Marina del Rey Harbor Mothers' Beach and Back Basins Bacteria TMDL

Table of Contents

Tables

Figures

Appendices

Acronyms

ACL	Administrative Civil Liability
BMPs	Best Management Practices
BRC	Beach Report Card
CalTrans	California Department of Transportation
CDOs	Cease and Desist Orders
CEQA	California Environmental Quality Act
CWA	Clean Water Act
DBH	Department of Beaches and Harbors
DHS	Department of Health Services
HDSFR	High-Density Single Family Residence
HTP	Hyperion Treatment Plant
LACDBH	Los Angeles County Department of Beach and Harbors
LACDPW	Los Angeles County Department of Public Works
LACDWP	Los Angeles County Department of Water and Power
LACVB	Los Angeles Convention and Visitors Bureau
LARWQCB	Los Angeles Regional Water Quality Control Board
LAs	Load Allocations
LAX	Los Angeles International Airport
LCB	Leo Carrillo Beach
MdR	Marina del Rey
MdRH	Marina del Rey Harbor
MFR	Multiple Family Residence
MGD	Million Gallons per Day
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
OAL	Office of Administrative Law
OFCB	Oxford Flood Control Basin
REC-1	Water Contact Recreation
REC-2	Non-contact Recreational Use
SCCWRP	Southern California Coastal Water Research Project
SMB	Santa Monica Bay
SMD	Shoreline Mile-Days
SMURRF	Santa Monica Urban Runoff Recycling Facility
TMDL	Total Maximum Daily Load
UCI	University of California at Irvine
USACE	United States Army Corps of Engineers
USC	University of Southern California
USEPA	Unites States Environmental Protection Agency
WDRs	Waste Discharge Requirements
WLAs	Waste Load Allocations
WQA	Water Quality Assessment

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Draft – 6/9/03

1 Introduction

This document covers the required elements of the Total Maximum Daily Load (TMDL) for bacteria at Marina del Rey Harbor (MdRH) Mothers' Beach and back basins (Basins D, E, and F) as well as providing a summary of some of the supporting technical analysis used in the development of the TMDL by the California Regional Water Quality Control Board, Los Angeles Region (Regional Board). The goal of this TMDL is to determine and set forth measures needed to prevent impairment of water quality due to bacteria at Mothers' Beach and MdRH back basins.[1]

Mothers' Beach and the back basins of MdRH were listed on the state's 1998 303(d) list as impaired due to bacteria for two reasons – the total and/or fecal coliform water quality standards contained in the Water Quality Control Plan for Ocean Waters of California (California Ocean Plan) were exceeded based on monitoring data or there were one or more beach closures during the period assessed.

Mothers' Beach and the back basins of MdRH were listed on the 1998 303(d) list due to exceedances of total and/or fecal coliform water quality standards (LARWQCB, 1996). The assessment was conducted during the 1996 regional water quality assessment (WQA). In the 1996 WQA, beaches were listed as impaired due to bacteria if, for the entire data set: (1) the fecal coliform standard of 400 organisms per 100 ml (MPN/100 ml) was exceeded in more than 15% of samples and/or (2) the total coliform standard of 10,000 MPN/100 ml was exceeded in more than 20% of samples.[2]

In addition, Mothers' Beach was listed on the 1998 303(d) list as impaired due to beach closures (LARWQCB, 1996). The majority of beach closures are due to the release of inadequately treated sewage. However, closures may also result from oil spills, vessel spills and in a few cases persistent elevated bacteria densities.[3] Beaches were originally listed in 1996 because there were one or more beach closures during the period assessed. Sewage spills are primarily addressed through enforcement actions such as Administrative Civil Liability (ACL) fines, Cease and Desist Orders (CDOs), and litigation.

During the 2002 WQA, Regional Board staff evaluated fecal and total coliform data for Mothers' Beach from December 1998 to January 2001, and fecal coliform data for the back basins of MdRH from December 1998 to August 2000. At Mothers' Beach fecal coliform ranged from 10

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[1] Bacteria can cause disease in and of itself, but is also used as an indicator of the likely presence of other disease-causing pathogens, such as viruses. Viruses are the principal agent of waterborne diseases throughout the world (National Research Council, 1999; US EPA, 2001).

[2] It should be noted that while this was the assessment guideline used in 1996, the fecal coliform assessment guideline recommended by the U.S. EPA (1997) is that no more than 10% of samples should exceed the fecal coliform objective of 400 organisms per 100 ml. Furthermore, the California Ocean Plan states that not more than 20% of samples shall exceed a density of 1,000 total coliform per 100 ml and that no single sample shall exceed a density of 10,000 total coliform per 100 ml. The 10% threshold was used for the 2002 WQA and is used in Section 2.3, which reviews more recent data to confirm water quality impairments due to bacteria.

[3] Beach postings on the other hand may result from routine monitoring that shows elevated bacteria densities at a particular sampling location.

to 12,997 MPN/100 ml and exceeded the fecal coliform standard (400 MPN/100 ml) in 11% of the samples, total coliform ranged from 20 to 24,196 MPN/100 ml and exceeded the total coliform standard (1,000 MPN/100 ml) in 21% of the samples. In the back basins of MdRH fecal coliform ranged from 10 to 4,106 MPN/100 ml and exceeded the standard in 22% of the samples. In addition, during the 2002 WQA beach postings and closures in 2000 were evaluated and beaches that were posted or closed for more than 10% of the year in 2000 were listed as impaired for beach closures. In 2000, Mothers' Beach was posted due to high bacteria indicator levels 95 days, which means that 26% of the year Mothers' Beach was posted. The 2002 WQA confirms the 1998 303(d) listing and supports the 2002 303(d) listings of Mothers' Beach as impaired for coliform and beach closures, and the back basins of MdRH as impaired for coliform.

A TMDL to address impairment of water quality at Santa Monica Bay beaches (SMB beaches) due to bacteria during dry-weather was adopted by the Regional Board on January 24, 2002 (see Appendix A for Regional Board Resolution No. R02-004). Subsequently, a TMDL to address impairment of water quality at SMB beaches due to bacteria during wet-weather was adopted by the Regional Board on December 12, 2002 (see Appendix B for Regional Board Resolution No. R2002-022). The Marina del Rey (MdR) Watershed is a subwatershed of the Santa Monica Bay Watershed. Therefore, to be consistent, this TMDL applies the same approach as that used in the SMB beaches TMDLs for bacteria. These TMDLs are based on extensive information from other entities concerning bacteriological water quality at SMB beaches as well as intensive wet-weather sampling, including related studies on bacterial degradation and dilution, undertaken specifically to support the development of the SMB beaches TMDL and other TMDLs.

What follows is a brief overview of the benefits of this TMDL, the geographical setting, regulatory requirements for preparing this TMDL, and an introduction to the approach used in this TMDL.

1.1 Benefits of TMDL

The TMDL has been prepared pursuant to state and federal requirements to preserve and enhance water quality in Santa Monica Bay and for the benefit of the 55 million beachgoers that visit the SMB beaches on average each year (Los Angeles County Fire Department, Lifeguard Operations, 2001). At stake is the health of swimmers and surfers and associated health costs as well as sizeable revenues to the local and state economy. A joint UC-Berkeley/USC study estimates that visitors to SMB beaches spend approximately $1.7 billion annually (Hanemann *et al.*, 2001).

The California coast has sizable economic value as a resource for various tourism and recreational activities throughout the year, including winter months. According to the Los Angeles Convention and Visitors Bureau (LACVB), in 2000, a total of 19.1 million people visited Los Angeles from other areas of the U.S.; approximately half of these visitors came to Los Angeles during the winter months of October through March. Of these, an estimated 1.25 million visited SMB beaches, spending an estimated $556 million. These numbers do not including beach visitation and spending by the 5.5 million international tourists that visit Los Angeles County annually nor do they include visitation and spending by local residents (LACVB, 2000). In a study specifically designed to elicit the value of beaches, Hanemann et al. (2001) estimated that visitors to SMB beaches spend approximately $1.7 billion annually.

The travel and tourism industry in Los Angeles also generates significant fees and taxes from travel related spending, including $751 million in state and local sales taxes and $212 million in federal taxes (LACVB, 2000). According to the Los Angeles Economic Development Corporation, spending by visitors to Los Angeles provides employment for approximately 280,000 area residents, making travel and tourism the fourth largest industry in Los Angeles County (LACVB, 2000).

Looking at the economic costs of poor bacteriological quality on the other hand, a UCI researcher, Ryan Dwight, estimated that out-of-pocket health costs such as doctor visits and lost days at work may range from $12 - $23 million per year in a study of Newport and Huntington Beaches where annual visitation is lower than at Santa Monica Bay beaches.

MdRH serves as a significant commercial and recreational facility for southern California. A variety of restaurants, shops and sites around the harbor are popular tourist destinations. The Los Angeles County South Bay Bicycle Trail, a 19.1 mile bike path from Torrance Beach to Santa Monica, provides a path for jogging/walking, roller skating and biking in the MdRH. The path weaves through the outskirts of the Marina and is used year-around. The Marina houses several parks attracting the public to the landscaped open space for recreation. The Marina also draws many anglers. Fishing is permitted along the public docks around the Marina. Mother's Beach located in Basin D of the Marina attracts, as its name implies, families with young children where protected from the waves, the children can swim in calm waters.

1.2 Geographical Setting

The MdR watershed is approximately 2.9 square miles located in the Santa Monica Bay, California. It is south of Venice and north of Playa del Rey, and approximately 15 miles southwest of downtown Los Angeles. The watershed includes the City of Los Angeles, Culver City and unincorporated areas of Los Angeles County (see Figure 1). The climate is warm and dry most of the year with intermittent wet weather events typically between November and March. The annual rainfall for a typical dry year and wet year are 5.53 inches and 20.67 inches, respectively (see Appendix E).[4]

MdRH was developed in the early 1960s on degraded wetlands that formed part of the estuary of Ballona Creek Wetlands. MdRH, which opens into Santa Monica Bay, was constructed by the Army Corps of Engineers and is the largest artificial small-craft harbor in the United States. MdRH harbors more than 6,000 wet berthed slips for privately owned pleasure craft, dry storage of approximately 3,000 boats, and launch facilities, which can accommodate approximately 240 trailered boats. The back basins (Basins D, E and F) house approximately 2,000 slips (Joseph Chesler, Los Angeles County Department of Beaches and Harbors, personal communication).

The Corps of Engineers maintains the harbor entrance channel and main channel for navigation by dredging. Since the late 1980's, the Corps of Engineers has not been able to use open water disposal for sediments dredged from the entrance channel due to the elevated levels of contaminants deposited from adjacent Ballona Creek. Based on Corps of Engineers' hydrodynamic numerical modeling (RMA4 model) results, the contaminant influence from

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[4] The 10^{th} and 90^{th} percentiles with respect to inches of rain were used as representative of a typical dry year and a typical wet year, respectively.

Ballona Creek does not travel to nor affect the back basins (USACE 1999). Therefore, the back basins of the MdRH are assumed to be outside any significant influence from Ballona Creek.

The MdR watershed is highly developed with high-density single family residence (HDSFR), multiple family residence (MFR), and mixed residential comprising the primary land use in the watershed (46.6%) followed by retail, commercial, and general office representing the second largest land use (12.2%). The receiving waters of MdRH constitute 11.6% of the land area and marina facilities cover 9.2% of the land use. Open space and recreation represents 4.8% of the land use in the watershed. Light industrial and vacant/urban vacant each represent 4.7% of the land use. The remaining 6% of land area is covered by educational institutions (3.8%), under construction (1.2%), institutional and military installations (0.6%), transportation (0.3%), and mixed urban (0.2%).

For the purposes of this TMDL, the Regional Board has divided the watershed into five subwatersheds based on the drainage patterns provided the Los Angeles County Department of Public Works (LACDPW). Area 1A drains into the back basins (Basins D, E and F) of MdRH and Area 1B drains into the rest of the MdRH area (all other basins). Area 2 drains into Ballona Lagoon and then to the harbor entrance. Area 3 drains into the back basins via storm drains and Area 4 drains into the Oxford Flood Control Basin (OFCB) via storm drains and then into Basin E through a tidal gate. Since the impairment addressed in this TMDL is confined to the back basins, only loading from Areas 1A, 3 and 4 are considered. (See Table 1-1 and Figure 2 for land use breakdowns by subwatersheds.)

Table 1-1. Land Use by Subwatershed Area for Marina del Rey Watershed**

Land Use Type	Marina del Rey Watershed (acres)				
	Area 1A	**Area 1B***	**Area 2***	**Area 3**	**Area 4**
Education			3		67
General Office	2	17			
HDSFR			65	38	304
Institutional	1	9			
Light Industrial				2	86
Marina Facilities	65	106			
MFR	32	128	201	14	50
Military Installations		1			
Mixed Residential			1	13	18
Mixed Urban					3
Open Space/Recreation	19	65	2		3
Other Commercial	16	3	9		2
Receiving Waters	44	151	13		8
Retail/Commercial	32	30	21		94
Transportation	4				2
Under Construction		2	11	4	6
Urban Vacant	2	4			29
Vacant		53			
Total	**217**	**569**	**326**	**71**	**672**

* Area does not drain into the back basins and are not included in this TMDL.
** Land use data was provided by the LACDPW on May 20, 2002 by Dr. T.J. Kim

1.3 Regulatory Background

The California Water Quality Control Plan, Los Angeles Region (Basin Plan) sets water quality standards for the Los Angeles Region, which include beneficial uses for surface and ground water, numeric and narrative objectives necessary to support beneficial uses, and the state's antidegradation policy; and describes implementation programs to protect all waters in the region. The Basin Plan establishes water quality control plans and policies for the implementation of the Porter-Cologne Water Quality Act within the Los Angeles Region and, along with the Water Quality Control Plan for Ocean Waters of California (California Ocean Plan), serves as the State Water Quality Control Plan applicable to regulating bacteria in MdRH, as required pursuant to the federal Clean Water Act (CWA).

Section 303(d)(1)(A) of the CWA requires each state to conduct a biennial assessment of its waters, and identify those waters that are not achieving water quality standards. The resulting list is referred to as the 303(d) list. The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and to develop and implement TMDLs for these waters.

