order No. R9-2007-0001 *San Diego County MS4 NPDES Requirements*	*Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, the San Diego Unified Port District, and the San Diego County Regional Airport Authority*
San Diego Water Board Order No. R9-2002-0001 *Orange County MS4 NPDES Requirements*	*Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of the County of Orange, the Incorporated Cities of Orange County, and the Orange County Flood Control District within the San Diego Region*

Publicly Owned Treatment Works (Wastewater Collection Systems and Treatment Plants)

There are no publicly owned treatment works (POTWs) or wastewater treatment plants that are known to directly discharge to the BB and SISP shorelines. However, sewage discharges from illegal cross-connections, leaky sanitary sewer pipes, and sanitary sewer overflows and spills may contribute to the bacteria loads that are causing the impairments at these shorelines. The Basin Plan includes waste discharge prohibitions specifically for the unauthorized discharge of treated or untreated sewage to waters of the state, thus these types of discharge are expressly prohibited and illegal.

Additionally, POTWs are subject to regulation under orders issued by the State Water Board and the San Diego Water Board, which also prohibit sanitary sewer overflows and leaking underground sewer pipes. These discharges are regulated by the waste discharge requirements prescribed in the State Water Board and San Diego Water Board orders listed in Table 10-2 below.

Table 10-2. San Diego Water Board Orders Regulating Sanitary Sewage Discharges

Order Number	Order Title
State Water Board Order No. 2006-0003-DWQ	*Statewide General Waste Discharge Requirements for Sanitary Sewer Systems*
San Diego Water Board Order No. R9-2007-0005	*Waste Discharge Requirements for Sewage Collection Agencies in the San Diego Region*

Marinas and Boats

Both BB and SISP have marinas that are located in close proximity to the sites. Dana Point Harbor is owned by the County of Orange, and is occupied by several marinas with slips available for approximately 2,400 boats. SISP has approximately 50 boat mooring locations directly off the shoreline area which are owned and operated by the San Diego Unified Port District. Discharges of sewage from boats may be a significant source of bacteria. However, Basin Plan includes waste discharge prohibitions specifically for the discharge of treated or untreated sewage from vessels to Dana Point Harbor and San Diego Bay. The County of Orange and the San Diego Unified Port District also have ordinances that prohibit the discharge of sewage from a vessel to Dana Point Harbor or San Diego Bay.[19]

At this time, the San Diego Water Board has not issued NPDES requirements or waste discharge requirements to regulate discharges from marinas, which can include discharges from boats. However, the waste discharge prohibitions in the Basin Plan for the discharge of treated or untreated sewage from vessels to Dana Point Harbor and San Diego Bay are directly enforceable. If evidence shows that illegal sewage discharges from marinas and/or are boats a significant contributor to elevated bacteria levels at these shorelines, or other areas of the San Diego Region, the San Diego Water Board can issue enforcement actions, NPDES requirements, or waste discharge requirements to marinas and/or issue enforcement actions against boat owners in the future.

10.3.2 Nonpoint Source Discharges

Nonpoint source discharges from natural and background sources (e.g., birds, terrestrial and aquatic animals, wrack line and aquatic plants, sediments, and other unidentified and unquantified sources in the waters) are largely uncontrollable, and therefore cannot be regulated. Bacteria loads attributed to natural and background sources were back-calculated by the dry weather EFDC model, as discussed in section 7.2.5. A number of assumptions were used in the receiving water model and its calculations for natural and background bacteria loads are estimates only. Until more information is obtained through further study to provide identification of the relative loading from natural and background sources, they were combined into a single existing load and LA for each shoreline segment.

[19] Codified Ordinances County of Orange sections 2-2-163 and 2-2-169 and San Diego Unified Port District Code section 8.50(a)

The land use information provided in Table 2-1 indicates that controllable nonpoint source discharges from agriculture, livestock operations, and horse ranches do not exist in the watersheds draining into BB and SISP. This is also supported by the source analysis presented in section 5 where controllable nonpoint sources from the watershed were not identified as contributors of bacteria. Therefore, no controllable nonpoint sources were identified or assigned an LA.

10.3.3 Responsible Municipal Dischargers

One WLA was assigned collectively to the Municipal Dischargers in each watershed. This WLA was not divided up among the individual jurisdictions in each watershed because MS4s under different jurisdictions are often interconnected. The Municipal Dischargers within each watershed are collectively responsible for meeting the WLA and required reductions in bacteria loads for these watersheds and for meeting all of the TMDL requirements. Responsible municipalities in each affected watershed are listed in Table 10-3 below.

Table 10-3. Responsible Municipalities

Waterbody	Hydrologic Descriptor	Shoreline Segment	Responsible Municipalities
Dana Point Harbor	Dana Point HSA (901.14)	Baby Beach	County of Orange City of Dana Point
San Diego Bay	Point Loma HA (908.10)	Shelter Island Shoreline Park	City of San Diego San Diego Unified Port District

10.4 Compliance Schedule for Achieving Allocations

The purpose of these TMDLs is to attain and maintain the applicable WQOs in impaired shoreline segments through incremental mandated reductions of bacteria from point sources discharging to impaired waters. The requirements of this project mandate that dischargers achieve wasteload reductions in their discharges.

By design, waste load allocations and load allocations are established at levels that when met, will result in the full attainment of water quality standards. For this reason, the San Diego Water Board expects that at the end of the TMDL compliance period, applicable load and waste load allocations, as well as the water quality objectives will be met at all times in the receiving water. In the event that water quality objectives are not met at the end of the compliance period, the Board will require the dischargers to conduct an investigation to identify the specific source(s) responsible for the failure to meet WQOs. If the source is found to be anthropogenic, the San Diego Water Board will initiate enforcement or other regulatory action as appropriate to correct the problem. If the source is natural, and if all of the conditions for using the natural sources exclusion approach (NSEA) have been met, the Board will consider the application of the NSEA, including the recalculation of the TMDLs to account for the natural sources.

10.4.1 Compliance Schedule

In establishing the compliance schedules for achieving the bacteria WLAs, the San Diego Water Board must balance the need of the dischargers for a reasonable amount of time to implement an effective bacteria load reduction program against the broad-based public interest in having water quality standards attained in the waters of the Region as soon as practicable. The public interest is best served when dischargers take all reasonable and immediately feasible actions to reduce pollutant discharges to impaired waters in the shortest possible time. In fact, pursuant to receiving water limitations in the San Diego and Orange County MS4 NPDES requirements (see section 10.5.2), the dischargers are already planning and implementing BMP programs, and monitoring for all MS4 bacteria and other pollutant discharges that cause or contribute to violations of water quality standards in the water quality limited segments within, or receiving pollutant discharges from their jurisdictions.

For example, the County of Orange has already conducted numerous studies and implemented a variety of non-structural and structural BMPs in an effort to reduce bacteria levels at BB since before 2002. These efforts have included installing seasonal plugs in storm drains, increased street sweeping efforts, expedited trash collection to control birds, the installation of bird netting under the pier, public education efforts against bird-feeding at the beach, artificial circulation of water at BB, a dry weather flow diversion structure and media filter system on the west end of the beach, catch basin filters, and the collection and disposal of bird fecal droppings from the exposed intertidal areas of the beach. These actions appear to have resulted in significant improvements in water quality since 2002. The County of Orange should be able to achieve the MS4 WLAs in the near future.

Based on the TMDLs, LAs, WLAs, past and current BMP programs that have been implemented, and water quality monitoring data, compliance schedules were developed for each impaired shoreline segment, as discussed below.

Baby Beach Compliance Schedule
According to Tables 8-1 through 8-3, no wet weather wasteload reductions are required for TC and FC. This means that according to the wet weather models for BB, REC-1 WQOs for TC and FC are not expected to be exceeded due to discharges from the MS4s. The only wet weather wasteload reductions required for MS4s discharging into the receiving waters along the shoreline at BB is for ENT. The compliance schedule for BB to achieve wet weather TMDLs is as shown in Table 10-4.