A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and allocates the pollutant loadings to point and nonpoint sources. The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in U.S. Environmental Protection Agency guidance (U.S. EPA, 1991). A TMDL is defined as the "sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2) such that the capacity of the waterbody to assimilate pollutant loads (the loading capacity) is not exceeded. The Regional Board is also required to develop a TMDL taking into account seasonal variations and including a margin of safety to address uncertainty in the analysis (40 CFR 130.7(c)(1)). Finally, states must develop water quality management plans to implement the TMDL (40 CFR 130.6).

The U.S. EPA has oversight authority for the 303(d) program and is required to review and either approve or disapprove the state's 303(d) list and each TMDL developed by the state. If the state fails to develop a TMDL in a timely manner or if the U.S. EPA disapproves a TMDL submitted by a state, EPA is required to establish a TMDL for that waterbody (40 CFR 130.7(d)(2)).

As part of its 1996 and 1998 regional water quality assessments, the Regional Board identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (LARWQCB, 1996, 1998). A 13-year schedule for development of TMDLs in the Los Angeles Region was established in a consent decree (*Heal the Bay Inc., et al. v. Browner, et al.* C 98-4825 SBA) approved on March 22, 1999.

For the purpose of scheduling TMDL development, the decree combined the over 700 waterbody-pollutant combinations into 92 TMDL analytical units. Analytical Unit 46 lists Mothers' Beach and the back basins of MdRH with impairments related to pathogens. The consent decree also prescribed schedules for certain TMDLs, and according to this schedule, a bacteria TMDL for MdRH was to be adopted by the Regional Board by March 2003. Under the terms of the consent decree, USEPA must either approve a state TMDL or establish its own, by Mach 22, 2004.

On May 6, 2003, the Regional Board held a California Environmental Quality Act (CEQA) scoping meeting to consult with the public and interested stakeholders about the environmental effects of the preliminary draft TMDL. At the meeting, the CEQA checklist of significant environmental issues and mitigation measures were discussed. This meeting fulfilled the requirements of early public consultation under CEQA (Public Resources Code, Section 21083.9).

1.4 Overview of TMDL Approach

Staff proposes a 'reference system/antidegradation approach' as the implementation procedure for the recently-adopted bacteria objectives for REC-1 waters (described in Section 2.2) as outlined in this TMDL and the SMB beaches TMDL. As required by the CWA and Porter-Cologne Water Quality Control Act, Basin Plans include beneficial uses of waters, water quality objectives to protect those uses, an antidegradation policy, collectively referred to as water quality standards, and other plans and policies necessary to implement water quality standards. TMDLs are incorporated into the Basin Plan as implementation plans for the Region's water quality standards.

The preferred 'reference system/antidegradation approach' means that on the basis of historical exceedance levels at existing monitoring locations, including a local reference beach within Santa Monica Bay, staff is proposing to permit a certain number of allowable daily exceedances of the single sample bacteria objectives. This approach is proposed in recognition of the fact that there are natural sources of bacteria that may cause or contribute to exceedances of the single sample objectives and that it is not the intent of the Regional Board to require treatment or diversion of natural coastal creeks or to require treatment of natural sources of bacteria from undeveloped areas. Staff was concerned that such an approach, while addressing the impairment of the REC-1 beneficial use, would adversely affect important aquatic life and wildlife beneficial uses.

As described later, staff proposes to use Leo Carrillo Beach and its associated drainage area, Arroyo Sequit Canyon, as the local reference system until other reference approaches are evaluated and the necessary data collected to support the use of alternative reference locations when the TMDL is revised in four years. Arroyo Sequit Canyon is the most undeveloped subwatershed in the Santa Monica Bay watershed with 98% open space and little evidence of human impact. In essence, the reference approach recognizes natural sources and focuses this TMDL to set waste load allocations and load allocations such that anthropogenic sources of bacteria do not cause or contribute to exceedances of bacteria water quality standards.

The reference beach approach, as set forth below, ensures that water quality is at least as good as that of the reference beach. In addition, this approach recognizes and is consistent with state and federal antidegradation policies, such that where existing water quality is better than that of the reference beach, no degradation of existing water quality is permitted.

2 Problem Identification

This section briefly discusses the health risks associated with swimming in marine water contaminated with human sewage and other sources of pathogens. It is these risks to public health that the Regional Board intends to reduce through the development and implementation of the TMDL. Second, the section describes the applicable water quality standards and provides background on their development. Finally, the section presents more recent data to support the original 303(d) listings made in 1996 and the subsequent 303(d) listings in 1998 and 2002.

2.1 Health Risks of Swimming in Water Contaminated with Bacteria

Swimming in marine waters contaminated with human sewage has long been associated with adverse health effects (Favero, 1985). The most commonly observed health effect associated with recreational water use is gastroenteritis with symptoms including vomiting, fever, stomach pain and diarrhea. Other commonly reported health effects include eye, ear, skin infections, and respiratory disease.

Since the 1950s, numerous epidemiological studies have been conducted around the world to investigate the possible links between swimming in fecal-contaminated waters and health risks. Recently, the World Health Organization completed a comprehensive review of 22 published epidemiological studies, 16 of which were conducted in marine waters (Pruss, 1998). Fourteen of the 16 marine water studies found a significant association between bacteria indicator densities and the rate of certain symptoms or groups of symptoms. Most significant associations were found for gastrointestinal illnesses. However, as shown in several large-scale epidemiological studies of recreational waters, other health outcomes such as skin rashes, respiratory ailments, and eye and ear infections are associated with swimming in fecal-contaminated water. The Santa Monica Bay study, discussed below, found swimming in urban runoff-contaminated waters resulted in an increased risk of chills, ear discharge, vomiting, coughing with phlegm and significant respiratory diseases (fever and nasal congestion, fever and sore throat, or coughing with phlegm).

In fact, significant respiratory disease was the most common outcome to swimmers exposed to runoff polluted water in Santa Monica Bay (Haile, *et al*., 1996, 1999). Cheung, *et al*. (1990a) found an increased risk of respiratory, skin rash and total illness associated with increased levels of bacteria indicator densities. Von Schirnding, *et al*. (1993) found increases in the risks of respiratory and skin symptoms with increasing bacteria indicator densities. Fattal, *et al*. (1986) found skin rash symptoms and "total sickness" (at least one health effect) outcomes increased with bacteria indicator densities. Corbett, *et al*. (1993) found a positive linear relationship between several symptoms including respiratory, ear, and eye symptoms and water pollution levels. These studies compel the conclusion that there is a causal relationship between health outcomes and recreational water quality, as measured by bacteria indicator densities.

2.1.1 Santa Monica Bay Epidemiological Study

One of the studies reviewed in Pruss (1998) was the Santa Monica Bay Restoration Project epidemiological study conducted in 1995. This was the first epidemiological study to specifically evaluate the increased health risks to people who swam in marine waters contaminated by *urban runoff* (Haile, *et al.*, 1996, 1999). The results of the Santa Monica Bay study provided much of the basis for the current recreational water quality standards for marine waters in California (e.g., standards developed by the California Department of Health Services in response to Assembly Bill 411 (1997 Stats. 765)). The study collected health effects data from 11,793 individuals visiting three SMB beaches, including Santa Monica Beach, Will Rogers State Beach, and Surfrider Beach. Bacteria indicators measured in the study included total coliform, fecal coliform, *E. coli*, and enterococcus.

The epidemiological study was unique in several ways. First, the source of bacteria was not effluent from a sewage treatment plant, but instead urban runoff discharged from storm drains. Second, it examined both gastrointestinal illness and non-gastrointestinal illnesses including skin rashes and upper respiratory illnesses. Third, it analyzed the correlation between adverse health effects and the total-to-fecal coliform ratio in addition to previously studied bacterial indicators (i.e. total coliform, fecal coliform, *E. coli* and enterococcus). Finally, the study compared people swimming near a flowing storm drain to other people swimming 400 meters away from the drain. Positive associations were observed between adverse health effects and the distance an individual swam from the drain. The study found that 1 in 25 people swimming in front of a storm drain will get sick and that the likelihood of getting sick is twice as high for individuals swimming in front of a storm drain. The number of excess cases of illness attributable to swimming at the drain reached into the hundreds per 10,000 exposed participants, suggesting that significant numbers of swimmers in the water near flowing storm drains are subject to increased health risks. In addition, an increased health risk was associated with increasing densities of bacteria. Table 2-1 summarizes some of the health outcomes that were significantly associated with the four bacterial indicators at the proposed numeric targets in the TMDL.

Table 2-1. Health Risks at Proposed Numeric Targets (Haile *et al.*, 1996, 1999; Haile and Witte, 1997)

Bacterial Indicator	**Health Outcome**	**Attr. # (per 10,000)***
Enterococcus	Diarrhea with blood	27
	Gastroenteritis I**	130
Total coliform	Skin rash	165
Fecal/total ratio	Nausea	230
	Diarrhea	281
	Gastroenteritis II***	98
	Chills	117
Fecal coliform	Skin rash	74

Notes: *Attributable number. **Highly credible gastrointestinal illness I with vomiting, diarrhea and fever, or stomach pain and fever. ***Highly credible gastrointestinal illness II with vomiting and fever.

2.2 Water Quality Standards

The Basin Plan designates beneficial uses for water bodies in the Los Angeles Region. These uses are recognized as existing (E), potential (P), or intermittent (I) uses. All beneficial uses must be protected. MdRH has a variety of beneficial use designations including Navigation, Contact and Non-contact Recreation, Commercial and Sport Fishing, Marine Habitat, Wildlife Habitat, Rare, Threatened, or Endangered Species Habitat, and Shellfish Harvesting. (See Table

2-2, Basin Plan, p. 2-19.) However, the focus of this TMDL is on the Water Contact Recreation (REC-1) beneficial use, which is designated as an existing use for Mothers' Beach and MdRH back basins.[5]

Table 2-2. Beneficial Uses of Marina del Rey

Marina del Rey	**Hydro. Unit #**	**NAV**	**REC-1**	**REC-2**	**COMM**	**MAR**	**WILD**	**RARE**	**SHELL**
Harbor	405.13	E	E	E	E	E	E		E
Public Beach Areas	405.13	E	E	E	E	E	E	E	
All Other Areas	405.13	E	P	E	E	E	E	E	E
Entrance Channel	405.13	E	E	E	E	E	E	E	E

The REC-1 beneficial use is defined in the Basin Plan as "[U]ses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs" (Basin Plan, p. 2-2). The Basin Plan and the California Ocean Plan, the provisions of which are included in the Basin Plan by reference, contain bacteria water quality objectives to protect the REC-1 use. In the current California Ocean Plan, total and fecal coliform bacteria are used as indicators of the likely presence of disease-causing pathogens in surface waters.

On October 25, 2001, the Regional Board adopted a Basin Plan amendment updating the bacteria objectives for waters designated as REC-1 (Regional Board Resolution R01-018, see Appendix C). The State Board approved the Regional Board's Basin Plan amendment on July 18, 2002 (State Board Resolution 2002-0142, see Appendix C), the Office of Administrative Law approved it on September 19, 2002 (OAL File No. 02-0807-01-S), and the US EPA approved it on September 25, 2002. The revised objectives include geometric mean limits and single sample limits for four bacterial indicators, including total coliform, fecal coliform, the fecal-to-total coliform ratio, and enterococcus.

The revised Basin Plan objectives for marine waters designated for Water Contact Recreation (REC-1) are as follows:

1.   Geometric Mean Limits
a.   Total coliform density shall not exceed 1,000/100 ml.
b.   Fecal coliform density shall not exceed 200/100 ml.
c.   Enterococcus density shall not exceed 35/100 ml.

2.   Single Sample Limits
a.   Total coliform density shall not exceed 10,000/100 ml.
b.   Fecal coliform density shall not exceed 400/100 ml.
c.   Enterococcus density shall not exceed 104/100 ml.

[5] Protection of REC-1 (the water contact recreation use) will result in protection of REC-2 (the non-contact recreation use) as the water quality objective for fecal coliform to protect REC-2 is set at 10 times the REC-1 fecal coliform objective.

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

The revised objectives are the same as those contained in state law (California Code of Regulations, Title 17, Section 7958, which implements Assembly Bill 411 (1997 Stats. 765)), which was passed in large part due to the Santa Monica Bay epidemiological study described above. Assembly Bill 411 resulted in changes to California Department of Health Services' regulations for public beaches and public water contact sports areas. These changes included (1) setting minimum protective bacteriological standards for waters adjacent to public beaches and public water contact sports areas based on four indicators (total coliform, fecal coliform, enterococcus, and the fecal-to-total coliform ratio) and (2) altering the requirements for monitoring, posting, and closing certain coastal beaches based on these four bacterial indicators. The revised objectives are also consistent with, but augment on the basis of the local SMB epidemiological study, current U.S. EPA guidance (1986), which recommends the use of enterococcus in marine water based on more recent national epidemiological studies (LARWQCB, 2001; Cabelli, 1983). Finally, the changes are consistent with those being drafted for the California Ocean Plan (Linda O'Connell, State Water Resources Control Board, personal communication). See Table 2-3 for the revised water quality objectives for protection of marine waters designated as REC-1 adopted by the Regional Board on October 25, 2001.

Table 2-3. Proposed Bacteria Objectives for REC-1 Marine Waters (LARWQCB, 2001)

Parameter	**Geometric Mean**	**Single Sample**
Total Coliform	1,000	10,000
		1,000 if FC/TC > 0.1
Fecal Coliform	200	400
Enterococcus	35	104

These objectives are generally based on an acceptable health risk in marine recreational waters of 19 illnesses per 1,000 exposed individuals per US EPA guidance (US EPA, 1986). Based on the findings of the Santa Monica Bay epidemiological study described earlier, the health risk associated with these objectives ranges from 7 illnesses per 1,000 (fecal coliform objective) to 28 illnesses per 1,000 (fecal-to-total coliform ratio objective) (see Table 2-1).

2.2.1 Implementation Provisions for Bacteria Objectives

The Basin Plan, as amended by the revised bacteria water quality objective change and the SMB Beaches Wet-Weather Bacteria TMDL, describes implementation provisions for bacteria objectives.

The single sample bacteriological objectives shall be strictly applied except when provided for in a Total Maximum Daily Load (TMDL). In all circumstances, including in the context of a TMDL, the geometric mean objectives shall be strictly applied. In the context of a TMDL, the Regional Board may implement the single sample objectives in fresh and marine waters by using a 'reference system/antidegradation approach' or 'natural sources exclusion approach' as discussed below. A reference system is defined as an area and associated monitoring point that is not impacted by human activities that potentially affect bacteria densities in the receiving water body.

These approaches recognize that there are natural sources of bacteria, which may cause or contribute to exceedances of the single sample objectives for bacterial indicators. They also acknowledge that it is not the intent of the Regional Board to require treatment or diversion of natural water bodies or to require treatment of natural sources of bacteria from undeveloped areas. Such requirements, if imposed by the Regional Board, could adversely affect valuable aquatic life and wildlife beneficial uses supported by natural water bodies in the Region.

Under the reference system/antidegradation implementation procedure, a certain frequency of exceedance of the single sample objectives in Table 2-3 shall be permitted on the basis of the observed exceedance frequency in the selected reference system(s) or the targeted water body, whichever is less, as previously described in section 1.4. The reference system/antidegradation approach ensures that bacteriological water quality is at least as good as that of a reference system and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of the selected reference system(s).

Under the natural sources exclusion implementation procedure, after all anthropogenic sources of bacteria have been controlled such that they do not cause or contribute to an exceedance of the single sample objectives and natural sources have been identified and quantified, a certain frequency of exceedance of the single sample objectives shall be permitted based on the residual exceedance frequency in the specific water body. The residual exceedance frequency shall define the background level of exceedance due to natural sources. The 'natural sources exclusion' approach may be used if an appropriate reference system cannot be identified due to unique characteristics of the target water body. These approaches are consistent with the State Antidegradation Policy (State Board Resolution No. 68-16) and with federal antidegradation requirements (40 CFR 131.12).

TMDLs and associated waste load allocations incorporated into permits, and load allocations for nonpoint sources are vehicles for implementation of our standards. Therefore, the appropriateness of a reference system/antidegradation approach or a natural sources exclusion approach and the specific exceedance frequencies to be permitted under each, will be evaluated within the context of TMDL development for a specific water body, at which time the Regional Board may select one of these approaches, if appropriate. As proposed in this draft TMDL, waste load allocations will be incorporated into NPDES permits for municipal storm water MS4[6], the Statewide Permit for Storm Water Discharges from the State of California Department of Transportation (CalTrans), non-storm water general NPDES permits, general industrial storm water permits, and general construction storm water permits. Load allocations for nonpoint sources will be implemented within the context of the TMDL.

The reference system/antidegradation approach is the approach proposed in this TMDL as well as the TMDLs for SMB beaches.

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[6] Municipal storm water discharges in the Los Angeles Region are those with permits under the Municipal Separate Storm Sewer System (MS4) NPDES Program. For example, the MS4 permits at the time of this amendment are the Los Angeles County Municipal Storm Water NPDES Permit, Ventura County Municipal Storm Water NPDES Permit, City of Long Beach Municipal Storm Water NPDES Permit, and elements of the statewide storm water permit for the California Department of Transportation (CalTrans).

2.3 Data Review

MdRH has been monitored by three agencies in the past; currently only two agencies continue to collect samples within MdRH. The City of Los Angeles Environmental Monitoring Division at the Hyperion Wastewater Treatment Plant monitors one location at Mothers' Beach on a daily basis. The Los Angeles County Department of Health Services (DHS) monitored three locations on a weekly basis until August 31, 2000. Two of the sampling stations were located at Mothers' Beach in Basin D, and the other one was at the Los Angeles County Fire Dock located at the end of the main channel. The Los Angeles County Department of Beaches and Harbors (DBH) monitors eighteen locations throughout the Marina on a monthly basis. Seven of the sampling locations are within the back basins of MdRH and two of the sampling locations are within the Oxford Flood Control Basin, which drains directly into Basin E through a tidegate.

Analysis of these data has consistently shown that bacteria densities within MdRH back basins and Mothers' Beach exceed REC-1 bacteria objectives during both dry and wet weather. During the 1996 WQA, the Regional Board evaluated total and fecal coliform monitoring data collected between 1988 and 1994 by the agencies listed above to determine whether a beach was impaired due to exceedances of the existing water quality objectives. The 1996 WQA supported the conclusion that Mothers' Beach and the back basins exceed the REC-1 bacteria objectives. For the 2002 WQA, the Regional Board evaluated total and fecal coliform monitoring data from 1998 to 2001 and again concluded that Mothers' Beach and the back basins of MdRH exceed the REC-1 bacteria objectives.

Five years of monitoring data (1995-2000) collected by the City of Los Angeles, Environmental Monitoring Division, and the Los Angeles County Department of Health Services, and six years of monthly date (1995-2001) collected by the Los Angeles County Department of Beaches and Harbors is summarized in Tables 2-4 through 2-6. During summer dry-weather, all 11 locations monitored in the Marina had a higher probability of exceedance than the beach adjacent to the most undeveloped subwatershed in Santa Monica Bay watershed, Leo Carrillo Beach, based on the single sample objectives. During winter dry weather, 10 of the 11 locations monitored in the Marina had a higher probability of exceedance than Leo Carrillo Beach based on the single sample objectives. During wet weather,[7] nine of the 11 locations monitored in the Marina had a higher probability of exceedance than Leo Carrillo Beach based on the single sample objective.

[7] In this analysis, wet weather was defined as rainfall of 0.1 inch or more plus the 3 days following the rain event following the protocol used by the Los Angeles County Department of Health Services to post beaches during and after a rain event.

Table 2-4. Summary of Number of Summer Dry Weather Samples Exceeding the Single Sample Objectives

SUMMER DRY WEATHER EXCEEDANCES (April 1 – October 31)		November 1, 1995 - October 31, 2001		
Location ID	**Monitoring Location**	**Total number of summer dry weather samples**	**Number of summer dry weather samples with an exceedance**	**Summer dry weather exceedance probability**
DHS (010)	Leo Carrillo Beach, at 35000 PCH – weekly	141	0	0.00
HYP (S9)	Mothers' Beach, Lifeguard Tower – daily	1004	59	0.06
DHS (109a)*	Mothers' Beach, Playground Area – weekly	141	23	0.16
DHS (109b)*	Mothers' Beach, between Lifeguard Tower and Boat Dock - weekly	140	32	0.23
DHS (109c)**	Los Angeles County Fire Dock - end of main channel – weekly	88	6	0.07
DBH (MDR-8)^	Mothers' Beach, near first slips outside swim area – monthly	42	1	0.02
DBH (MDR-18)^	Mothers' Beach, 20 meters off of the wheel chair ramp - monthly	42	3	0.07
DBH (MDR-19)^	Mothers' Beach, end of wheel chair ramp – monthly	42	5	0.12
DBH (MDR-9)^	Basin F, innermost end – monthly	42	2	0.05
DBH (MDR-11)^	End of Main Channel – monthly	42	6	0.14
DBH (MDR-10)^	Basin E, near center of basin – monthly	42	17	0.40
DBH (MDR-20)^	Basin E, in front of Tidegate from Oxford Basin – monthly	42	17	0.40
DBH (MDR-13)^	Oxford Flood Control Basin, in front of Tidegate – monthly	42	22	0.52
DBH (MDR-22)^	Oxford Flood Control Basin, at Washington Blvd. Drain - monthly	41	27	0.66

* Only four years and ten months of data were available, since DHS stopped collecting weekly samples at these locations as of August 31, 2000.
** Only three years and five months of data were available, since DHS stopped collection weekly samples at this location as of March 31, 1999.
^ Six years of monthly monitoring data from DBH were used in the analysis.

Table 2-5. Summary of Number of Winter Dry Weather Samples Exceeding the Single Sample Objectives

WINTER DRY WEATHER EXCEEDANCES (November 1 – March 31)		**November 1, 1995 - October 31, 2001**		
Location ID	**Monitoring Location**	**Total number of winter dry weather samples**	**Number of winter dry weather samples with an exceedance**	**Winter dry weather exceedance probability**
DHS (010)	Leo Carrillo Beach, at 35000 PCH – weekly	64	2	0.03
HYP (S9)	Mothers' Beach, Lifeguard Tower – daily	474	77	0.16
DHS (109a)*	Mothers' Beach, Playground Area – weekly	64	16	0.25
DHS (109b)*	Mothers' Beach, between Lifeguard Tower and Boat Dock - weekly	64	16	0.25
DHS (109c)**	Los Angeles County Fire Dock - end of main channel – weekly	48	7	0.15
DBH (MDR-8)^	Mothers' Beach, near first slips outside swim area – monthly	20	1	0.05
DBH (MDR-18)^	Mothers' Beach, 20 meters off of the wheel chair ramp - monthly	20	0	0.00
DBH (MDR-19)^	Mothers' Beach, end of wheel chair ramp – monthly	20	1	0.05
DBH (MDR-9)^	Basin F, innermost end – monthly	20	2	0.10
DBH (MDR-11)^	End of Main Channel - monthly	20	3	0.15
DBH (MDR-10)^	Basin E, near center of basin - monthly	20	5	0.25
DBH (MDR-20)^	Basin E, in front of Tidegate from Oxford Basin - monthly	20	10	0.50
DBH (MDR-13)^	Oxford Flood Control Basin, in front of Tidegate - monthly	20	13	0.65
DBH (MDR-22)^	Oxford Flood Control Basin, at Washington Blvd. Drain - monthly	20	17	0.85

* Only four years and ten months of data were available, since DHS stopped collecting weekly samples at these locations as of August 31, 2000.
** Only three years and five months of data were available, since DHS stopped collection weekly samples at this location as of March 31, 1999.
^ Six years of monthly monitoring data from DBH were used in the analysis.

Table 2-6. Summary of Number of Wet Weather Samples Exceeding the Single Sample Objectives

WET WEATHER EXCEEDANCES[8]		November 1, 1995 - October 31, 2001		
Location ID	**Monitoring Location**	**Total number of wet weather samples**	**Number of wet weather samples with an exceedance**	**Wet weather exceedance probability**
DHS (010)	Leo Carrillo Beach, at 35000 PCH - weekly	46	10	0.22
HYP (S9)	Mothers' Beach, Lifeguard Tower - daily	337	146	0.43
DHS (109a)*	Mothers' Beach, Playground Area - weekly	45	27	0.60
DHS (109b)*	Mothers' Beach, between Lifeguard Tower and Boat Dock - weekly	45	29	0.64
DHS (109c)**	Los Angeles County Fire Dock - end of main channel - weekly	35	19	0.54
DBH (MDR-8)^	Mothers' Beach, near first slips outside swim area - monthly	10	3	0.30
DBH (MDR-18)^	Mothers' Beach, 20 meters off of the wheel chair ramp - monthly	10	2	0.20
DBH (MDR-19)^	Mothers' Beach, end of wheel chair ramp - monthly	10	4	0.40
DBH (MDR-9)^	Basin F, innermost end - monthly	10	1	0.10
DBH (MDR-11)^	End of Main Channel - monthly	10	3	0.30
DBH (MDR-10)^	Basin E, near center of basin - monthly	10	8	0.80
DBH (MDR-20)^	Basin E, in front of Tidegate from Oxford Basin - monthly	10	9	0.90
DBH (MDR-13)^	Oxford Flood Control Basin, in front of Tidegate - monthly	10	8	0.80
DBH (MDR-22)^	Oxford Flood Control Basin, at Washington Blvd. Drain - monthly	10	10	1.00

* Only four years and ten months of data were available, since DHS stopped collecting weekly samples at these locations as of August 31, 2000.
** Only three years and five months of data were available, since DHS stopped collection weekly samples at this location as of March 31, 1999.
^ Six years of monthly monitoring data from DBH were used in the analysis.

[8] Wet weather is defined as rainfall of 0.1 inch or more plus the 3 days following the rain event following the protocol used by the Los Angeles County Department of Health Services to post beaches during and after a rain event.

In addition to the above analysis, several other entities have collected and analyzed bacteriological monitoring data for Mothers' Beach. Heal the Bay compiles and analyzes data collected by local health agencies throughout Southern California and publishes its results monthly on the Internet and in an annual Beach Report Card (BRC). The BRC assigns each beach a grade from A to F, taking into consideration the frequency and magnitude of indicator threshold exceedances over a 28-day period.[9] Mothers' Beach sampled at the playground received a grade of B for dry weather and F for wet weather for the period April 2001 through March 2002. The 2001-02 BRC also confirms the findings of the Regional Board's 2002 WQA.

Also, in support of the TMDL, the Southern California Coastal Water Research Project (SCCWRP) conducted a 5-year (1995-99) retrospective evaluation of shoreline bacteria data (Schiff *et al.*, 2001). Rather than examining the percentage of samples that exceeded the water quality objectives for a particular monitoring location, SCCWRP analyzed the percentage of shoreline mile-days that exceeded water quality objectives.[10] It should be noted that while examining exceedances in terms of shoreline mile-days provides insight into the frequency of exceedances, it does not shed light on the magnitude of exceedances.

SCCWRP's evaluation reached several conclusions about the nature of bacteria contamination along beaches. First, SCCWRP found that only 13% of shoreline mile-days exceeded bacteria objectives during the 5-year period. This result highlights the fact that during dry weather, the prevailing condition in Southern California, most beaches do not exceed water quality standards. Second, SCCWRP found that although rainstorms are relatively infrequent in Southern California and only one-quarter of the samples were collected during wet weather, approximately 40% of all fecal coliform exceedances, 50% of all enterococcus exceedances, and 65% of all total coliform exceedances occurred during wet weather, indicating that the percentage of shoreline mile-days exceeding the objectives during wet weather is significantly higher than the percentage exceeding during dry weather.

SCCWRP's analysis also enables the Regional Board to rank sites, and groups of sites, in terms of their relative contribution to the total number of shoreline mile-days that exceed the bacteria objectives. For both wet and dry weather, 53% of exceedances occurred near storm drains, while

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[9] The indicator thresholds used in the BRC are the same as those recently adopted by the Regional Board for marine waters designated as REC-1 and those proposed as targets in the TMDL, which include total coliform, fecal coliform, enterococcus, and a fecal-to-total coliform ratio.

[10] Shoreline mile-days are calculated as follows:

$$SMD = \frac{\sum_{i=1}^{n} s_i \times d_i \times 200}{\sum_{i=1}^{n} d_i \times 200}$$

Where:
SMD = proportion of shoreline mile-days that exceed a water quality threshold for a stratum (i.e., storm drain, open beach)
s_i = samples that exceed water quality threshold for indicator *y* (i.e., fecal coliform) for strata *i*
d_i = temporal weighting equivalent to the number of days until the next sampling event in strata *i*
200 = shoreline distance weighting (in meters)
The water quality objectives used in the evaluation are the single sample objectives recently adopted by the Regional Board and proposed as the numeric targets in the TMDL.