Table 10-4. Compliance Schedule for Baby Beach to Achieve Wet Weather TMDLs

Year (after OAL Approval)	Required Wasteload Reduction	TMDL Compliance Action
1	No reduction required	▪ Water Quality Monitoring ▪ Implement BMPs
2	Same as above	▪ Water Quality Monitoring ▪ Implement BMPs
3	Same as above	▪ Water Quality Monitoring ▪ Implement BMPs
4	Same as above	▪ Water Quality Monitoring ▪ Implement BMPs
5	Same as above	▪ Water Quality Monitoring ▪ Implement BMPs
6	Same as above	▪ Water Quality Monitoring ▪ Implement BMPs
7	50 percent ENT reduction	▪ Water Quality Monitoring ▪ Implement BMPs
8	Same as above	▪ Water Quality Monitoring ▪ Implement BMPs
9	Same as above	▪ Water Quality Monitoring ▪ Implement BMPs
10	100 percent ENT reduction	▪ Water Quality Monitoring ▪ Implement BMPs ▪ Submit request for removal from 303(d) List (if not requested and removed earlier)
10+	Same as above	▪ Water Quality Monitoring ▪ Implement BMPs ▪ Submit request for TMDL revisions based on Natural Sources Exclusion Approach if supported by data (if not requested and recalculated earlier) ▪ Submit request for removal from 303(d) List (if not requested and removed earlier)

At this time, control of bacteria loads for MS4s during wet weather is inherently difficult because the MS4 systems are traditionally designed to convey water quickly for flood control purposes. However, new approaches to stormwater runoff management and BMP implementation can reduce the stormwater runoff flow and associated pollutant loads. The phased compliance schedule to achieve wet weather TMDLs will provide the MS4 dischargers time to identify sources, develop plans and implement enhanced and expanded BMPs capable of achieving the mandated decreases in bacteria densities at the BB shoreline.

According to Tables 8-4 through 8-6, dry weather wasteload reductions are required for TC, FC, and ENT. Based on the data reviewed in the impairment overview discussed in section 2.3.1, of the samples collected between January 2002 and December 2006, only the number of exceedances for ENT (283 exceedances) are greater than the number of allowed exceedances to recommend removal from the 303(d) List (193 exceedances). However, most of the exceedances for ENT occurred before 2006. The trend in the water quality data from BB indicate that the number of REC-1 WQO exceedances have declined significantly beginning in 2006.

If the current trend continues, the San Diego Water Board believes that the dry weather TMDLs for BB can be achieved within the next 5 years. The compliance schedule for BB to achieve dry weather TMDLs is as shown in Table 10-5.

Table 10-5. Compliance Schedule for Baby Beach to Achieve Dry Weather TMDLs

Year (after OAL Approval)	Required Wasteload Reduction	TMDL Compliance Action
1	No reduction required	▪ Water Quality Monitoring ▪ Implement BMPs
2	Same as above	▪ Water Quality Monitoring ▪ Implement BMPs
3	50 percent reduction	▪ Water Quality Monitoring ▪ Implement BMPs
4	Same as above	▪ Water Quality Monitoring ▪ Implement BMPs
5	100 percent reduction	▪ Water Quality Monitoring ▪ Implement BMPs ▪ Submit request for removal from 303(d) List (if not requested and removed earlier)
5+	Same as above	▪ Water Quality Monitoring ▪ Implement BMPs ▪ Submit request for TMDL revisions based on Natural Sources Exclusion Approach if supported by data (if not requested and recalculated earlier) ▪ Submit request for removal from 303(d) List (if not requested and removed earlier)

For both of the Baby Beach compliance schedules, if the REC-1 WQOs cannot be met in the receiving waters, and if natural and background sources appear to be the sole source of continued impairment, the natural sources exclusion approach (NSEA) may be applied.[20] However, the Municipal Dischargers are responsible for collecting the data to support the application of the NSEA to recalculate the TMDL.

Shelter Island Shoreline Park Compliance Schedule

According to Tables 8-1 through 8-6, there are no wasteload reductions required for MS4s discharging into the receiving waters along the shoreline at SISP under both wet weather and dry weather conditions. This means that according to the wet weather and dry weather models for SISP, REC-1 WQOs are not expected to be exceeded due to discharges from the MS4s. Additionally, based on the data reviewed in the impairment overview discussed in section 2.3.2, of the samples collected between January 2003 and November 2006, only the number of exceedances for ENT (24 exceedances) are greater than the number of allowed exceedances to recommend removal from the 303(d) List (23 exceedances).

Given that the modeled wasteload reductions for both wet weather and dry weather conditions for all indicator bacteria are zero percent, no compliance schedules were developed to meet wasteload reductions for SISP. However the existing wasteload cannot exceed the WLA and SISP will remain on the 303(d) List until enough data are collected to support removing it from the 303(d) List. Therefore, in order to comply with these TMDLs, the responsible municipalities must continue implementing BMPs and collecting data until there are enough data to support and maintain the removal of SISP from the 303(d) List. In addition, the reporting requirements for the Shelter Island Shoreline Park TMDL must also include a periodic demonstration, no less often than every 2 years, that wasteload allocations and water quality objectives are being met.

The trend in the water quality data from SISP indicate that the number of REC-1 WQO exceedances have declined significantly since 2003 (Brown and Caldwell, 2006). If the current trend continues, the San Diego Water Board expects that SISP will have enough data to support removal of SISP from the 303(d) List by 2010, and no later than 2012. The compliance schedule for SISP to achieve wet weather and dry weather TMDLs is as shown in Table 10-6.

Table 10-6. Compliance Schedule for Shelter Island Shoreline Park to Achieve Wet Weather and Dry Weather TMDLs

Year	TMDL Compliance Action
2012	▪ Water Quality Monitoring ▪ Implement BMPs ▪ Submit request for TMDL revisions based on Natural Sources Exclusion Approach if supported by data (if not requested and recalculated earlier) ▪ Submit request for removal from 303(d) List (if not requested and removed earlier)

[20] After approval of the Basin Plan amendment (Resolution No. R9-2008-0028) authorizing the use of the Natural Sources Exclusion Approach by the Office of Administrative Law, anticipated by the end of 2008 or early 2009.

If the REC-1 WQOs cannot be met in the receiving waters by 2012, and if natural and background sources appear to be the source of continued impairment, the NSEA may be applied.[21] However, the Municipal Dischargers are responsible for collecting the data to support the application of the NSEA to recalculate the TMDLs.

10.5 Specific Implementation Objectives

Since 2002, the dischargers have implemented several non-structural BMP programs and structural BMPs that have resulted in measureable improvements in water quality at the impaired shoreline segments. The County of Orange has already conducted numerous studies and implemented a variety of non-structural and structural BMPs in an effort to reduce bacteria levels at BB since before 2002. These efforts have included installing seasonal plugs in storm drains, increased street sweeping efforts, expedited trash collection to control birds, the installation of bird netting under the pier, public education efforts against bird-feeding at the beach, artificial circulation of water at Baby Beach, a dry weather flow diversion structure and media filter system on the west end of the beach, catch basin filters, and the collection and disposal of bird fecal droppings from the exposed intertidal areas of the beach. The San Diego Unified Port District has also implemented several non-structural BMP programs since 2002. Water quality data recently obtained from the County of Orange and the San Diego Unified Port District indicates that bacteria levels in the waters at BB and SISP have shown significant decreases in the number of exceedances of the REC-1 indicator bacteria WQOs since 2002.

As shown in Tables 8-1 through 8-6, the modeling results indicate that no load reductions are required for TC, FC, and ENT for SISP during wet weather or dry weather conditions. Additionally, the modeling results indicate only ENT wet weather load reductions are required for BB and no wet weather load reductions are required for TC and FC. For dry weather, BB requires between approximately 83 percent and 96 percent wasteload reductions for TC, FC, or ENT. However, based only on the water quality data collected during 2006, the number of samples that exceed the REC-1 WQOs are less than the allowable number of exceedances for recommending removal from the 303(d) List. This trend implies that the past and current BMPs that have been implemented are effective in reducing bacteria loads to the receiving waters and that water quality in the impaired shoreline segments already meet REC-1 WQOs during dry weather. However, additional monitoring is required to confirm this trend, and additional BMPs may be needed to meet the REC-1 WQOs during wet weather.

While submission of the Bacteria Load Reduction Plans (BLRPs), as described in section 10.6.2, will still be required from the dischargers, if current trends continue, monitoring and permanent implementation of the current programs and BMPs may be adequate in meeting the wet weather and dry weather TMDLs. If the REC-1 WQOs

[21] After approval of the Basin Plan amendment (Resolution No. R9-2008-0028) authorizing the use of the Natural Sources Exclusion Approach by the Office of Administrative Law, anticipated by the end of 2008 or early 2009.

cannot be met in the receiving waters by the end of the compliance schedules, and if natural and background sources appear to be the sole source of continued impairment, application of the NSEA to revise the TMDLs, as described in section 10.6.5, may be appropriate.[22]

Therefore, if the water quality data support delisting before the NPDES requirement revisions are considered, specific objectives of this Implementation Plan are as follows:

1. Persons responsible for monitoring the impaired shoreline segments of BB and SISP for bacteria will continue with the monitoring program to ensure REC-1 WQOs are maintained.
2. If REC-1 WQOs are exceeded, actions outlined in Attachment B of Order Nos. R9-2007-0001 and R9-2002-0001 in section II.C, Coastal Storm Drain Outfall Monitoring, will be implemented.
3. If sources of bacteria persist at levels that exceed water quality standards, then the persons responsible will take appropriate actions to identify and eliminate the controllable source or sources of the chronic contamination. If natural and background sources appear to be the sole source of the impairment, application of the NSEA to revise the TMDLs may be appropriate.

If the impaired shoreline segments of BB and SISP remain on or are put back on the List during subsequent iterations of the 303(d) listing process due to impacts from controllable sources of bacteria, the San Diego Water Board will revise the current NPDES requirements and/or issue additional waste discharge requirements to be consistent with these TMDLs, and/or issue enforcement actions to compel the dischargers to comply with these TMDLs.

10.6 San Diego Water Board Actions

The San Diego Water Board regulates discharges of waste by issuing waste discharge prohibitions, waste discharge requirements, or conditional waivers of waste discharge requirements. Violation of a waste discharge prohibition, waste discharge requirement, or waiver condition is subject to enforcement actions. This section describes the actions that the San Diego Water Board will take to implement the TMDLs.

10.6.1 Process and Schedule for Issuing NPDES Requirements

The TMDLs will be implemented primarily by reissuing or revising the existing NPDES waste discharge requirements for MS4 discharges to include WQBELs that are consistent with the assumptions and requirements of the bacteria WLAs for MS4 discharges. The process for issuance of NPDES requirements is distinct from the TMDL process, and is described below. WQBELs for municipal stormwater discharges can be either numeric or non-numeric. Non-numeric WQBELs typically are a program

[22] After approval of the Basin Plan amendment (Resolution No. R9-2008-0028) authorizing the use of the Natural Sources Exclusion Approach by the Office of Administrative Law, anticipated by the end of 2008 or early 2009.

of expanded or better-tailored BMPs. The USEPA expects that most WQBELs for NPDES-regulated municipal discharges will be in the form of BMPs, and that numeric limitations will be used only in rare instances.[23] WQBELs can be incorporated into NPDES requirements for MS4 discharges by reissuing or revising these requirements. The public process for issuing NPDES requirements is distinct from but similar to the process for adopting TMDLs. For NPDES requirements, the process begins when the operator of the facility (discharger) submits a report of waste discharge (RoWD) to the San Diego Water Board for review. After reviewing the RoWD, the San Diego Water Board must make a decision to proceed with the NPDES requirements. Using the information and data in the RoWD, the San Diego Water Board develops draft NPDES requirements and the justification for the conditions (referred to as the fact sheet).

The first major step in the development process is to develop numerical effluent limitations on the amounts of specified pollutants that may be discharged and/or specified BMPs designed to minimize water quality impacts. These numerical effluent limitations and BMPs or other non-numerical effluent limitations must implement both technology-based and water quality-based requirements of the Clean Water Act. TBELs represent the degree of control that can be achieved by point sources using various levels of pollution control technology. If necessary to achieve compliance with applicable water quality standards, NPDES requirements must contain WQBELs, derived from the applicable receiving water quality standards, more stringent than the applicable technology-based standards. In the context of a TMDL, the WQBELs must be consistent with the assumptions and requirements of the WLAs of any applicable TMDL. Following the development of effluent limitations, the San Diego Water Board develops appropriate monitoring and reporting conditions, facility-specific special conditions, and includes standard provisions that are the same for all NPDES requirements.

After the draft NPDES requirements are complete, the San Diego Water Board provides an opportunity for public participation in the process. A public notice announces the availability of the draft requirements, and interested persons may submit comments. Based on the comments, the San Diego Water Board develops the final requirements, documenting the process and decisions in the administrative record. The final NPDES requirements are issued to the facility in an order adopted by the San Diego Water Board.

Although NPDES requirements must contain WQBELs that are consistent with the assumptions and requirements of the TMDL WLAs, the federal regulations[24] do not require the WQBELs to be identical to the WLAs. The regulations leave open the possibility that the San Diego Water Board could determine that fact-specific circumstances render something other than literal incorporation of the WLA into

[23] USEPA memorandum entitled “Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs,” dated November 22, 2002.
[24] Code of Federal Regulation Title 40 section 122.44(d)(1)(vii)(B)

discharge requirements to be consistent with the TMDL assumptions and requirements. For example, the WLAs in Tables 8-1 through 8-6 are expressed as billion MPN per 30 days (or per day); however, the WQBELs prescribed in response to the WLAs may or may not be written using the same metric. WQBELs may be expressed as numeric effluent limitations using a different metric, or, more likely, as BMP development, implementation, and revision requirements.

NPDES requirements should be issued, reissued, or revised "as expeditiously as practicable" to incorporate WQBELs derived from the TMDL WLAs. "As expeditiously as practicable" means the following:

1. **New point sources**. "New" point sources previously unregulated by NPDES requirements must obtain their NPDES requirements before they can lawfully discharge pollutants. For point sources receiving NPDES requirements for the first time, "as expeditiously as practicable" means that the San Diego Water Board incorporates WQBELs that are consistent with the assumptions and requirements of the WLAs into the NPDES requirements and requires compliance with the WQBELs upon the commencement of the discharge.

2. **Point Sources Currently Regulated Under NPDES Requirements**. For point sources currently regulated under NPDES requirements, "as expeditiously as practicable" means that:

    a. WQBELs that are consistent with the assumptions and requirements of the WLAs should be incorporated into NPDES requirements during their 5-year term, prior to expiration, in accordance with the applicable NPDES requirement reopening provisions, taking into account factors such as available NPDES resources, staff and budget constraints, and other competing priorities.

    b. In the event the NPDES requirement revisions cannot be considered during the 5-year term, the San Diego Water Board will incorporate WQBELs that are consistent with the assumptions and requirements of the WLAs into the NPDES requirements at the end of the 5-year term.

10.6.2 Actions with Respect to Phase I Municipal Dischargers

California's Municipal Stormwater Program regulates stormwater discharges from MS4s. NPDES requirements for MS4 discharges were issued in two phases. Under Phase I, which began in 1990, the Regional Water Boards adopted NPDES urban runoff requirements for medium (serving between 100,000 and 250,000 people) and large (serving 250,000 people) municipalities. Most of these requirements are issued to a group of municipalities encompassing an entire metropolitan or county area. These requirements are issued for fixed terms of five years and are reissued upon the request of the discharger as they expire.

The Phase I Municipal Dischargers in San Diego and Orange County are required under Receiving Water Limitations A.3.a.1 and C.2[25] of Orders No. R9-2007-0001 and R9-2002-0001, respectively (San Diego County and Orange County MS4 NPDES requirements), and any subsequent amendment or renewal, to implement additional BMPs to reduce bacteria discharges in impaired watersheds to the maximum extent practicable and to restore compliance with the bacteria WQOs. This obligation is triggered when either the discharger or the San Diego Water Board determines that MS4 discharges are causing or contributing to an exceedance of an applicable WQO, in this case the REC-1 indicator bacteria WQOs. Designation of the BB and SISP shoreline segments as water quality limited segments under Clean Water Act section 303(d) and this TMDL project analysis provided sufficient evidence that that MS4 discharges may be causing or contributing to the violation of water quality standards. Thus, the Municipal Dischargers should be, and have been implementing the provisions of Receiving Water Limitation C.2 with respect to bacteria discharges into water quality limited segments.

In addition to enforcing the provisions of Receiving Water Limitation C.2, the San Diego Water Board shall reissue or revise Orders No. R9-2007-0001 and R9-2002-0001, to incorporate WQBELs consistent with the assumptions and requirements of the bacteria WLAs, and requirements for monitoring and reporting. In those orders, the Phase I Municipal Dischargers are referred to as "Copermittees."[26] WQBELs and other requirements implementing the TMDLs can be incorporated into these NPDES requirements upon the normal renewal cycle or sooner, if appropriate. The requirements implementing the TMDLs shall include the following:

a. WQBELs consistent with the requirements and assumptions of the bacteria WLAs described in Tables 8-1 through 8-6 and a schedule of compliance applicable to the MS4 discharges into the impaired shoreline segments described in Tables 10-4 through 10-6. At a minimum, WQBELs shall include a BMP program to attain the WLAs.