40% occurred on sandy beaches. (It should be noted that the influence of storm drains may have been underestimated in the analysis, since sampling sites are located 50 meters north or south of storm drains and water quality impairments may have occurred at less than 50 meters.[11])

The top five most contaminated beach sites, (three in Marina del Rey and two in Malibu) accounted for 48% of all beach water quality exceedences during dry-weather conditions and 34% of all beach water quality exceedences during wet-weather conditions. The three sampling locations in MdR, all located at Mothers' Beach, comprised one-fifth (20.7%) of the shoreline mile days exceeding standards during dry weather, and a quarter (26.8%) of the exceedances during wet-weather. See Appendix D for the complete retrospective evaluation published in SCCWRP's 2000-01 Annual Report.

In summary, MdRH has been identified by the Regional Board in its 1996, 1998, and 2002 WQAs and by other entities as impaired due to exceedances of bacteriological water quality standards.

[11] A recent Southern California Bight-wide summer shoreline bacteriological survey showed that 90% of all exceedances of health standards observed during the 5-week study occurred near a flowing storm drain (Noble *et al.* 1999).

3 Numeric Target

The TMDL will have a multi-part numeric target based on the bacteria objectives for marine waters designated for contact recreation (REC-1), specified in the Basin Plan amendment adopted by the Regional Board on October 25, 2001. As stated earlier, these objectives are the same as those specified in the California Code of Regulations, Title 17, Section 7958 "Bacteriological Standards" and consistent with those recommended in "Ambient Water Quality for Bacteria – 1986" (U.S. EPA, 1986). The objectives include four bacterial indicators: total coliform, fecal coliform, enterococcus, and the fecal-to-total coliform ratio. (See Table 2-3.)

For the TMDL, the numeric targets will be the same as the recently adopted Basin Plan objectives, as measured at point zero (also referred to as the "mixing zone" or "wave wash"). Point zero is the point at which water from the storm drain initially mixes with ocean water, and is consistent with the 'point of initial dilution' as defined in the California Ocean Plan (2001). For Mothers' Beach, the targets will apply at existing or new monitoring sites, with samples taken at ankle depth. For Basins D, E, and F the targets will also apply at existing or new monitoring sites with samples collected at ankle depth and at depth. These targets apply during both dry and wet weather, since there is water contact recreation throughout the year, including during wet weather. The geometric mean targets are based on a rolling 30-day period, and may not be exceeded at any time.

To implement the recently adopted single sample bacteria objectives for waters designated REC-1 and to set allocations based on the single sample targets, the Regional Board has chosen to set an allowable number of exceedance days for each monitoring site. Staff proposes expressing the numeric target in the TMDL as 'allowable exceedance days' because bacterial density and the frequency of single sample exceedances are most relevant to public health. The US EPA allows states to select the most appropriate measure to express the TMDL; allowable exceedance days are considered an 'appropriate measure' consistent with the definition in 40 CFR 130.2(i). The number of allowable exceedance days is based on one of two criteria: (1) bacteriological water quality at any site is *at least* as good as at a designated reference site, and (2) there is no degradation of existing bacteriological water quality if historical water quality at a particular site is *better than* the designated reference site. Applying these two criteria allows the Regional Board to avoid imposing requirements to divert natural coastal creeks or treat natural sources of bacteria from undeveloped areas. This approach, including the allowable exceedance levels during summer dry-weather, winter dry-weather and wet-weather, is further explained in Section 7, Waste Load Allocations and Load Allocations.

4 Assessing Sources

The TMDL requires an estimate of loadings from point sources and nonpoint sources. In the TMDL process, waste load allocations are given for point sources and load allocations for nonpoint sources. Point sources typically include discharges from a discrete human-engineered point (e.g., a pipe from a wastewater treatment plant or industrial facility). These types of discharges are regulated through the federal National Pollutant Discharge Elimination System (NPDES) program, which the Regional Boards have been delegated to implement through the issuance of Waste Discharge Requirements (WDRs). In addition, the Regional Board, under the authority of the Porter-Cologne Water Quality Control Act, issues WDRs for discharges to groundwater from nonpoint sources (i.e. septic systems).

In Los Angeles County, storm water and dry-weather runoff to MdRH is regulated under four storm water NPDES permits, which are regulated as a point source discharge. The first, is the County of Los Angeles Municipal Storm Water NPDES Permit (MS4 Permit), which was renewed in December 2001 (Regional Board Order No. 01-182). There are 85 co-permittees covered under this permit including 84 cities and the County of Los Angeles. The second, is a separate storm water permit specifically for the California Department of Transportation (Order No. 99-06-DWQ). The third, is the Construction Activities Storm Water General Permit (Order No. 99-08-DWQ). The fourth, is the Industrial Activities Storm Water General Permit (Order No. 97-03-DWQ).

Runoff from the storm drain system may have elevated levels of bacterial indicators due to sanitary sewer leaks and spills, illicit connections of sanitary lines to the storm drain system, runoff from homeless encampments, pet waste, and illegal discharges from recreational vehicle holding tanks among others. Sources of elevated bacteria to marine waters may also include direct illegal discharges from boats, illicit discharges from private drains such as restaurants, and swimmer "wash-off." The bacteria indicators used to assess water quality are not specific to human sewage; therefore, fecal matter from animals and birds can also be a source of elevated levels of bacteria, and vegetation and food waste can be a source of elevated levels of total coliform bacteria, specifically.

4.1 Point Sources

There are no major or minor individual NPDES permit discharges in the MdR Watershed, other than the Los Angles County MS4 and CalTrans storm water permits. As of December 2002, there were seven dischargers located within the MdR watershed. These dischargers were issued general NPDES permits, general industrial and/or general construction storm water permits. The bacteria loads associated with these discharges are largely unknown, since most do not monitor for bacteria. The discharge flows associated with these general permits are generally low (less than 1 million gallons per day (MGD)). In addition, these permits are typically for episodic discharges rather than continuous flows. Table 4-1 lists the general NPDES permits, and general industrial and general construction storm water permits within the MdR Watershed. Staff does not expect dewatering of groundwater during construction to contribute to the bacteria loading into the MdRH back basins for two reasons. First, there are no septic systems within the MdR watershed. Second, from 1993 to 2001, the LACDPW has lined 8.12 miles out of a total 11.24 miles of sewers within MdRH. Currently, there are no plans to line the remaining 3.12 miles of sewer since there is no indication that maintenance is needed. In addition, staff does not expect storm water runoff from the three industrial facilities and construction site to be a significant source of bacterial loading.

Table 4-1. General NPDES Permits that discharge in the Marina del Rey Watershed as of December 2002

NPDES No.	Facility	Address	Flow/Size	Status	Discharge Type
CAG994002	Lincoln Property Company	13620 Marina Pointe Dr.	0.025 MGD	Active	Construction Dewatering
CAG994002	Esprit, Marina Parcel 12	13900 Marquesas Way	0.95 MGD	Not Active	Construction Dewatering
CAG994002	Marina Harbor Apartments	4500 Via Marina	0.65 MGD	Not Active	Construction Dewatering
CAS000001	Federal Express	4170 Del Rey Avenue	2000 ft^2.	Active	Industrial Storm Water
CAS000001	Seamark Boat Yard	13441 Mindanao Way	10,000 ft^2	Active	Industrial Storm Water
CAS000001	Windward Yacht and Repair	13645 West Fiji Way	76,000 ft^2	Active	Industrial Storm Water
CAS000002	Marina Point III Apartments	13700 Marina Pointe Dr.	3 acres	Active	Construction Storm Water

4.2 Storm Water Runoff

As mentioned above, all runoff to MdRH is regulated as a point source under the Los Angeles County MS4 Permit, the CalTrans Storm Water Permit, and the General Construction and Industrial Storm Water Permits.

4.2.1 Existing Data Characterizing Sources

The following section summarizes existing data on bacteria densities for a variety of land uses and receiving water sites for dry and wet weather. Although, there is little routine monitoring in the subwatersheds draining to the impaired back basins of MdRH, monitoring is conducted monthly by the Los Angeles County Department of Beaches and Harbors (LACDBH) at the Oxford Flood Control Basin. Los Angeles County, the lead permittee for the existing municipal storm water permit,[12] conducts a storm water monitoring program, which is the principal source of data on water quality during wet weather. Summaries of data on dry and wet weather sources of bacteria are presented below.

4.2.2 Dry Weather Source Characterization

Many of the storm drains to MdRH flow during both wet and dry weather. Dry weather flows are not directly attributable to precipitation, but rather to nuisance flows generated from over-irrigation of lawns, car washing, restaurant washout and other activities in the watershed. Dry weather flows and associated pollutant loads are not well documented in the MdR Watershed, and to accurately describe them would require a detailed survey of the watershed. Such detailed surveys were outside the initial scope of the TMDL development; however, staff identified two sources of data characterizing bacteria densities during dry-weather in Oxford Flood Control Basin (OFCB).

Table 4-2 summarizes six storm years of dry-weather data collected monthly by LACDBH from 1995 to 2001.[13] As part of the yearly assessment of MdRH, LACDBH samples two locations in the OFCB. One sampling station is located at the northeast end of the basin where the Washington Boulevard drain empties into the OFCB (MDR-22). The other sampling location is

[12] In the current permit, the Los Angeles County Flood Control District is specifically named the principal permittee.
[13] The storm year is defined as November 1 to October 31 to be consistent with the periods specified in AB411.

at the southwest end in front of the tidegate, which drains from the OFCB to Basin E of the Marina (MDR-13). This location is subject to tidal flushing, storm water runoff and street drainage.

The data collected at MDR-22 shows that at least one of the single sample objectives for total coliform, fecal coliform or enterococcus were exceeded by more than 40% of the samples collected during dry-weather from 1996 to 2001. In 1999, all three indicators were exceeded during dry-weather in more than 50% of the samples collected at MDR-22. In 1998 and 1999 all three indicators were exceeded during dry-weather in more than 50% of the samples collected at MDR-13.

As indicated in Table 4-2, the total and fecal coliform percent exceedances are generally greater at sampling location MDR-22 than at MDR-13. Every year, except for 1998, there was a reduction in total and fecal coliform percent exceedances from sampling location MDR-22 to MDR-13 by approximately 70% and 50%, respectively. The 1998 storm year, was the wettest on record for the last 50 years with a total of 30.79 inches of rain (see Appendix E) which could explain why 1998 did not follow the same trend as the other storm years.

The enterococcus percent exceedances do not show any clear trend between the two sampling locations. For three out of six years, the percent exceedances were greater at MDR-13 than at MDR-22, for two years the percent exceedances were greater at MDR-22 and once the percent exceedances were the same.

Table 4-2. Yearly Arithmetic Mean Dry Weather Bacteria Densities (MPN/100 ml), 1995-2001 (LACDBH)

		Total Coliform			Fecal Coliform			Enterococcus		
Location	**Storm Year**	**N**	**Arithmetic Mean**	**Percent (%) Exceedance**	**N**	**Arithmetic Mean**	**Percent (%) Exceedance**	**N**	**Arithmetic Mean**	**Percent (%) Exceedance**
MDR-22: Oxford Basin at Washington Boulevard Drain	1996	9	5,284	22.2	9	372	44.4	9	23	0.0
	1997	12	7,658	33.3	12	3,968	50.0	12	48	33.3
	1998	9	8,677	44.4	9	381	33.3	9	82	11.1
	1999	10	16,000	100.0	10	5,893	90.0	10	414	60.0
	2000	12	11,003	66.7	12	1,646	33.3	12	438	58.3
	2001	9	8,094	44.4	9	1,854	11.1	9	345	44.4
MDR-13: Oxford Basin at Tidegate	1996	9	887	0.0	9	32	0.0	9	38	11.1
	1997	12	4,718	8.3	12	564	16.7	12	42	16.7
	1998	9	12,508	77.8	9	4,271	66.7	9	189	55.6
	1999	10	10,710	60.0	10	4,751	60.0	10	259	60.0
	2000	12	3,808	16.7	12	1,278	16.7	12	271	66.7
	2001	10	3,881	20.0	10	296	10.0	10	60	20.0

The Los Angeles County Department of Public Works (LACDPW) collected water quality samples at the OFCB as part of the "Field Sampling and Analysis Plan for Marina del Rey TMDLs" (see Appendix F). Between June 6, 2002 and July 16, 2002, four sampling events were conducted at two week intervals. The samples from the OFCB were collected in front of the tidegate. The sampling results for total coliform ranged from 1,400 to 2,800 MPN/100 ml, fecal coliform ranged from 110 to 1,400 MPN/100 ml, and enterococcus ranged from 21 to 9,000 MPN/100 ml.

4.2.3 Wet Weather Source Characterization

Data to characterize wet weather sources of bacteria to beaches is available from the monitoring program conducted as a requirement of the Los Angeles County MS4 Permit as well as other storm water NPDES permits throughout Southern California. The Los Angeles County permit requires monitoring of both instream water quality (to calculate mass emissions for various pollutants) as well as land use monitoring to attempt to quantify pollutant loads from specific land uses. In addition, the Los Angeles County Department of Beaches and Harbors collected limit wet-weather data from the OFCB.

Table 4-3 summarizes the wet-weather data for specific land uses collected by Los Angeles County under the Municipal Storm Water Permit for the period 1994-2000, as well as similar land use specific data from all storm water monitoring programs in Southern California for the period 1990-1999, compiled and analyzed by SCCWRP in 2001. All land use sites in both data sets exceeded the objectives for total coliform, fecal coliform and enterococcus. The Los Angeles County data set indicated that the high-density/single-family residential category had the highest densities of all three bacterial indicators, followed by the commercial land use for total coliform and fecal coliform, and the light-industrial land use for enterococcus. SCCWRP's aggregated data set from all of the storm water monitoring programs in Southern California indicated that the industrial land use category had the highest densities of all three indicators (SCCWRP, 2001).