[25] Receiving Water Limitations A.3.a.1 and C.2.a provide that "[u]pon a determination by either the Copermittee or the San Diego Water Board that MS4 discharges are causing or contributing to an exceedance of an applicable water quality standard, the Copermittee shall promptly notify and thereafter submit a report to the San Diego Water Board that describes BMPs that are currently being implemented and additional BMPs that will be implemented to prevent or reduce any pollutants that are causing or contributing to the exceedance of water quality standards. The report may be incorporated in the annual update to the Jurisdictional URMP unless the San Diego Water Board directs an earlier submittal. The report shall include an implementation schedule. The San Diego Water Board may require modification to the report." Additional requirements are included in sections C.2.b-d.

[26] Copermittees own or operate MS4s through which urban runoff discharges into waters of the U.S. within the San Diego Region. These MS4s fall into one or more of the following categories: (1) a medium or large MS4 that services a population of greater than 100,000 or 250,000 respectively; or (2) a small MS4 that is "interrelated" to a medium or large MS4; or (3) an MS4 which contributes to a violation of a water quality standard; or (4) an MS4 which is a significant contributor of pollutants to waters of the United States.

b. If the WQBELs consist of BMP programs, then the reporting requirements shall consist of annual progress reports on BMP planning, implementation, and effectiveness in attaining the WQOs in impaired shoreline segments, and annual water quality monitoring reports. The first progress report shall consist of a Bacteria Load Reduction Plan (BLRP), which may be included as part of the annual NPDES reporting requirements. BLRPs must be specific to each impaired waterbody.

   To provide guidance to the dischargers in preparing BLRPs, the following bullets describe components that should be considered for incorporation in the BLRPs.

   Comprehensive Watershed Approach

   - Dischargers should identify the Lead Watershed Contact for their BLRPs. The Lead Watershed Contact should serve as liaison between all other common watershed dischargers and the San Diego Water Board, where appropriate.

   - Dischargers should describe a program for encouraging collaborative, watershed-based, land-use planning in their jurisdictional plans.

   - Dischargers should develop and periodically update a map of the BLRP watershed, to facilitate planning, assessment, and collaborative decision-making. As appropriate, the map should include features such as receiving waters; Clean Water Act section 303(d) impaired receiving waters; water quality projects; land uses; MS4s; major highways; jurisdictional boundaries; and inventoried commercial, industrial, and municipal sites.

   - Dischargers should annually assess the water quality of the impaired water body in their BLRPs in order to identify all water quality problems within the impaired water body. This assessment should use applicable water quality data, reports, and analysis generated in accordance with the requirements of the applicable NPDES MS4 monitoring and reporting programs, as well as applicable information available from other public and private organizations.

   - Dischargers should develop and implement a collective watershed BLRP strategy to meet the bacteria TMDL. The strategy should guide dischargers in developing a Bacteria Compliance Schedule (BCS) which includes BMP planning and scheduling as outlined below.

- Dischargers should collaborate to develop and implement the BLRPs. The BLRP should include a proposal for regularly scheduled meetings among the dischargers in the impaired watershed.

- Because water quality data will ultimately determine if a waterbody will be delisted from the 303(d) List, the BLRP should include a monitoring and reporting program that contains the following elements:
    - Locations of water quality sampling sites that are spatially representative of the waterbody and appropriate for identifying potential sources, including, at a minimum, the monitoring stations currently used to monitor water quality.
    - Schedule of water quality sampling that is temporally representative of both wet weather and dry weather conditions. Wet weather samples are collected during storms of 0.2 inches of rainfall and the 72 hour period after the storm. Dry weather samples are collected from during times when rain has not fallen for the preceding 72 hours.
    - Presentation of past and present water quality data that have been collected.
    - Analysis of water quality data compared to the applicable Basin Plan water quality objectives. Dry weather water quality data are compared to long-term (e.g., geometric mean, mean, or median) water quality objectives, as well as short-term (e.g., single sample maximum) water quality objectives. Wet weather water quality data are compared to short-term (e.g., single sample maximum) water quality objectives.
    - Analysis of water quality data to correlate measureable improvements in water quality with past and current BMPs that have been implemented and are effective.
    - Analysis of water quality data to correlate elevated bacteria levels with known or suspected sewage spills from wastewater collection systems and treatment plants or boats.
- Recommendations for increased or decreased water quality sampling based on water quality data analyses.

- Each BLRP and BCS should be reviewed annually to identify needed modifications and improvements. The dischargers should develop and implement a plan and schedule, included in the BCS, to address the identified modifications and improvements. All updates to the BLRP should be documented in the BLRP, and submitted to the San Diego Water Board. Individual dischargers should also review and modify their jurisdictional ordinances and activities as necessary so that they are consistent with the requirements of the BLRP.

Bacteria Compliance Schedule - BMP Planning and Scheduling

The BCS should identify the BMPs/water quality projects that have been implemented or are planned for implementation and provide an implementation schedule for each BMP/water quality project. The BCS should demonstrate how the BMPs/water quality projects will address all the bacteria TMDLs. The BCS, at a minimum, should include scheduling for the following:

Non-structural BMP phasing:

- Completed Non-Structural BMP Analysis – Information should be provided regarding the non-structural BMPs completed and/or currently in practice, a timeline of BMP implementation and maintenance, and an assessment of effectiveness.

If the Completed Non-Structural BMP Analysis indicates additional non-structural BMPs are necessary, the following should be included in the BCS:

- New Non-Structural BMP Analysis - Watershed data should be analyzed to identify new effective non-structural BMPs for implementation. This should be completed and included in the BCS.

- Scheduled Annual Non-structural BMP Implementation - The above analysis should be used to identify BMPs that have and will be implemented and to develop an aggressive non-structural BMP implementation schedule. The BCS should include a schedule of the current BMP staffing for each impaired area, and provide a discussion on adjustments to staff scheduling to meet possible new non-structural BMP demands. Schedules should be realistic and justifiable.

- Scheduled Annual BMP Assessment and Optimizing Adjustments - As the non-structural BMPs are implemented, a scheduled in-depth assessment of the non-structural BMPs' performance should follow. Non-structural BMPs that are found to be ineffective should be modified to incorporate optimizing adjustments to improve performance or be replaced by other effective non-structural BMPs. The results from this assessment should also be used to determine structural BMP selection and the schedule for structural BMP implementation. The BCS should include an annual schedule for in-depth non-structural BMP assessment and optimizing adjustments.

- Scheduled Continuous Budget and Funding Efforts - Securing budget and funding for non-structural BMP staffing and equipment should be scheduled early and continue until the bacteria TMDLs are met. The BCS should include a schedule for staff time, including position and job description, authorized for securing budget and funding for non-structural BMP implementation.

Structural BMP phasing:

- Completed Structural BMP Analysis – Information should be provided regarding the structural BMPs completed and/or currently in practice, a timeline of BMP implementation and maintenance, and an assessment of effectiveness.

If the Completed Structural BMP Analysis indicates additional structural BMPs are necessary, the following should be included in the BCS:

- Scheduled New Structural BMP Analysis – Structural BMP analysis should utilize all available information, including the non-structural BMP assessment and existing structural BMP assessment, to identify, locate, design and build possible new structural BMPs, or a train of BMPs, to meet the these bacteria TMDLs. The BCS should include a schedule for structural BMP analysis.

- Scheduled Annual BMP Construction - The BCS should include a projected general construction schedule with a realistic and justifiable timeline for possible new BMP construction.

- Scheduled Annual BMP Assessment, Optimization Adjustments, and Maintenance - Assessment for structural BMPs should begin immediately upon initial BMP completion, followed by continuously scheduled BMP assessment, optimization adjustments, and maintenance, to both the individual structural BMPs and the structural BMP program as a whole. The BCS should include an annual schedule for in-depth structural BMP assessment.

- Scheduled Continuous Budget and Funding Effort - Securing budget and funding for structural BMPs and additional maintenance staff should be scheduled early and continue until the bacteria TMDLs are met. The BCS should include a schedule for staff time, including position and job description, authorized for securing budget and funding for structural BMP implementation.

Subsequent reports should assess and describe the effectiveness of implementing the Bacteria Load Reduction Plan. Effectiveness assessments should be based on a program effectiveness assessment framework, such as the one developed by the California Stormwater Quality Association (CASQA, 2005). Using the CASQA framework as an example, the assessments should address the framework's outcome levels 1-5 on an annual basis, and outcome level 6 once every five years.[27] Methods used for assessing effectiveness should include the following or their equivalent: surveys, pollutant loading estimations, and receiving water quality monitoring. The long-term strategy should also discuss the role of monitoring data in substantiating or refining the assessment. Once WQOs have been attained, or the anthropogenic sources have been eliminated and pollutant loads can be attributed to only natural and background sources, a reduced level of monitoring may be appropriate.

In addition to these requirements, if load-based numerical WQBELs are included in the NPDES requirements, the monitoring requirements should include flow and bacteria density measurements to determine if bacteria loads in effluent are in compliance with WQBELs.

The BLRPs are the municipal dischargers' opportunity to propose methods for assessing compliance with WQBELs that implement TMDLs. The monitoring components included in the BLRPs should be formulated according to particular compliance assessment strategies. The monitoring components are expected to be consistent with, and support whichever compliance assessment methods are proposed. The San Diego Water Board will coordinate with the municipal dischargers during the development of their proposed monitoring components and associated compliance assessment methods.

If NPDES requirements are not likely to be issued, reissued or revised within 6 months of OAL approval of these TMDLs, the San Diego Water Board may issue an investigative/monitoring order to dischargers pursuant to sections 13267 or 13383 of the Water Code. This order would require assessment of current BMPs, possible planning for additional BMPs, and receiving water quality monitoring in adherence to performance measures described above.

The BLRPs may be re-evaluated at set intervals (such as 5-year renewal cycles for NPDES requirements, or upon request from responsible dischargers, as appropriate and in accordance with the San Diego Water Board priorities). Plans may be iterative and adaptive according to assessments and any special studies.

10.6.3 Actions with Respect to Wastewater Collection Systems and Treatment Plants

The San Diego Water Board will conduct surveillance of and enforce the provisions of State Water Board Order No. 2006-0003-DWQ, and San Diego Water Board Order No. R9-2007-0005 as needed to ensure that collection systems for waste water treatment plants do not overflow, leak, or otherwise discharge into MS4s or surface

[27] Outcome level 1 assesses compliance with activity-based permit requirements. Outcome level 2 assesses changes in attitudes, knowledge, and awareness. Outcome level 3 assesses behavioral change and BMP implementation. Outcome level 4 assesses pollutant load reductions. Outcome level 5 assesses changes in urban runoff and discharge water quality. Outcome level 6 assesses changes in receiving water quality. See CASQA "An Introduction to Stormwater Program Effectiveness Assessment."

waters. If necessary, San Diego Water Board Order No. R9-2007-0005 can be revised to require more aggressive collection system monitoring, maintenance, and repair schedules.

10.6.4 Actions with Respect to Marinas and Boats

If discharges from boats are shown to be a significant source of bacteria contributing to exceedances of water quality objectives, the San Diego Water Board will enforce the waste discharge prohibitions in the Basin Plan to ensure that illegal discharges from boats to surface waters do not occur. This may require issuing NPDES requirements or waste discharge requirements to the marina and harbor operators and/or the muncipalities requiring implementation of BMPs (e.g., public education and outreach, enforcing ordinances, and/or requiring dye tabs in boat sewage holding tanks) to eliminate illegal discharges of sewage, in addition to water quality monitoring and reporting.

10.6.5 Additional Actions

Additional actions that the San Diego Water Board can take to ensure implementation of the bacteria TMDLs are to take enforcement actions, and recommend high prioritization of TMDL implementation projects for grant funds. Additionally, if the REC-1 WQOs cannot be met in the receiving waters, and if natural and background sources appear to be the sole source of continued impairment, the San Diego Water Board may allow for exceedances of the REC-1 WQOs using the Natural Sources Exclusion Approach. These actions are described below.

Take Enforcement Actions

The San Diego Water Board shall consider enforcement actions,[28] as necessary and appropriate, against any discharger failing to comply with applicable WDRs or discharge prohibitions. Enforcement actions may be taken, as necessary and appropriate, to control the discharge of bacteria to impaired shorelines to attain compliance with the bacteria WLAs specified in this Technical Report, or to attain compliance with the REC-1 indicator bacteria WQOs.

[28] An enforcement action is any formal or informal action taken to address an incidence of actual or threatened noncompliance with existing regulations or provisions designed to protect water quality. Potential enforcement actions including notices of violation (NOVs), notices to comply (NTCs), imposition of time schedules (TSO), issuance of cease and desist orders (CDOs) and cleanup and abatement orders (CAOs), administrative civil liability (ACL), and referral to the attorney general (AG) or district attorney (DA). The San Diego Water Board generally implements enforcement through an escalating series of actions to: (1) assist cooperative dischargers in achieving compliance; (2) compel compliance for repeat violations and recalcitrant violators; and (3) provide a disincentive for noncompliance.

Recommend High Priority for Grant Funds

The San Diego Water Board shall recommend that the State Water Board assign a high priority to awarding grant funding[29] for projects to implement the bacteria TMDLs. Special emphasis will be given to projects that can achieve quantifiable bacteria load reductions consistent with the specific bacteria TMDL WLAs and LAs.

Apply the Natural Sources Exclusion Approach[30]

Under the Natural Sources Exclusion Approach (NSEA), all anthropogenic sources of indicator bacteria to the water bodies subject to an indicator bacteria TMDL must be controlled. Dischargers must also demonstrate that all anthropogenic sources of indicator bacteria to the target water body are controlled and that residual indicator bacteria densities do not indicate a health risk.

Once control of all anthropogenic sources and demonstration of appropriate health risk levels have been achieved, the residual indicator bacteria loads in the waterbodies attributable to uncontrollable sources can be identified and measured. Likewise, the frequency that uncontrollable sources cause exceedances of indicator bacteria water quality objectives in the water body can be identified. The information can be used to establish an allowable indicator bacteria WQO exceedance frequency in the impaired water body based upon the residual exceedance frequency observed. This information can then be used to recalculate the TMDLs, WLAs, and LAs.

The use of the NSEA is contingent upon demonstration of control of all anthropogenic sources of indicator bacteria to the waterbodies subject to an indicator bacteria TMDL. Since this task is likely to be formidable, use of the NSEA is not expected to occur immediately. Rather, the NSEA would be used to recalculate TMDLs at some point after their initial adoption, following demonstration of control of all anthropogenic sources.

The dischargers are responsible for collecting and providing the data to support the application of the NSEA. If the data support the application of the NSEA, the San Diego Water Board will recalculate the TMDLs, WLAs, and LAs to allow for the exceedances of the REC-1 indicator bacteria WQOs due to uncontrollable sources.

10.7 Coordination and Execution of Special Studies

The San Diego Water Board recognizes that coordination and execution of special studies by dischargers and other interested persons could result in improved TMDL

[29] In most cases, the State Water Board administers the awarding of grants funded from Proposition 13, Proposition 50, Clean Water Act section 319(h) and other federal appropriations to projects that can result in measurable improvements in water quality, watershed condition, and/or capacity for effective watershed management. Many of these grant fund programs have specific set-asides for expenditures in the areas of watershed management and TMDL project implementation for non-point source pollution.

[30] After approval of the Basin Plan amendment (Resolution No. R9-2008-0028) authorizing the use of the Natural Sources Exclusion Approach by the Office of Administrative Law, anticipated by the end of 2008 or early 2009.

analyses that more accurately protect beneficial uses. Areas of study that could benefit TMDL analysis include collection of data that can be used to improve model output, improved understanding of bacteria levels and the relationship to health effects, and identification of an appropriate and affordable method(s) to measure pathogens directly. Additionally, studies designed to measure BMP effectiveness and bacteria source identification (see section 10.5.2) will be useful for dischargers in identifying appropriate strategies to meet the requirements of this TMDL project.

10.7.1 Collect Data Useful for Model Improvement

Calibration and validation of the computer models used for TMDL analysis was based on limited data (water quality and/or flow) and assumed values for input parameters such as rates for bacteria die-off and re-growth. Limited data are available related to fecal bacteria that can be attributed to natural and background sources (e.g., waterfowl, terrestrial and aquatic wildlife, wrack line and aquatic plants, sediments, and other unidentified and unquantified sources within the waters). Studies designed to collect additional data that can be used for model improvement will result in more accurate TMDL results. Also, actual flow and loading data from each watershed and expanded receiving water data can be used to construct models that can more accurately reflect site-specific conditions.