Table 4-3. Summary of Bacteria Densities from Various Land Uses during Wet Weather

Data Source	Land Use	Total Coliform		Fecal Coliform		Enterococcus	
		N	Arithmetic Mean	N	Arithmetic Mean	N	Arithmetic Mean
LA County (1994-2000)	Commercial	8	1,140,000	8	528,740	8	86,250
	Light Industrial	5	454,000	5	338,220	5	98,200
	Vacant	21	9,187	21	1,397	21	679
	HD/SF Residential	3	1,366,667	3	933,333	3	610,000
	Transportation	4	692,500	4	328,750	4	32,000
SCCWRP (2001)	Agriculture	15	399,333	15	89,133	NS	NS
	Commercial	75	353,767	85	130,690	35	92,163
	Industrial	68	665,218	85	268,899	17	1,081,368
	Open	48	209,435	48	101,505	40	98,606
	Residential	98	401,424	113	185,254	47	305,536

Table 4-4 summarizes the limited wet-weather data collected in the OFCB by LACDBH from 1995 to 2001. The yearly arithmetic mean bacteria densities for all three indicators exceeded the thresholds for all four years at both sampling locations. As indicated in Table 4-4, the total and fecal coliform percent exceedances are generally greater at sampling location MDR-22 than at MDR-13 and the enterococcus percent exceedances do not show any clear trend between the two sampling locations. These trends match the trends observed in the dry-weather data set from the OFCB.

Table 4-4. Yearly Arithmetic Mean Wet Weather Bacteria Densities (MPN/100 ml), 1995-2001 (LACDBH)

Location	Storm Year	Total Coliform			Fecal Coliform			Enterococcus		
		N	Arithmetic Mean	Percent (%) Exceedance	N	Arithmetic Mean	Percent (%) Exceedance	N	Arithmetic Mean	Percent (%) Exceedance
MDR-22: Oxford Basin at Washington Boulevard Drain	1996	3	27,333	100.0	3	11,233	100.0	3	157	66.7
	1998	3	16,000	100.0	3	10,833	100.0	3	119	33.3
	1999	2	16,000	100.0	2	12,500	100.0	2	205	100.0
	2001	2	16,000	100.0	2	1,100	100.0	2	1,250	100.0
MDR-13: Oxford Basin at Tidegate	1996	3	33,900	66.7	3	5,637	66.7	3	110	33.3
	1998	3	12,333	66.7	3	10,713	66.7	3	635	66.7
	1999	2	9,200	50.0	2	9,200	100.0	2	1,050	100.0
	2001	2	12,500	50.0	2	665	50.0	2	950	100.0

As part of the "Field Sampling and Analysis Plan for Marina del Rey TMDLs" (see Appendix F), the LACDPW will be collecting storm water samples at the OFCB, Basin E and a storm water manhole on Palawan Way, located between Basins D and E. The sample from Palawan Way will be a flow-weighted composite sample, with samples collected at the beginning of the rain event then every two hours for a total of three samples.

While the storm water monitoring program collects valuable data to help characterize wet weather bacteria densities, there remain significant data gaps. For example, the samples collected under the storm water monitoring program are grab samples, which do not allow an evaluation of changes in bacteria density during the course of a storm event. In addition, the storm water monitoring program is limited in terms of the types of "critical sources" of bacteria that are sampled. The "critical sources" include land use categories where high bacterial levels are expected (i.e. industrial food processors or high density residential with high pet density). Both of these types of data are valuable when exploring management scenarios.

4.2.3.1 Wet Weather Source Characterization Study – Phase I

In response to the data gaps mentioned above, the Regional Board in partnership with other entities[14] undertook a study to characterize wet-weather bacteria densities from various land uses and in major watercourses (SCCWRP, 2000).

[14] The other entities included: Southern California Coastal Water Research Project, City of Los Angeles, County of Los Angeles, County Sanitation Districts of Los Angeles County, Heal the Bay, Santa Monica Bay Restoration Project, and others.

The study design entailed sampling eight key land uses during multiple storms. In addition, the sample design entailed sampling multiple sites within a general land use to characterize the range of bacteria densities that might be found within each land use category. See Table 4-5 for a list of the eight general land uses, 19 land use sites, the targeted number of samples, and number of samples collected at each location during Phase I. Two-thirds of the targeted site-events were sampled between January and April 2001. The remaining sites, were sampled during the 2001-02 and 2002-03 wet seasons, although, the data have not been received by the Regional Board.

Table 4-5. Wet-Weather Source Characterization Sites

Land Use Category	**Critical Sources within Land Use**	**Target Number of Samples**	**Number Collected**
High Density Residential	Mixed	2	2
	High pet density	1	0
Low Density Residential	Sewered	2	2
	Unsewered	1	0
Commercial	Mixed	2	2
	Mixed, with homeless population	1	0
	Restaurant	1	0
	Shopping mall	1	0
Industrial	Mixed	2	2
	Food industry	1	0
	Auto salvage	1	1
	Oil extraction	1	0
Agriculture	Mixed	2	2
	Nursery	1	1
Recreation	Golf course	1	0
	Horse stable	2	2
Transportation	Rail yard	1	1
	Gas station	1	0
Open Space	Open	2	1
Total		26	16

Table 4-6 summarizes the preliminary results from the land use sites sampled under Phase I of the wet weather characterization study.[15] All land use sites except for open space exceeded REC-1 single sample bacteria objectives for total coliform, fecal coliform and/or enterococcus by at least an order of magnitude. The horse stable and nursery sites had the highest values for

[15] Note that the bacteria densities presented in this table cannot be directly compared to those presented in Tables 4-3 and 4-4 as the values are flow-weighted geometric means, rather than arithmetic means.

all three bacterial indicators. Overall, total coliform was exceeded by a factor of three (low-density residential) to 230 (agriculture-nursery). Fecal coliform was exceeded by a factor of three (industrial) to 660 (recreation-horse stable). Enterococcus was exceeded by a factor of four (open space) to 2,900 (agriculture-nursery).

Table 4-6. Wet Weather Source Characterization Study: First-Year Data Summary (Flow-weighted Geometric Means)

Sampling Sites			**Total Coliform (#/100 ml)**		**Fecal Coliform (#/100 ml)**		**Enterococcus (#/100 ml)**	
		N	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Land Use Sites	Open Space	10	6,453	.	59	.	382	.
	Transportation (Railyard)	12	6,557	.	130	.	3,591	.
	Recreation (Horse Stable)	24	1,031,356	729,189	265,481	205,721	82,856	21,980
	Agriculture (Nursery)	13	2,347,197	.	56,223	.	302,199	.
	Agriculture	36	202,079	75,518	22,898	21,176	26,186	8,521
	Industrial	18	31,630	18,468	1,071	651	2,445	1,591
	Industrial (Auto Salvage)	12	160,185	.	13,673	.	65,931	.
	Commercial	22	284,558	266,134	3,198	2,949	20,020	19,452
	High Density Residential	22	75,557	24,679	14,620	8,700	8,260	3,734
	Low Density Residential	23	52,643	28,484	4,898	1,615	8,706	2,038

4.3 Nonpoint Sources

Nonpoint sources of bacterial contamination at Mothers' Beach and the back basins of MdRH include marina activities such as waste disposal from boats, boat deck and slip washing, swimmer "wash-off", restaurant washouts and natural sources from birds, waterfowl and other wildlife. The bacteria loads associated with these nonpoint sources are unknown.

Regional Board staff does not consider waste disposal from boats to be a significant source of bacterial loading, since, the lowest exceedance probabilities generally occur during summer dry-weather when the use of private and commercial boats would be highest. In addition, only the back basins of MdRH are listed as impaired for coliform. If boats were a major source of bacterial loading then one would expect other areas of the Marina to be impaired.

5 Linkage Analysis

Based on the retrospective evaluation of monitoring data discussed in Section 2.3 and source analysis presented in Section 4, staff has concluded that dry weather urban runoff and storm water conveyed by storm drains are the primary sources of elevated bacterial indicator densities to MdRH back basins during dry and wet-weather. As stated previously, the lowest exceedance probabilities generally occur during summer dry-weather both at Mothers' Beach and at the other back basins of MdRH. The highest exceedance probabilities occur during wet-weather, with the greatest magnitude of exceedance probability occurring within the OFCB (100% and 80%) and Basin E (90% and 80%). As can be seen in Table 5-1, there is a clear correlation between the exceedance probability within the OFCB and Basin E. The exceedance probabilities are consistently greater in the OFCB then in Basin E or any other basin, with Basin E having the next highest set of exceedance probabilities during each of the time periods of concern. The lowest exceedance probability during wet-weather occurs in Basin F, which does not have a storm drain discharging into the basin, which further supports the conclusion that storm water is the primary source of bacteria loading within the Marina.

Table 5-1. Summary of Calculated Exceedance Probabilities

EXCEEDANCES PROBABILITIES		**(November 1, 1995 - October 31, 2001)**		
Location ID	**Monitoring Location**	**Summer dry weather exceedance probability**	**Winter dry weather exceedance probability**	**Wet weather exceedance probability**
DBH (MDR-22)^	Oxford Flood Control Basin, at Washington Blvd. Drain - monthly	0.66	0.85	1.00
DBH (MDR-13)^	Oxford Flood Control Basin, in front of Tidegate - monthly	0.52	0.65	0.80
DBH (MDR-20)^	Basin E, in front of Tidegate from Oxford Basin - monthly	0.40	0.50	0.90
DBH (MDR-10)^	Basin E, near center of basin - monthly	0.40	0.25	0.80
DHS (109c)*	Los Angeles County Fire Dock - end of main channel - weekly	0.07	0.15	0.54
DBH (MDR-11)^	End of Main Channel - monthly	0.14	0.15	0.30
DBH (MDR-9)^	Basin F, innermost end - monthly	0.05	0.10	0.10
HYP (S9)	Mothers' Beach, Lifeguard Tower - daily	0.06	0.16	0.43
DHS (109a)**	Mothers' Beach, Playground Area - weekly	0.16	0.25	0.60
DHS (109b)**	Mothers' Beach, between Lifeguard Tower and Boat Dock - weekly	0.23	0.25	0.64
DBH (MDR-19)^	Mothers' Beach, end of wheel chair ramp - monthly	0.12	0.05	0.40
DBH (MDR-18)^	Mothers' Beach, 20 meters off of the wheel chair ramp - monthly	0.07	0.00	0.20
DBH (MDR-8)^	Mothers' Beach, near first slips outside swim area - monthly	0.02	0.05	0.30

^ Six years of monthly monitoring data from DBH were used in the analysis.
* Only three years and five months of data were available, since DHS stopped collection weekly samples at this location as of March 31, 1999.
** Only four years and ten months of data were available, since DHS stopped collecting weekly samples at these locations as of August 31, 2000.

Studies show that bacterial degradation and dilution during transport from the watershed to the receiving water do not significantly affect bacterial indicator densities (see Appendices H and I). Therefore, the loading capacity is defined in terms of bacterial indicator densities and is equivalent to the numeric targets in Section 3.

5.1 Critical Condition

The critical condition in a TMDL defines an extreme condition for the purpose of setting allocations to meet the TMDL numeric target. While a separate element of the TMDL, it may be thought of as an additional margin of safety such that the allocations are set to meet the numeric target during an extreme (or above average) condition.[16] Unlike many TMDLs, the critical condition for bacteria loading is not during low flow conditions or summer months, but rather during wet weather. This is because intermittent or episodic loading sources such as surface runoff can have maximal impacts at high (i.e. storm) flows (US EPA, 2001). Local and bight-wide shoreline monitoring data show a higher percentage of daily exceedance of the single sample targets during wet weather, as well as more severe bacteriological impairments indicated by higher magnitude exceedances and exceedances of multiple indicators (Noble *et al*., 2000a, Schiff *et al*., 2001).

To more specifically identify the critical condition within wet weather, in order to set the allowable number of exceedance days (described in Section 7, Waste Load Allocations and Load Allocations), staff propose using the 90th percentile storm year in terms of wet days as the reference year.[17] Staff selected the 90th percentile year for several reasons. First, selecting the 90th percentile year avoids an untenable situation where the reference system is frequently out of compliance. Second, selecting the 90th percentile year allows responsible jurisdictions and responsible agencies to plan for a 'worst-case scenario', as a critical condition is intended to do. Finally, the Regional Board expects that there will be fewer exceedance days in drier years, since structural controls will be designed for the 90th percentile year.

The 90th percentile storm year in terms of wet days was identified by constructing a cumulative frequency distribution of annual wet weather days using historical rainfall data from LAX from 1947-2001 (see Appendix E). This means that only 10% of years should have more wet days than the 90th percentile year. The 90th percentile year in terms of wet days was 1993, which had 75 wet days. The number of wet days was selected instead of total rainfall because a retrospective evaluation of data showed that the number of sampling events during which greater than 10% of samples exceeded the fecal coliform objective on the day after a rain was nearly equivalent for rainstorms less than 0.5 inch and those greater than 0.5 inch, concluding that even small storms represent a critical condition (Noble *et al*., 2000a). This is particularly true since the TMDL's numeric target is based on number of days of exceedance, not on the magnitude of the exceedance.

[16] Critical conditions are often defined in terms of flow, such as the seven-day-ten-year low flow (7Q10), but may also be defined in terms of rainfall amount, days of measurable rain, etc.
[17] The storm year is defined as November 1 to October 31 to be consistent with the periods specified in AB411.

6 Margin of Safety

A margin of safety has been implicitly included through several conservative assumptions, as described below. In addition, an explicit margin of safety has been incorporated, as the load allocations will allow exceedances of the single sample targets no more than 5% of the time on an annual basis, based on the cumulative allocations proposed for dry and wet weather in Section 7 below. Currently, the Regional Board concludes that there is water quality impairment if more than 10% of samples at a site exceed the single sample bacteria objectives annually.[18]

6.1 Dilution between Drain and Wave Wash

One conservative assumption is that no dilution takes place between the storm drain and the wave wash. Two local studies have examined dilution between the storm drain and wave wash during dry weather, though no similar studies have been conducted during wet weather (Taggart, 2001; City of Los Angeles, 2001). In the two studies conducted at storm drains discharging to Santa Monica Bay, researchers have observed a high degree of variability in the amount of dilution temporally, spatially, and among bacterial indicators – with dilution between the storm drain and wave wash spanning the gamut from 100% to negative values. The negative dilution values observed, indicating a higher indicator density in the wave wash as compared to the storm drain, may have several explanations. First, in the study conducted by Taggart, initial analysis suggests that measurement error, as estimated from duplicate samples, is able to account for almost all of the negative dilution values. Second, there may be a source of bacteria in the surf zone, but not in the storm drain (e.g., birds, bathers). Third, samples from the storm drain and wave wash were not collected at the same time and therefore do not represent the same parcel of water; as a result, natural variability may account for the apparent "negative dilution."