10.7.2 Improve Understanding Between Bacteria Levels and Health Effects

The San Diego Water Board recognizes that there are potential problems associated with using indicator bacteria WQOs to indicate the presence of human pathogens in receiving waters free of sewage discharges. The indicator bacteria WQOs were developed, in part, based on epidemiological studies in waters with sewage inputs. The risk of contracting a water-born illness from contact with urban runoff devoid of sewage, or human-source bacteria is not known. Some pathogens, such as *giardia* and *cryptosporidium* can be contracted from animal hosts. Likewise, domestic animals can pass on human pathogens through their feces. These and other uncertainties need to be addressed through special studies and, as a result, revisions to the TMDLs established in this project may be appropriate.

Indicator bacteria are used to measure the risk of swimmer illness because they have been shown to indicate the presence of human pathogens, such as viruses, when human bacteria sources are present. Indicator bacteria have been historically used because they are easier and less costly to measure than the pathogens themselves (see Appendix A). In recent years, however, questions have been raised regarding the validity of using indicator bacteria to ascertain risk to swimmers in recreational waters, since they appear to be less correlated to viruses when sources are from urban runoff (Jiang et al, 2001). In fact, most epidemiology studies conducted to measure the risk of swimmer illness in the presence of indicator bacteria have taken place in receiving waters containing known sewage impacts.

To date, only two epidemiology studies have been conducted where the bacteria source was primarily urban runoff. The Santa Monica Bay epidemiology study (Haile et al,

1999) reported that there was a direct correlation between swimming related illnesses and densities of indicator bacteria. The sites included in this study were known to contain human sources of fecal contamination. Most recently, the Mission Bay epidemiological study (Colford et al, 2005) showed that there was no correlation between swimmer illness and concentrations of indicator bacteria. Unlike Santa Monica Bay, bacteria sources in Mission Bay were shown to be primarily of nonhuman origin (City of San Diego and MEC/Weston, 2004). The studies caution against extrapolating the results from the Mission Bay study to other locations, since there have been extensive cleanup activities on this waterbody and subsequently bacteria source analyses have shown that human fecal sources are only a minor contributor. The link between bacteria loads from urban runoff containing mostly nonhuman sources, and risk of illness needs to be better understood.

Recent studies have also shown that bacteria regrowth is a significant phenomenon (City of San Diego and MEC/Weston, 2004; City of Laguna Niguel and Kennedy Jenks, 2003). Such regrowth can cause elevations in bacteria levels that do not correspond to an increase in human pathogens and risk of illness. For example, the Mission Bay Source Identification Study found that bacteria multiply in the wrack line on the beach (eel grass and other debris) during low tide, caused exceedances of the water quality objectives during high tide when the wrack is inundated. This same phenomenon likely occurs inside storm drains, where tidal cycles and freshwater input can cause bacteria to multiply. In both these cases, an increase in bacteria densities does not necessarily correlate to an increase in the presence of human pathogens. The regrowth phenomenon is problematic since responsible parties must expend significant resources to reduce the current bacteria loads to receiving waters to meet the required waste load reductions. For example, bacteria regrowth and residence time may be a factor at Baby Beach, where studies have shown high levels of bacteria resident in beach sediments near storm drains.

As information is gathered, initiating special studies to understand the uncertainties between bacteria levels and bacteria sources within the watersheds may be useful. Specifically, continuing research may be helpful to answer the following questions:

- What is the risk of illness from swimming in water contaminated with urban/stormwater runoff devoid of sewage?
- Do exceedances of the bacteria water quality objectives from animal sources (wildlife and domestic) increase the risk of illness?
- Are there other, more appropriate surrogates for measuring the risk of illness than the indicator bacteria WQOs currently used?

Addressing these uncertainties is needed to maximize effectiveness of strategies to reduce the risk of illness, which is currently measured by indicator bacteria densities. Dischargers may work with the San Diego Water Board to determine if such special studies are appropriate.

10.7.3 Identification of Method for Direct Pathogen Measurement

Ultimately, the San Diego Water Board supports the idea of measuring pathogens (the agents causing impairment of beneficial uses) or an acceptable alternative indicator, rather than indicator bacteria (surrogates for pathogens). However, as stated previously, indicator bacteria have been used to measure water quality historically because measurement of pathogens is both difficult and costly. The San Diego Water Board is supportive of any efforts by the scientific community to perform epidemiological studies and/or investigate the feasibility of measuring pathogens directly. The San Diego Water Board further supports subsequent modification of WQOs as a result of such studies. Ultimately, TMDLs will be recalculated if WQOs are modified due to results from future studies.

10.8 TMDL Implementation Milestones

Accomplishing the goals of the implementation plan will be achieved by cooperative participation from all responsible parties, including the San Diego Water Board. Major milestones are described below in Table 10-7.

Table 10-7. TMDL Implementation Milestones

Item	Implementation Action	Responsible Parties	Date
1	Effective date of Baby Beach and Shelter Island Shoreline Park Bacteria TMDL Waste Load Allocations (WLAs).	▪ San Diego Water Board ▪ Phase I Municipal Dischargers	Effective date*
2	Issue, reissue, or revise Phase I Municipal NPDES WDRs to include WQBELs consistent with the WLAs.	▪ San Diego Water Board	Within 5 years of effective date
3	Submit annual Progress Report to San Diego Water Board.	▪ Phase I Municipal Dischargers	Annually after reissue of NPDES WDRs
4	Recommend TMDL-related projects as high priority for grant funds.	▪ San Diego Water Board	As needed after effective date
5	Coordination and execution of special studies.	▪ San Diego Water Board ▪ Phase I Municipal Dischargers	As needed after effective date
6	Meet 50% wasteload reductions.	▪ Baby Beach Phase I Municipal Dischargers	3 years after effective date for dry weather 7 years after effective date for wet weather
		▪ Shelter Island Shoreline Park Phase I Municipal Dischargers	No load reductions required. Removal from 303(d) List by 2012.
7	Meet 100% wasteload reductions.	▪ Baby Beach Phase I Municipal Dischargers	5 years after effective date for dry weather 10 years after effective date for wet weather
		▪ Shelter Island Shoreline Park Phase I Municipal Dischargers	No load reductions required. Removal from 303(d) List by 2012.
8	Take enforcement actions to attain compliance with the WLAs.	▪ San Diego Water Board	As needed after effective date
9	Issue NPDES requirements or waste discharge requirements to marina and harbor operators and/or the muncipalities to eliminate sewage discharges from boats	▪ San Diego Water Board	As needed after effective date
10	Apply NSEA and recalculate TMDLs	▪ Baby Beach Phase I Municipal Dischargers	As appropriate after effective date, if data are available to support the action.
		▪ Shelter Island Shoreline Park Phase I Municipal Dischargers	

* Effective date is date of approval of these TMDLs by the Office of Administrative Law

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11 Environmental Analysis, Environmental Checklist, and Economic Factors

The San Diego Water Board must comply with the California Environmental Quality Act (CEQA) when amending the Basin Plan[31] as proposed in this project to adopt these TMDLs for bacteria at the impaired shorelines of BB and SISP. Under the CEQA, the San Diego Water Board is the Lead Agency[32] for evaluating the environmental impacts of the reasonably foreseeable methods of compliance with the proposed TMDLs. The following section summarizes the environmental analysis conducted to fulfill the CEQA requirements. The complete environmental analysis, including the environmental checklist and discussion of economic factors, are discussed in detail in Appendix M.

11.1 California Environmental Quality Act Requirements

The CEQA authorizes the Secretary of the Resources Agency to certify state regulatory programs, designed to meet the goals of the CEQA, as exempt from its requirements to prepare an Environmental Impact Report (EIR), Negative Declaration, or Initial Study. The State Water Resources Control Board's (State Water Board's) and San Diego Water Board's Basin Plan amendment process is a certified regulatory program and is therefore exempt from the CEQA's requirements to prepare such documents.

The State Water Board's CEQA implementation regulations describe the environmental documents required for Basin Plan amendment actions. These documents consist of a written report that includes a description of the proposed activity, alternatives to the proposed activity to minimize or eliminate potentially significant environmental impacts, and identification of mitigation measures to minimize any significant adverse impacts.

The CEQA and CEQA Guidelines limit the scope to an environmental analysis of the reasonably foreseeable methods of compliance with the WLAs and LAs. The State Water Board CEQA Implementation Regulations for Certified Regulatory Programs require the environmental analysis to include at least the following:

1. A brief description of the proposed activity. In this case, the proposed activity is the TMDL Basin Plan amendment.
2. Reasonable alternatives to the proposed activity.
3. Mitigation measures to minimize any significant adverse environmental impacts of the proposed activity.

Additionally, the CEQA and CEQA Guidelines require the following components, some of which are repetitive of the list above:

[31] Public Resources Code section 21080.
[32] Public Resources Code section 21067. "Lead Agency" means the public agency, which has the principal responsibility for carrying out or approving a project. The Lead Agency will decide whether an EIR or Negative Declaration will be required for the project and will cause the document to be prepared.

1. An analysis of the reasonably foreseeable environmental impacts of the methods of compliance.
2. An analysis of reasonably foreseeable mitigation measures relating to those impacts.
3. An analysis of reasonably foreseeable alternative means of compliance with the rule or regulation, which would avoid or eliminate the identified impacts.

Additionally, the CEQA Guidelines require the environmental analysis take into account a reasonable range of:

1. Environmental factors.
2. Economic factors.
3. Technical factors.
4. Population.
5. Geographic areas.
6. Specific sites.

11.2 Analysis of Reasonably Foreseeable Methods of Compliance

The analysis of potential environmental impacts is based on the numerous alternative means of compliance available for controlling bacteria loading to the impaired shoreline segments of BB and SISP. The only controllable sources of bacteria are attributed to the MS4s that drain the watersheds that drain into the receiving waters. Attainment of the WLAs will be achieved through discharger implementation of structural and non-structural BMPs for point sources. The BMP control strategies should be designed to reduce bacteria loading in urban and stormwater runoff.

The controls evaluated in Appendix M include the following non-structural and structural BMPs:

- Education and outreach;
- Road and street maintenance;
- Storm drain system cleaning;
- BMP inspection and maintenance;
- Enforcement of local ordinances;
- Buffer strips and vegetated swales;
- Bioretention
- Infiltration trenches
- Sand filters
- Diversion/treatment systems.

Structural and non-structural control strategies can be based on specific land uses, sources, or periods of a storm event. In order to comply with these TMDLs, emphasis should be placed on BMPs that control the sources of pollutants and on the maintenance of BMPs that remove pollutants from runoff.

11.3 Possible Environmental Impacts

The CEQA and CEQA Guidelines require an analysis of the reasonably foreseeable environmental impacts of the methods of compliance with the TMDL Basin Plan amendment. The environmental checklist identifies the potential environmental impacts associated with these methods with respect to earth, air, water, plant life, animal life, noise, light, land use, natural resources, risk of upset, population, housing, transportation, public services, energy, utilities and services systems, human health, aesthetics, recreation, and archeological/historical concerns. In addition to the potential impacts evaluated above, mandatory findings of significance regarding potential to degrade, short-term, cumulative, and substantial adverse impacts were evaluated.

The evaluation considered whether the implementation and/or construction or implementation of the non-structural and/or structural controls would cause a substantial, adverse change within the areas affected by the control. Based on this review, the San Diego Water Board concluded that the potentially significant cumulative impacts can be mitigated to less than significant levels as discussed in Appendix M. Broad mitigation approaches have been identified that if employed, would reduce the potentially significant adverse impacts identified to less than significant. However, such mitigation approaches are within the responsibility and jurisdiction of other public agencies, and not the San Diego Water Board. Water Code section 13360 precludes the San Diego Water Board from dictating the manner in which responsible agencies comply with any of the San Diego Water Board's regulations or orders.

The San Diego Water Board does not engage in speculation or conjecture regarding the projects that may be implemented to comply with the TMDLs and only considers the reasonably foreseeable alternative methods of compliance, the reasonably foreseeable feasible environmental impacts of the these methods of compliance, and the reasonably foreseeable mitigation measures which would avoid or eliminate the identified impacts, all from a broad general perspective consistent with the uncertainty regarding how the TMDLs, ultimately, will be implemented. When the agencies responsible for implementing projects to comply with this TMDL determine how they will proceed, the agencies responsible for those parts of the project can and should incorporate such mitigation approaches into any subsequent projects or project approvals to reduce any potentially significant impacts to less than significant. See sections M.4 and M.5 in Appendix M for a complete discussion of the potential environmental impacts and mitigation measures.

11.4 Alternative Means of Compliance

The CEQA requires an analysis of reasonably foreseeable alternative means of compliance with the rule or regulation, which would avoid or eliminate the identified impacts. The dischargers can use the structural and non-structural BMPs described in Appendix M or other structural and non-structural BMPs, to control and prevent pollution, and meet the TMDLs' required load reductions. The alternative means of compliance with the TMDLs consist of the different combinations of structural and non-structural BMPs that the dischargers might use. Since most of the adverse environmental effects are associated with the construction and installation of large scale structural BMPs, to avoid or eliminate impacts, compliance alternatives should minimize structural BMPs, maximize non-structural BMPs, and site, size, and design structural BMPs in ways to minimize environmental effects.

11.5 Reasonably Foreseeable Methods of Compliance at Specific Sites

The San Diego Water Board analyzed various reasonably foreseeable methods of compliance at specific sites within the subject watersheds. The specific sites analysis was focused on reviewing potential compliance methods within various land uses. The land uses analyzed correspond to the land uses that were utilized for watershed model development (discussed in section 7 above).

In the discussion of potential compliance methods in section M.6 of Appendix M, the San Diego Water Board assumed that, generally speaking, the BMPs suitable for the control of bacteria generated from a specific land use within a given watershed were also suitable for the control of bacteria generated from the same land use category within a different watershed. For example, a BMP used to control the discharge of bacteria from a residential area in the San Diego County watershed is likely suitable to control the discharge of bacteria from a residential area in the Orange County watershed. However, in addition to land use, BMP selection includes considering site-specific geographical factors such as average rainfall, soil type, and the amount of impervious surfaces, and non-geographical factors such as available funding. Such factors vary between watersheds. The most suitable BMP(s) for a particular site must be determined by the dischargers in a detailed, project-specific environmental analysis.

In order to meet TMDL requirements, dischargers will determine and implement the actual compliance method(s) after a thorough analysis of the specific sites suitable for BMP implementation within each watershed. In most cases, the San Diego Water Board anticipates a potential strategy to be the use of non-structural BMPs as a first step in controlling bacteria discharges, followed by structural BMP installation if necessary.

11.6 Economic Factors

The environmental analysis required by the CEQA must take into account a reasonable range of economic factors. This section contains estimates of the costs of implementing the reasonably foreseeable methods of compliance with the TMDL Basin Plan amendment. Specifically, this analysis estimates the costs of implementing the structural and non-structural BMPs which the dischargers could use to reduce bacteria loading.

As discussed in section M.7 in Appendix M, the cost estimates for non-structural BMPs ranged from $0 to $211,000. For SISP, the cost estimates for treating 10 percent of the watershed with structural BMPs ranged from approximately $900 to over $1 million, depending on BMP selection, with yearly maintenance costs estimated from less than $200 to over $10,000. For BB, the cost estimates for treating 10 percent of the watershed with structural BMPs ranged from approximately $46,000 to approximately $11 million, depending on BMP selection, with yearly maintenance costs estimated from approximately $8,000 to over $760,000. Implementation of these TMDLs will also entail water quality monitoring which has associated costs. Assuming that a two-person sampling team can collect samples from 4 locations in one 8-hour day, the total cost for one day of sampling would be $3,291.

The specific BMPs to be implemented will be chosen by the dischargers after adoption of these TMDLs. All costs are preliminary estimates since particular elements of a BMP, such as type, size, and location, would need to be developed to provide a basis for more accurate cost estimations.

11.7 Reasonable Alternatives to the Proposed Activity

The environmental analysis must include an analysis of reasonable alternatives to the proposed activity. The proposed activity is a Basin Plan Amendment to incorporate bacteria TMDLs for the impaired shoreline segments of BB and SISP. The purpose of this analysis is to determine if there is an alternative that would feasibly attain the basic objective of the rule or regulation (the proposed activity), but would lessen, avoid, or eliminate any identified impacts. The alternatives analyzed include taking no action or modifying water quality standards. These alternative actions are discussed in section M.8 of Appendix M. Because these alternatives are not expected to attain the basic objective of the proposed activity at this point in time, the preferred alternative is the proposed activity itself, which is the Basin Plan amendment incorporating the bacteria TMDLs.

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12 Necessity of Regulatory Provisions

The Office of Administrative Law (OAL) is responsible for reviewing administrative regulations proposed by state agencies for compliance with standards set forth in California's Administrative Procedure Act, Government Code section 11340 *et seq.*, for transmitting these regulations to the Secretary of State and for publishing regulations in the California Code of Regulations. Following State Water Board approval of this Basin Plan amendment establishing TMDLs, any regulatory portions of the amendment must be approved by the OAL per Government Code section 11352. The State Water Board must include in its submittal to the OAL a summary of the necessity[33] for the regulatory provision.