The study conducted by Taggart shows that dilution is site-specific and dependent on oceanographic and climatic parameters including tide height, longshore velocity in the surf zone, wave height, and wind speed (see Appendix G for further discussion).

Because of the high variability in the amount of dilution temporally, spatially, and among bacterial indicators, staff decided to select a conservative dilution factor based on approximately the 10^{th} percentile dilution factor from the two studies mentioned above. The 10^{th} percentile ranged from -10% for total coliform, -19% for fecal coliform, and -40% for enterococcus (see Appendix G). Instead of specifying a negative dilution ratio, staff chose on the basis of the data to specify 0% dilution between the drain and the wave wash. Zero percent dilution corresponded to the 11^{th} percentile for total coliform and 12^{th} percentile for fecal coliform and enterococcus.

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[18] Regional Board staff are hesitant to base an impairment decision on one sample, knowing that bacteria densities can be highly variable (Noble *et al.* 1999, 2000a, 2000b; Taggart, 2001). Some researchers contend one sample is of limited value because of the high variability in bacteria densities, and central tendencies and variability are needed to define water quality at a particular site (Pike, 1992; Cheung, *et al.*, 1990b). Therefore, while single sample results may be appropriate for public notification purposes, they are not generally appropriate for evaluating water quality to determine impairment.

6.2 Bacterial Degradation

Based on three experiments conducted to mimic natural conditions in or near Santa Monica Bay, two in marine water and one in fresh water, bacterial degradation was shown to range from hours to days. Transport time from the subwatersheds of MdR during wet-weather is short. Therefore, the conclusion is that bacteria degradation is not fast enough to greatly affect bacteria densities in the wave wash or at Oxford Flood Control Basin during wet-weather. Based on the results of the marine water experiments, the model assumes a first-order decay rate for bacteria of 0.8 d^{-1} (or 0.45 per day). (Degradation rates were shown to be as high as 1.0 d^{-1}.) (See Appendix H for a discussion of the experimental design and results of the bacteria degradation study.)

7 Waste Load Allocations and Load Allocations

Waste load allocations (WLAs) and load allocations (LAs) in this TMDL are expressed in a unique way. WLAs and LAs are expressed as the number of daily or weekly sample days that may exceed the single sample targets identified in Section 3 at a monitoring site. WLAs and LAs are expressed as allowable exceedance days because the bacterial density and frequency of single sample exceedances are the most relevant to public health protection. Allowable exceedance days are 'appropriate measures' consistent with the definition in 40 CFR 130.2(i).

For each monitoring site, allowable exceedance days are set on an annual basis as well as for three other time periods. These three periods are (1) summer dry-weather (April 1 to October 31), (2) winter dry-weather (November 1 to March 31), and (3) wet-weather (defined as days of 0.1 inch of rain or more plus three days following the rain event).[19] The County of Los Angeles, City of Los Angeles, Culver City, and CalTrans are the responsible jurisdictions and responsible agencies[20] for the Marina del Rey Watershed. The responsible jurisdictions and responsible agencies within the MdR watershed are jointly responsible for complying with the waste load allocation at each monitoring location. All proposed WLAs for summer dry-weather are zero (0) days of allowable exceedances. The proposed WLAs for winter dry-weather and wet-weather vary by location based on the process described below.

The proposed waste load allocation for the rolling 30-day geometric mean for the County of Los Angeles, City of Los Angeles, Culver City, and CalTrans is zero (0) days of allowable exceedances.

As discussed in Section 4.1, discharges from general NPDES permits, general industrial storm water permits and general construction storm water permits are not expected to be a significant source of bacteria. Therefore, the proposed WLAs for these dischargers as listed in Table 4-1 are zero (0) days of allowable exceedances for all three time periods and for the single sample limits and the rolling 30-day geometric mean. Any future enrollees under a general NPDES permit, general industrial storm water permit or general construction storm water permit within the MdR Watershed will also be subject to a WLA of zero days of allowable exceedances. Since, all storm water runoff to MdRH is regulated as a point source, load allocations (LAs) of zero (0) days of allowable exceedances for nonpoint sources are proposed in this TMDL for each time period. The load allocation for the rolling 30-day geometric mean for nonpoint sources is zero (0) days of allowable exceedances. If a nonpoint source is directly impacting bacteriological water quality and causing an exceedance of the numeric targets, the permittee(s) under the Municipal Storm Water NPDES Permits are not responsible through these permits. However, the jurisdiction or agency adjacent to the monitoring location may have further obligations to identify such sources, as described in Section 9.1.1, Follow-up Monitoring.

[19] These time periods are consistent with the AB-411 implementing regulations (CCR, Title 17) as well as with protocols used by the Los Angeles County Department of Health Services to post beaches during wet weather.

[20] For the purposes of this TMDL, "responsible jurisdictions and responsible agencies" are defined as (1) local agencies that are permittees or co-permittees on a municipal storm water permit, (2) local or state agencies that have jurisdiction over Mothers' Beach or the back basins of MdRH, and (3) the California Department of Transportation pursuant to its storm water permit.

The following section is comprised of three parts. In the first, we further discuss why WLAs are defined as allowable exceedance days. In the second, we introduce the criteria for determining allowable exceedance days. Finally, we describe the decision-making process used to set allowable exceedance days for each monitoring site.

7.1 Why waste load allocations are defined as allowable exceedance days: The role of natural subwatersheds

The bacteria indicators used to assess water quality are not specific to human sewage. Fecal matter from wildlife and birds can be a source of elevated levels of bacteria, and vegetation can be a source of elevated levels of total coliform bacteria, specifically.

Based on historical data, even the most undeveloped subwatersheds of SMB occasionally exceed the single sample targets outlined in Section 3. For example, Leo Carrillo Beach (LCB) has an associated subwatershed, Arroyo Sequit Canyon, that is 98% open space.[21] LCB exceeded one or more of the single sample targets on average 0% of the summer dry-weather days sampled, 3% of the winter dry-weather days sampled, and 22% of the wet-weather days sampled over the 5-year period from November 1995 to October 2000.

In light of these findings, strictly applying the single sample targets identified in Section 3 would likely require implementing agencies to capture or treat dry and wet-weather runoff from natural areas. It is not the intent of this TMDL to require diversion of natural coastal creeks or to require treatment of natural sources of bacteria from undeveloped areas. Therefore, the implementation procedure for the recently-adopted bacteria objectives for REC-1 waters and the WLA approach proposed herein set allowable exceedance days based on bacteriological water quality conditions that are achievable at reference beach(es) associated with largely undeveloped subwatershed(s) within Santa Monica Bay or based on antidegradation principles.

7.2 Criteria for determining allowable exceedance days: The role of the reference system and antidegradation

As previously described in Section 3, staff proposes to set the number of allowable exceedance days for each monitoring site to ensure that two criteria are met (1) bacteriological water quality is at least as good as that of a largely undeveloped system, and (2) there is no degradation of existing bacteriological water quality.

7.3 Determining allowable dry-weather and wet-weather exceedance days

Staff ensures that the two criteria above are met by using the smaller of two exceedance probabilities for any monitoring site multiplied by the number of dry days or wet days for the critical condition (discussed in Section 5.1).[22] An exceedance probability, P(E), is simply the

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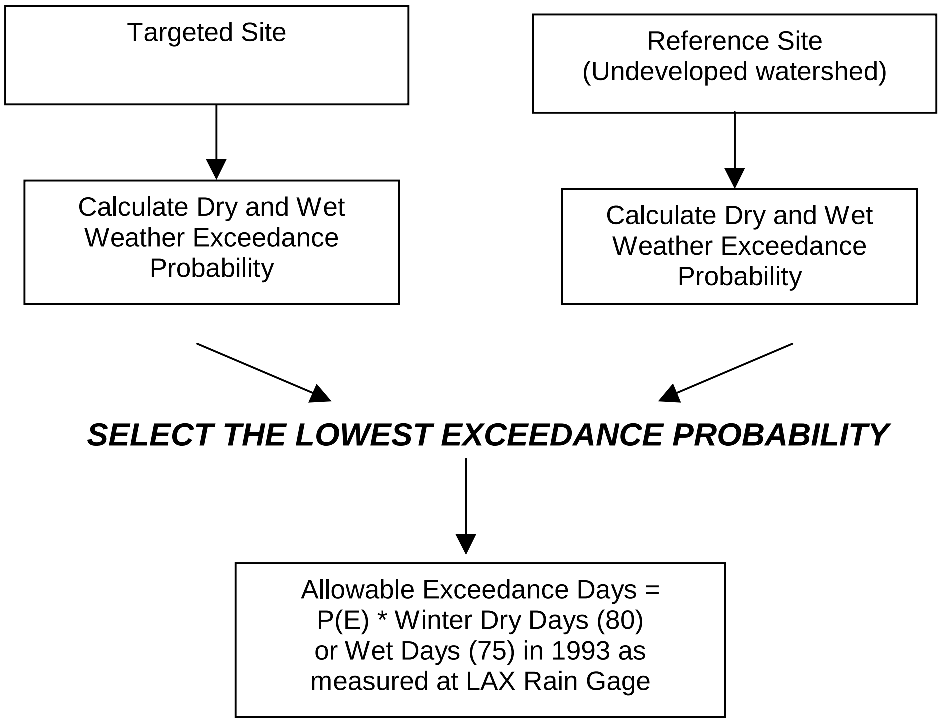
[21] Arroyo Sequit Canyon is approximately 12 square miles in size and has the highest percentage (98%) of open space in comparison to the other subwatersheds in Santa Monica Bay.

[22] As a reminder, the critical condition proposed is the 90th percentile storm year in terms of wet days. The storm year is defined as November 1-October 31. Wet days are defined as days with ≥0.1 inch of rain plus the three days following and a dry day is any non-wet day. The 90th percentile storm year based on historical data
Footnote continued on next page

probability that one or more single sample targets described in Section 3 will be exceeded at a particular monitoring site, based on historical data. The flow diagram below illustrates the decision-making process for determining allowable exceedance days at a monitoring site.

Figure 3. Decision-Making Process for Determining Waste Load Allocations (expressed as allowable exceedance days)



For any one monitoring site, two exceedance probabilities are compared and the lowest one is selected (1) the dry-weather or wet-weather exceedance probability in the reference system, $P(E)_R$ and (2) the dry-weather or wet-weather exceedance probability based on historical bacteriological data at that particular site, $P(E)_i$. (In other words, if $P(E)_R$ is greater than $P(E)_i$, then $P(E)_i$ will apply to that particular site (i.e., the site-specific exceedance probability would override the "default" exceedance probability of the reference system)). Next, the chosen dry-weather or wet-weather exceedance probability is multiplied by the dry or wet days in the reference year as measured at the LAX meteorological station.

Below we provide background information and justification for the two steps in the process described above. First, we describe how the dry and wet-weather exceedance probabilities for the monitoring sites were calculated. Then we discuss how these exceedance probabilities are translated into allowable exceedance days for each time period at the targeted monitoring site, including justifications for the proposed reference beach and reference year.

from the LAX meteorological station is 1993. In 1993 there were 75 wet days and 290 dry days, 80 of which were winter dry days.

7.3.1 Step 1: Calculating Dry-Weather and Wet-Weather Exceedance Probabilities

The dry-weather exceedance probability is simply the probability that one or more single sample targets will be exceeded on a dry day at a particular location. The wet-weather exceedance probability is simply the probability that one or more single sample targets will be exceeded on a wet day at a particular location.

The most recent five or six years of monitoring data (November 1, 1995 to October 31, 2001) were used to determine the exceedance probability for each monitoring site for each of the three time periods of concern (i.e., summer dry-weather, winter dry-weather, and wet-weather).[23] Samples were identified as dry or wet-weather samples using rainfall data from LAX. See Table 7-1 for the exceedance probabilities for each time period of concern at each monitoring location, based on historical data.[24]

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[23] As a reminder, wet weather was defined as those days with 0.1 inch of rain or more, and the three days following the rain event. This definition is the same as that used by the Los Angeles County Department of Health Services for rain-related beach postings. A dry day is defined as a non-wet day.

[24] The storm years of 1996-2001 represented a wide range of rainfall conditions in terms of wet days for the historical record at LAX (1947-2001): 1996 (66th percentile), 1997 and 2001 (32nd percentile), 1998 (98th percentile), 1999 (77th percentile), 2000 (57th percentile); and dry days at LAX: 1996 (34th percentile), 1997 and 2001 (62nd percentile), 1998 (2nd percentile), 1999 (21st percentile), and 2000 (43rd percentile).

Table 7-1. Summary of Calculated Exceedance Probabilities

EXCEEDANCES PROBABILITIES		(November 1, 1995 - October 31, 2001)		
Location ID	**Monitoring Location**	**Summer dry weather exceedance probability**	**Winter dry weather exceedance probability**	**Wet weather exceedance probability**
DHS (010)	Leo Carrillo Beach, at 35000 PCH - weekly	0.00	0.03	0.22
HYP (S9)	Mothers' Beach, Lifeguard Tower - daily	0.06	0.16	0.43
DHS (109a)*	Mothers' Beach, Playground Area - weekly	0.16	0.25	0.60
DHS (109b)*	Mothers' Beach, between Lifeguard Tower and Boat Dock - weekly	0.23	0.25	0.64
DHS (109c)**	Los Angeles County Fire Dock - end of main channel - weekly	0.07	0.15	0.54
DBH (MDR-8)^	Mothers' Beach, near first slips outside swim area - monthly	0.02	0.05	0.30
DBH (MDR-18)^	Mothers' Beach, 20 meters off of the wheel chair ramp - monthly	0.07	0.00	0.20
DBH (MDR-19)^	Mothers' Beach, end of wheel chair ramp - monthly	0.12	0.05	0.40
DBH (MDR-9)^	Basin F, innermost end - monthly	0.05	0.10	0.10
DBH (MDR-11)^	End of Main Channel - monthly	0.14	0.15	0.30
DBH (MDR-10)^	Basin E, near center of basin - monthly	0.40	0.25	0.80
DBH (MDR-20)^	Basin E, in front of Tidegate from Oxford Basin - monthly	0.40	0.50	0.90
DBH (MDR-13)^	Oxford Flood Control Basin, in front of Tidegate - monthly	0.52	0.65	0.80
DBH (MDR-22)^	Oxford Flood Control Basin, at Washington Blvd. Drain - monthly	0.66	0.85	1.00

* Only four years and ten months of data were available, since DHS stopped collecting weekly samples at these locations as of August 31, 2000.
** Only three years and five months of data were available, since DHS stopped collection weekly samples at this location as of March 31, 1999.
^ Six years of monthly monitoring data from DBH were used in the analysis.