This Basin Plan amendment for Bacteria Impaired Waters meets the "necessity standard" of Government Code section 11353(b). Amendment of the Basin Plan to establish and implement bacteria TMDLs in affected watersheds in the San Diego Region is necessary because the existing water quality does not meet applicable numeric WQOs for indicator bacteria. Applicable state and federal laws require the adoption of this Basin Plan amendment and regulations as provided below.

The State Water Board and Regional Water Boards are delegated the responsibility for implementing California's Porter-Cologne Water Quality Control Act and the federal Clean Water Act. Pursuant to relevant provisions of both of those acts the State Water Board and San Diego Water Board establish water quality standards, which include designated beneficial uses and water quality criteria or objectives to protect those uses.

Clean Water Act section 303(d) [United States Code Title 33 section 1313(d)] requires the states to identify certain waters within their borders that are not attaining water quality standards and to establish TMDLs for certain pollutants impairing those waters. USEPA regulations[34] provide that a TMDL is a numerical calculation of the amount of a pollutant that a water body can assimilate and still meet water quality standards. A TMDL includes one or more numeric targets that represent attainment of the applicable standards, considering seasonal variations and a margin of safety (MOS), in addition to the allocation of the target or load among the various sources of the pollutant. These include wasteload allocations (WLAs) for point sources, and load allocations (LAs) for nonpoint sources and background sources. TMDLs established for impaired waters must be submitted to the USEPA for approval.

Clean Water Act section 303(e) requires that TMDLs, upon USEPA approval, be incorporated into the state's Water Quality Management Plans, along with adequate

[33] "Necessity" means the record of the rulemaking proceeding demonstrates by substantial evidence the need for a regulation to effectuate the purpose of the statute, court decision, provision of law that the regulation implements, interprets, or makes, taking into account the totality of the record. For purposes of this standard, evidence includes, but is not limited to, facts, studies, and expert opinion. [Government Code section 11349(a)].

[34] Code of Federal Regulations Title 40 section 130.2

measures to implement all aspects of the TMDL. In California, these are the basin plans for the nine regions. Water Code sections 13050(j) and 13242 require that basin plans have a program of implementation to achieve WQOs. The implementation program must include a description of actions that are necessary to achieve the objectives, a time schedule for these actions, and a description of surveillance to determine compliance with the objectives. State law requires that a TMDL project include an implementation plan because TMDLs normally are, in essence, interpretations or refinements of existing WQOs. The TMDLs have to be incorporated into the Basin Plan,[35] and, because the TMDLs supplement, interpret, or refine existing objectives, State law requires a program of implementation.

[35] Clean Water Act section 303(e)

13 Public Participation

Public participation is an important component of TMDL development. The federal regulations require that TMDL projects be subject to public review.[36] All public hearings and public meetings have been conducted as stipulated in the regulations,[37] for all programs under the Clean Water Act. Public participation was provided through one public workshop, and through the formation and participation of the Stakeholder Advisory Group. In addition, staff contact information was provided on the San Diego Water Board's website, along with periodically updated drafts of the TMDL project documents. Public participation also took place through the San Diego Water Board's Basin Plan amendment process, which included an additional public workshop, a hearing, and a formal public comment period. A chronology of public participation and major milestones is provided in Table 14-1.

Table 14-1. Public Participation Milestones

Date	Event
February 18. 2003	Notice of Public Workshop and CEQA Scoping Meeting
March 27, 2003	Public Workshop and CEQA Scoping Meeting
May 23, 2005	SAG Meeting and Preliminary Draft Technical Report released for SAG review
June 30, 2005	SAG Meeting
January 15, 2008	Draft Documents released for SAG review
February 14, 2008	SAG Meeting
February 19, 2008	Notice of Public Hearing
February 22, 2008	Draft Documents released for public review
April 9, 2008	Public Hearing
June 11, 2008	Adoption Hearing

[36] Code of Federal Regulations Title 40 section 130.7
[37] Code of Federal Regulations Title 40 section 25.5 and 25.6

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14 References

Bicknell, B.R., J.C. Imhoff, J.L. Kittle, A.S. Donigian, and R.C. Johanson. 1996 *Hydrological Simulation Program – FORTRAN (HSPF): User's Manual Release 12*. National Exposure Research Laboratory, Office of Research and Development, USEPA, Athens, Georgia.

Brown and Caldwell. 2006. *Report Summarizing Comments from the Port of San Diego Requesting Delisting of the San Diego Bay Shoreline, Point Loma Hydrologic Area (908.10) at Shelter Island Shoreline Park for Bacteria Indicators*. Prepared by Brown and Caldwell for Port of San Diego, San Diego, CA.

California Stormwater Quality Association (CASQA). 2005. An Introduction to Stormwater Program Effectiveness Assessment. 10 pp.

City of San Diego. 2004. *Mission Bay Clean Beaches Initiative Bacterial Source Identification Study.* Final Report to the State Water Resources Control Board.

County of Orange Public Facilities and Resources Department. 2003. *State of the Beach Report, Baby Beach Region, Dana Point Harbor, California*. Prepared with the assistance of Science Applications International Corporation. June 2003.

County of San Diego Department of Environmental Health. 2000. *County of San Diego—Ocean Illness Survey Results (August 1997–December 1999)*. County of San Diego Department of Environmental Health, San Diego, CA.

Fleming, R., and H. Fraser. 2001. *The Impact of Waterfowl on Water Quality: Literature Review.* Ridgetown College, University of Guelph.

Grant, S., B. Sanders, A. Boehm, J. Redman, J. Kim, R. Mrse, A. Chu, M. Gouldin, C. McGee, N. Gardiner, B. Jones, J. Svejkovsky, G. Leipzig, and A. Brown. 2002. Generation of enterococci bacteria in coastal saltwater marsh and its impact on the surf zone water quality. *Environmental Science & Technology* (November 12, 2001)35: pp. 2407-2416.

Haile, R.W., J.S. Witte, M. Gold, R. Cressey, C. McGee, R.C. Millikan, A. Glasser, N. Harawa, C. Ervin, P. Harmon, J. Harper, J. Dermand, J. Alamillo, K. Barrett, M. Nides and G.-Y. Wang. 1999. The health effects of swimming in ocean water contaminated by storm drain runoff. *Epidemiology* 10:355-363.

Los Angeles Water Board. 2002. *Total Maximum Daily Load to Reduce Bacterial Indicator Densities at Santa Monica Bay Beaches During Wet Weather*. Los Angeles Regional Water Quality Control Board, Los Angeles, CA.

Los Angeles Water Board. 2003. *Total Maximum Daily Loads for Bacteria in the Malibu Creek Watershed*. Los Angeles Regional Water Quality Control Board, Los Angeles, CA.

San Diego Water Board. 1994. *Water Quality Control Plan for the San Diego Basin (9)*. San Diego Regional Water Quality Control Board, San Diego, CA.

San Diego Water Board. 2002. *Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining to the Watersheds of the County of Orange, the Incorporated Cities of Orange County, and the Orange County Flood Control District Within the San Diego Region (NPDES No. CAS0108740)*. Order No. R9-2002-01. San Diego Regional Water Quality Control Board, San Diego, CA.

San Diego Water Board. 2007. *Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining to the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, the San Diego Unified Port District, and the San Diego county Regional Airpot Authority (NPDES No. CAS0108758)*. Order No. R9-2007-0001. San Diego Regional Water Quality Control Board, San Diego, CA.

San Diego Water Board. 2007. Total Maximum Daily Loads for Indicator Bacteria, Project I- Beaches and Creeks in the San Diego Region. Technical Report. San Diego Regional Water Quality Control Board, San Diego, CA.

USDA. 1986. *Urban Hydrology for Small Watersheds*. U.S. Department of Agriculture. Soil Conservation Service, Engineering Division, Technical Release 55 (TR-55).

USEPA (U.S. Environmental Protection Agency). 2003a. Fact Sheet: Loading Simulation Program in C++ (LSPC). USEPA, Watershed and Water Quality Modeling Technical Support Center, Athens, GA. Available at http://www.epa.gov/athens/wwqtsc/LSPC.pdf (accessed in March 2008).

USEPA (U.S. Environmental Protection Agency). 2003b. Fact Sheet: Environmental Fluid Dynamics Code (EFDC). USEPA, Watershed and Water Quality Modeling Technical Support Center, Athens, GA. Available at http://www.epa.gov/athens/wwqtsc/EFDC.pdf (accessed in March 2008).