7.3.2 Step 2: Calculating Allowable Exceedance Days at a Targeted Location

To determine allowable exceedance days, the smaller of the two exceedance probabilities – that of the targeted site or the reference site – is selected to use in subsequent calculations.

Staff proposes to use Leo Carrillo Beach (LCB) as the reference site. To translate the exceedance probabilities into allowable exceedance days and exceedance-day reductions, staff proposes to use the number of wet weather days and the number of dry weather days in the 90th percentile storm year, based on rainfall data from the Los Angeles International Airport (LAX) meteorological station. Justification for this decision is provided below.

7.3.2.1 Justification for reference beach

Three criteria were used to rate candidate sites for selection as the reference beach. These were (1) percentage of undeveloped land in the watershed, (2) presence of a freshwater outlet to the beach, and (3) availability of historical monitoring data. Leo Carrillo Beach and its associated drainage, Arroyo Sequit Canyon, best met these criteria. Arroyo Sequit Canyon has the largest percentage of land area in open space (98%) relative to all other Santa Monica

Bay subwatersheds, LCB has a freshwater outlet (Arroyo Sequit) to the beach, and there is an existing monitoring site at the beach (see Table 7-2). Furthermore, field surveys by Regional Board staff have confirmed that there is very little evidence of anthropogenic impact in most of this relatively large subwatershed. The reference system will be re-evaluated as part of the fourth year revision of the TMDL.

Table 7-2. Comparison of Subwatershed Size and Percent Open Space

Subwatershed	**Open**	**Total Land Area (acres)**	**Size Rank**	**Open Space Rank**
Arroyo Sequit	98.0%	7,549	5	1
Solstice Canyon	97.2%	2,841	14	2
Pena Canyon	97.1%	608	27	3
Tuna Canyon	96.4%	1,013	24	4
Nicholas Canyon	91.6%	1,235	22	5
Latigo Canyon	91.0%	813	25	6
Encinal Canyon	90.5%	1,794	21	7
Las Flores Canyon	90.4%	2,897	13	8
Los Alisos Canyon	90.3%	2,396	16	9
Topanga Canyon	89.8%	12,575	1	10
Corral Canyon	89.6%	4,280	10	11
Escondido Canyon	88.6%	2,295	18	12
Trancas Canyon	88.4%	6,514	7	13
Zuma Canyon	85.8%	6,339	8	14
Castlerock	85.0%	4,976	9	15
Carbon Canyon	84.7%	2,320	17	16
Piedra Gorda Canyon	81.9%	644	26	17
Ramirez Canyon	78.3%	3,334	12	18
Santa Monica Canyon	77.6%	10,088	2	19
Pulga Canyon	76.6%	1,955	19	20
Santa Ynez	46.1%	1,203	23	21
Palos Verdes	33.6%	10,023	3	22
Santa Monica	13.0%	8,850	4	23
Dockweiler	12.8%	6,573	6	24
Redondo	5.5%	3,544	11	25
Marina del Rey	4.8%	1,855	20	26
Hermosa	2.9%	2,624	15	27

7.3.2.2 Justification for critical condition (reference year)

Based on an examination of historical rainfall data from the Los Angeles International Airport (LAX) meteorological station,[25] staff propose using the 90th percentile storm year[26] in terms of wet-weather days as the critical condition for determining the allowable wet-weather exceedance days. The reference year of 1993 was chosen because it is the 90th percentile year in terms of wet-weather days, based on 54 storm years (1948-2001) of rainfall data from LAX (see Appendix E). In the 1993 storm year, there were 75 wet-weather days, therefore, there were 290 dry days, 80 of which occurred during the winter months.[27] By selecting the 90th percentile year, we avoid creating a situation where the reference beach frequently exceeds its allowable exceedance days (i.e., 9 years out of 10, the number of exceedance days at the reference beach should be less than the *allowable* exceedance days at the reference beach).[28]

7.3.3 Translating exceedance probabilities into estimated exceedance days during the critical condition

The estimated number of exceedance days during the critical condition (reference year) was calculated for each site by multiplying the site-specific exceedance probability by the estimated number of dry or wet days in the reference year. The site-specific exceedance probability is taken directly from the historical data analysis, as listed in Table 7-1. Based on 54 storm years of rainfall data from LAX meteorological station, 1993 is the reference year for both dry and wet weather.

$$E_{CC} = P(E)_i * days_{1993} \qquad \text{(Equation 7.1)}$$

Where E_{CC} is the estimated number of exceedance days under the critical condition and $P(E)_i$ is the average probability of exceedance for any site. The average exceedance probability is appropriate since the weekly sampling is systematic and the rain events are randomly distributed; therefore, sampling will be evenly spread over the dry-weather and wet-weather events (i.e., the rain day, day after, 2nd day after, 3rd day after).[29]

To estimate the number of exceedance days during the reference year *given a weekly sampling regime*, the number of days was adjusted by solving for *x* in the following equation:

$$\frac{days_{1993}}{365 \text{ days}} = \frac{x}{52 \text{ weeks}} \qquad \text{(Equation 7.2)}$$

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[25] Staff used data from the LAX meteorological station, since it has the longest historical rainfall record.

[26] The "storm year" is defined as November 1 to October 31, in order to be consistent with AB-411 implementing regulations.

[27] For comparison, in the 1993 storm year, there were 41 *days of rain*, which represented the 75th percentile, and 22.93 *inches of rain*, representing the 94th percentile, for the historical rainfall record at LAX.

[28] Conversely, if we were to select the 10th percentile year in terms of wet days to set the allowable exceedance days, the reference beach could foreseeably exceed the allowable exceedance days 9 years out of 10.

[29] Also, note that SCCWRP found no correlation between the day of the week and the percentage of samples exceeding the single sample objectives (Schiff *et al.*, 2002, p. 40).

Using these equations, the exceedance probability of the reference beach is translated to exceedance days as follows. Analysis of historical monitoring data for Leo Carrillo Beach, the reference beach, shows that summer dry-weather exceedance probability is 0.00, the winter dry-weather exceedance probability is 0.03, and the wet-weather exceedance probability is 0.22. Per Equation 7.1, the number of summer dry-weather exceedance days is zero (0) at Leo Carrillo Beach, therefore, no exceedances are allowed at any site during summer dry weather. The exceedance probability of 0.03, for winter dry-weather, is multiplied by 80 days, the number of winter dry-weather days in the 1993 storm year, per Equation 7.1 resulting in three (3) exceedance days. The exceedance probability of 0.22, for wet-weather, is multiplied by 75 days, the number of wet-weather days in the 1993 storm year at, per Equation 7.1 resulting in 17 exceedance days.

Staff recognizes that the number of winter dry-weather days and wet-weather days will change from year-to-year and, therefore, the exceedance probabilities of 0.03 for winter dry-weather and 0.22 for wet-weather will not always equate to 3 or 17 days, respectively. However, staff proposes setting the allowable number of exceedance days based on the reference year rather than adjusting the allowable number of exceedance days annually based on the number of dry or wet days in a particular year. This is because it would be difficult to design diversion or treatment facilities to address such variability from year to year. Staff expects that by designing facilities for the 90th percentile storm year, during drier years there will most likely be fewer exceedance days than the maximum allowable.

To estimating the number of exceedance days at Leo Carrillo Beach in the reference year under a weekly sampling regime for winter dry-weather and wet-weather, the number of days was adjusted by solving for x in Equation 7.2 as follows:

$$\frac{80\ days}{365\ days} = \frac{x}{52\ weeks} \qquad \text{(Equation 7.2 for winter dry-weather)}$$

$$\frac{75\ days}{365\ days} = \frac{x}{52\ weeks} \qquad \text{(Equation 7.2 for wet-weather)}$$

For winter dry-weather, solving for x equals 11.4, which is then multiplied by 0.03, resulting in one (1) exceedance day during winter dry-weather when weekly sampling is conducted. For wet-weather, x equals 10.7 multiplied by 0.22, results in three (3) exceedance days during wet-weather when weekly sampling is conducted.

The estimated exceedance days for all the other sites are calculated in the same way, using the site-specific exceedance probabilities for each time period.

For illustrative purposes, in Tables 7-3 through 7-5, for each monitoring site (and assuming a daily sampling regime), staff present the estimated number of exceedance days under the critical condition, the allowable number of exceedance days calculated as described above, and the necessary exceedance-day reduction for each time period.

Table 7-3. Estimated Summer Dry-Weather Exceedance Days in Critical Year, Allowable Exceedance Days, and Exceedance-Day Reductions, by Site

Monitoring Location	**Estimated no. of summer dry-weather exceedance days in critical year**	**Allowable no. of summer dry-weather exceedance days (daily sampling)**	**Estimated final summer dry-weather exceedance-day reduction**
Leo Carrillo Beach, at 35000 Pacific Coast Highway	0	0	0
Mothers' Beach, at Lifeguard Tower	13	0	13
*Mothers' Beach, at Playground Area	34	0	34
*Mothers' Beach, between Lifeguard Tower and Boat Dock	49	0	49
**Los Angeles County Fire Dock - end of main channel	15	0	15
^Mothers' Beach, near first slips outside swim area	5	0	5
^Mothers' Beach, 20 meters off of the wheel chair ramp	15	0	15
^Mothers' Beach, end of wheel chair ramp	26	0	26
^Basin F, innermost end	11	0	11
^End of Main Channel	30	0	30
^Basin E, near center of basin	84	0	84
^Basin E, in front of Tidegate from Oxford Basin	84	0	84

* Only four years and ten months of data were available, since DHS stopped collecting weekly samples at these locations as of August 31, 2000.
** Only three years and five months of data were available, since DHS stopped collection weekly samples at this location as of March 31, 1999.
^ Six years of monthly monitoring data from DBH were used in the analysis.

The WLA of zero (0) exceedance days for summer dry-weather is further supported by the fact that the California Department of Health Services has established minimum protective bacteriological standards, the same as the numeric targets proposed in this TMDL. Which, when exceeded during the period of April 1 though October 31, are used to post beaches with health hazard warnings (California Code of Regulations, Title 17, Section 7958). In order to fully protect public heath and prevent beach postings during this period, staff does not propose to change the zero exceedance days during summer dry-weather.

Table 7-4. Estimated Winter Dry-Weather Exceedance Days in Critical Year, Allowable Exceedance Days, and Exceedance-Day Reductions, by Site

Monitoring Location	Estimated no. of winter dry-weather exceedance days in critical year	Allowable no. of winter dry-weather exceedance days (daily sampling)	Estimated final winter dry-weather exceedance-day reduction
Leo Carrillo Beach, at 35000 Pacific Coast Highway	3	3	0
Mothers' Beach, at Lifeguard Tower	13	3	10
*Mothers' Beach, at Playground Area	20	3	17
*Mothers' Beach, between Lifeguard Tower and Boat Dock	20	3	17
**Los Angeles County Fire Dock - end of main channel	12	3	9
^Mothers' Beach, near first slips outside swim area	4	3	1
^Mothers' Beach, 20 meters off of the wheel chair ramp	0	0	0
^Mothers' Beach, end of wheel chair ramp	4	3	1
^Basin F, innermost end	8	3	5
^End of Main Channel	12	3	9
^Basin E, near center of basin	20	3	17
^Basin E, in front of Tidegate from Oxford Basin	40	3	37

* Only four years and ten months of data were available, since DHS stopped collecting weekly samples at these locations as of August 31, 2000.
** Only three years and five months of data were available, since DHS stopped collection weekly samples at this location as of March 31, 1999.
^ Six years of monthly monitoring data from DBH were used in the analysis.

For the back basins of MdRH, the estimated exceedance-day reductions during winter dry-weather represents a 80% reduction in the expected number of exceedance days that would occur under the defined critical condition. For individual locations, the exceedance-day reductions range from a maximum of 37 days to 0 days (where the antidegradation standard is applied). The range of allowable winter dry-weather exceedance days is zero (0) to a maximum of three (3) days.

Table 7-5. Estimated Wet-Weather Exceedance Days in Critical Year, Allowable Exceedance Days, and Exceedance-Day Reductions, by Site

Monitoring Location	**Estimated no. of wet-weather exceedance days in critical year (90th percentile)**	**Allowable no. of wet-weather exceedance days (daily sampling)**	**Estimated final wet-weather exceedance-day reduction**
Leo Carrillo Beach, at 35000 Pacific Coast Highway	17	17	0
Mothers' Beach, at Lifeguard Tower	33	17	16
*Mothers' Beach, at Playground Area	45	17	28
*Mothers' Beach, between Lifeguard Tower and Boat Dock	48	17	31
**Los Angeles County Fire Dock - end of main channel	41	17	24
^Mothers' Beach, near first slips outside swim area	23	17	6
^Mothers' Beach, 20 meters off of the wheel chair ramp	15	15	0
^Mothers' Beach, end of wheel chair ramp	30	17	13
^Basin F, innermost end	8	8	0
^End of Main Channel	23	17	6
^Basin E, near center of basin	60	17	43
^Basin E, in front of Tidegate from Oxford Basin	68	17	51

* Only four years and ten months of data were available, since DHS stopped collecting weekly samples at these locations as of August 31, 2000.
** Only three years and five months of data were available, since DHS stopped collection weekly samples at this location as of March 31, 1999.
^ Six years of monthly monitoring data from DBH were used in the analysis.

For the back basins of MdRH, the estimated exceedance-day reductions during wet-weather represents a 55% reduction in the expected number of exceedance days that would occur under the defined critical condition. For individual locations, the exceedance-day reductions range from a maximum of 51 days to 0 days (where the antidegradation standard is applied). The range of allowable wet-weather exceedance days is eight (8) to a maximum of 17 days.

8 IMPLEMENTATION STRATEGIES

8.1 Introduction

As required by the federal Clean Water Act, discharges of pollutants to MdRH from municipal storm water conveyances are prohibited, unless the discharges are in compliance with a NPDES permit. In December 2001, the Los Angeles County Municipal NPDES Storm Water Permit was re-issued jointly to Los Angeles County and 84 cities as co-permittees. The Los Angeles County Municipal Storm Water NPDES Permit and the CalTrans Storm Water Permit will be key implementation tools for this TMDL. Future storm water permits will be modified in order to address implementation and monitoring of this TMDL and to be consistent with the waste load allocations of this TMDL.

The Porter Cologne Water Quality Control Act prohibits the Regional Board from prescribing the method of achieving compliance with water quality standards, and likewise TMDLs. Below staff have identified some potential implementation strategies; however, there is no requirement to follow the particular strategies proposed herein as long as the maximum allowable exceedance days for each time period are not exceeded. The County of Los Angeles, City of Los Angeles, Culver City and CalTrans are jointly responsible for meeting the TMDL requirements for MdRH. Therefore, they may jointly decide how to achieve the necessary reductions in exceedance days at each location by employing one or more of the implementation strategies discussed below or any other viable strategy. Since, MdRH is located in an unincorporated area of the County of Los Angeles, the County of Los Angeles is the primary jurisdiction. Staff expects that after an additional year or two of sampling, the source characterization study will assist municipalities in focusing their implementation efforts on key land uses, critical sources and storm periods.

As mentioned earlier, the necessary reductions in the number of exceedance days must be achieved in the wave wash or at ankle depth for “open beach” monitoring stations (i.e., monitoring stations located away from any storm drain). This means that each municipality and permittee will be required to meet the total reduction at the monitoring location, not necessarily an allocation for their jurisdiction or for specific land uses. Clearly the focus should be on developed areas or areas with significant human use (i.e., open space heavily used for recreation). Flexibility will be allowed in determining how to reduce bacteria densities as long as the required allocations are achieved in the wave wash or at ankle depth.

To achieve the necessary exceedance-day reductions to meet the allowable exceedance days presented in Section 7, Regional Board staff recognizes the need to balance short-term capital investments directed to addressing this and other TMDLs in the MdR watershed with long-term planning activities for storm water management in the region as a whole. It should be emphasized that the potential implementation strategies discussed below may significantly contribute to the implementation of other TMDLs for MdRH.

8.2 Potential Implementation Strategies

Three potential implementation strategies are presented below 1) a diversion and treatment strategy, 2) a circulation strategy, and 3) a structural and non-structural control strategy.

8.2.1 Diversion and Treatment Strategy

The diversion and treatment strategy includes the installation of facilities to provide capture and storage of dry and/or wet-weather runoff and diversion of the stored runoff to the wastewater collection system for treatment at the City's Hyperion Treatment Plant (HTP) during low flow conditions at the plant (typically during the early morning hours of 12-6 a.m.), if possible. If diversion to the HTP is not an option, other strategies such as small dedicated runoff treatment plants such as the Santa Monica Urban Runoff Recycling Facility (SMURRF) or alternative best management practices (BMPs) would need to be implemented to meet the TMDL requirements.

8.2.2 Circulation Strategy

The Los Angeles County Department of Beaches and Harbors is proposing to construct a water infusion system to pump cleaner water from adjacent basins through a piping or culvert system, discharging the cleaner water through dispersion pipes that will be strategically situated at the western end of Basin D. The infusion system would draw a sufficient quantity of cleaner water, in order to, enhance the circulation and flushing, and to reduce water retention time in the swim area of Mothers' Beach. This strategy is expected to help meet or exceed state health standards at Mothers' Beach sampling locations and may also be applicable to Basins E and F.

8.2.3 Structural and Non-Structural Control Strategy

The structural and non-structural control strategy is based on the premise that specific land uses, critical sources, or specific periods of a storm event can be targeted to achieve the TMDL waste load allocations. It is this strategy that the wet-weather study described in Section 4.2.3.1 was designed to evaluate. For example, non-structural controls may include better enforcement of pet waste disposal ordinances and food waste disposal ordinances for restaurants and food industries, or designated diaper receptacles at Mothers' Beach. Also, education and encouraging boat owners to use pump out facilities. Structural controls may include placement of storm water treatment devices specifically designed to reduce bacteria densities or storage and infiltration facilities at critical upstream points in the storm water conveyance system. These structural solutions may be further targeted to a specific storm period such as the first 0.1 inch or 0.5 inch if the bacteria wash-off pattern mimics a 'first-flush' effect.

8.3 Implementation Schedule

The proposed implementation schedule shall consist of a phased approach as discussed below and outlined in Table 8-1.

Within three years of the effective date of the TMDL, there shall be no allowable exceedances at any location during summer dry-weather (April 1 to October 31). Within six years of the effective date of the TMDL, compliance with the allowable number of winter dry-weather exceedance days (November 1 to March 31) as listed in Table 7-4 must be achieved. Within ten years of the effective date of the TMDL, compliance with the allowable number of wet-weather exceedance days as listed in Table 7-5 must be achieved.

To be consistent with the SMB beaches TMDLs, the Regional Board intends to revise this TMDL, in conjunction with the revision of the SMB beaches TMDLs. The SMB beaches TMDLs are scheduled to be revised in four years: to re-evaluate the allowable winter dry-weather and wet-weather exceedance days based on additional data on bacterial indicator densities in the wave wash; to re-evaluate the reference system selected to set allowable exceedance levels; and to re-evaluate the reference year used in the calculation of allowable exceedance days.

Until the TMDL is revised, the allowable number of winter dry-weather and wet-weather exceedance days will remain as presented in Tables 7-4 and 7-5. Revising the TMDL will not create a conflict in the interim, since the TMDL does not require compliance during winter dry-weather or wet-weather until six and ten years, respectively, from the effective date of the TMDL. Therefore, the allowable exceedance days for winter dry-weather and wet-weather will be revised as necessary before the compliance deadlines.

Table 8-1. Summary of Implementation Schedule

Date	Action
120 days after the effective date of the TMDL	Pursuant to a request from the Regional Board, responsible jurisdictions and responsible agencies[30] must submit coordinated monitoring plan(s) to be approved by the Executive Officer. The monitoring plan shall including a list of new sites[31] and/or sites relocated to the point where the effluent from the storm drain initially mixes with the receiving water. At which time responsible jurisdictions and responsible agencies shall select between daily or systematic weekly sampling.
1 year after effective date of TMDL	Responsible jurisdictions and responsible agencies shall provide a written report to the Regional Board outlining how each intends to cooperatively achieve compliance with the TMDL. The report shall include implementation methods, an implementation schedule, and proposed milestones.
3 years after effective date of the TMDL	Responsible jurisdictions and responsible agencies shall provide to the Regional Board results of the study conducted to determine the relative bacterial loading from storm drains versus birds at the OFCB and Mothers' Beach.
3 years after effective date of the TMDL	Achieve compliance with the allowable exceedance days as set forth in Table 7-3 and rolling 30-day geometric mean targets during summer dry-weather (April 1 to October 31).
4 years after effective date of the Santa Monica Bay Beaches TMDLs	The Regional Board shall reconsider this TMDL to: refine allowable winter dry-weather and wet weather exceedance days based on additional data on bacterial indicator densities, an evaluation of site-specific variability in exceedance levels, and the results of the study of relative loading from storm drains versus birds, re-evaluate the reference system selected to set allowable exceedance levels, including a reconsideration of whether the allowable number of exceedance days should be adjusted annually dependent on the rainfall conditions and an evaluation of natural variability in exceedance levels in the reference system(s), re-evaluate the reference year used in the calculation of allowable exceedance days, and re-evaluate whether there is a need for further clarification of revision of the geometric mean implementation provision.
6 years after effective date of the TMDL	Achieve compliance with the allowable exceedance days as set forth in Table 7-4 and rolling 30-day geometric mean targets during winter dry-weather (November 1 to March 31).
10 years after effective date of the TMDL	Achieve compliance with the allowable exceedance days as set forth in Table 7-5 and rolling 30-day geometric mean targets during wet-weather.

[30] For the purposes of this TMDL, "responsible jurisdictions and responsible agencies" are defined as (1) local agencies that are permittees or co-permittees on a municipal storm water permit, (2) local or state agencies that have jurisdiction over Mothers' Beach or the back basins of MdRH, and (3) the California Department of Transportation pursuant to its storm water permit.

[31] For those areas of the Marina without an existing monitoring site, responsible jurisdictions and responsible agencies must establish a monitoring site if there is measurable flow from a publicly owned storm drain to the basin during dry weather.

8.4 Implementation Cost Estimates

8.4.1 Diversion and Treatment Strategy

The following cost estimates for the diversion and treatment strategy were provided by the City of Los Angeles as part of its implementation strategy proposal for the SMB beaches TMDLs. Cost estimates for conveying, storing, and diverting flows per the diversion and treatment implementation strategy were developed assuming conveyance, storage, and diversion from the Oxford Flood Control Basin. It is expected that the siting of the storage facilities and conveyance of the flows will be the most challenging aspects to this strategy.

Table 8-2 summarizes the capital and operation and maintenance (O&M) costs for the diversion strategy.

Table 8-2. Diversion Present Worth Cost Comparisons

Number of Diversions	**Present Worth Costs[1, 2] ($, millions)**			
	Capital	**O&M[3]**		**TOTAL**
		Annual	**Present Worth**	**Present Worth**
1	**31.6**	**0.03**	**0.31**	**32**

Notes:

[1] These concept-level costs are order-of-magnitude estimates which have a range of accuracy between –30 and +50 percent. All costs are in year 2001 dollars.

[2] Present worth costs based on 7 percent interest over 20-year return period. Uniform series discount factor 105940 applied to O&M annual costs.

[3] O&M cost primarily associated with power requirements for pumping from storage tank to diversion structure.

8.4.2 Circulation Strategy

The following cost estimates were provided by the Los Angeles County Department of Beaches and Harbors as part of the Clean Beaches Initiative Proposal for the Marina del Rey Beach Water Quality Improvement Project. The capital costs for the entire project, as proposed, have been estimated at approximately $3.125 million. The project has divided into four tasks as follows: Task 1 - Initial Feasibility Study; Task 2 - Problem Identification and Plan Development; Task 3 - Design and Procedures; and Task 4 - Construction.

Task 1, to complete an engineering feasibility study to investigate the potential effectiveness and costs of a water infusion system is estimated to cost $25,000. Task 2, to conduct a hydrodynamic assessment to evaluate possible hydraulic interactions between Basin D and the adjacent basins, in particular the possible transport of contaminates from the OFCB to the Marina; conduct an investigation of the dry and wet-weather runoff from nearby parking lots, buildings and landscaped areas; and to develop a water quality improvement plan to identify mitigation strategies is estimated to cost $200,000. Task 3, to design the appropriate systems and procedures to achieve the goals of the water quality improvement plan to remediate the contaminant sources identified in Task 2 is estimated to cost $400,000. The design may include a water infusion system, implementation of BMPs for water runoff management, or any other measures determined to be appropriate. Task 4, implementation and construction of the water quality improvement procedures and systems as determined in Task 3 is estimated to cost $2.5 million.

The system design is anticipated to require only periodic maintenance and upkeep, including monitoring of pumps and dispersion valves. Annual operation and maintenance costs are estimated to be $10,000 to $25,000, plus periodic specialized maintenance.

8.4.3 Structural and Non-Structural Controls Strategy

It is not possible to reliably estimate the cost of the structural and non-structural controls strategy at this time because there is insufficient data to accurately model various implementation scenarios. Additional details of this strategy including various implementation scenarios and cost estimates will be available when the TMDL is revised. The Regional Board expects that such targeted upstream structural and non-structural controls will be much less costly than the end-of-pipe diversion strategy for which costs are provided in this document.

9 Monitoring Program

A compliance monitoring program is required for the TMDL, to assess compliance with the allowable exceedance days for the Mothers' Beach and the back basins of MdRH.

It is anticipated that the responsible jurisdictions and responsible agencies responsible for MdRH will also be participating with the reference and source characterization monitoring programs implemented as part of the SMB beaches TMDLs. The County of Los Angeles and other municipalities within MdR are strongly encouraged to pool efforts and coordinate with municipalities within the Santa Monica Bay watershed other appropriate monitoring agencies, in order to, meet the challenges posed by this TMDL and the SMB beaches TMDLs by developing cooperative monitoring programs.

9.1 Compliance Determination

Responsible jurisdictions and responsible agencies shall conduct daily or systematic weekly sampling in the wave wash at all major drains[32], at existing monitoring stations or at other designated monitoring stations to determine compliance.[33] Samples collected at ankle depth shall be taken on an incoming wave. At locations where there is a freshwater outlet, during wet weather, samples should be taken as close as possible to the wave wash, and no further away than 10 meters down current of the storm drain or outlet.[34] At locations where there is a freshwater outlet, samples shall be taken when the freshwater outlet is flowing into the surf zone.[35]

If the number of exceedance days is greater than the allowable number of exceedance days, the responsible jurisdictions and/or responsible agencies shall be considered out-of-compliance with the TMDL. Responsible jurisdictions and/or responsible agencies shall not be deemed out of compliance with the TMDL if the investigation described in the paragraph below demonstrates that bacterial sources originating within the jurisdiction of the responsible agency have not caused or contributed to the exceedance.

In addition, the MdR responsible jurisdictions and responsible agencies are required to conduct a study to determine the relative bacterial loading from storm drains versus birds at the OFCB and Mothers' Beach. Once this study is completed in three years, the Regional Board will adjust the WLAs, if appropriate based on the study, during the scheduled revision of the SMB beaches TMDL.

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[32] Major drains are those that are publicly owned and have measurable flow to the beach during dry weather.

[33] The frequency of sampling (i.e., daily versus weekly) will be at the discretion of the implementing agencies. However, the number of sample days that may exceed the objectives will be scaled accordingly (see Equation 7.2).

[34] Safety considerations during wet weather may preclude taking a sample in the wave wash.

[35] At some freshwater outlets and storm drains, during high tide conditions, the tide pushes the freshwater discharge back into the drain. As a result, sampling under these conditions is not representative of water quality conditions when the drain is flowing into the surf zone. The tide height at which this situation occurs will vary with the size, slope and configuration of the drain and the beach. Responsible agencies must ensure that samples are collected only when drains are flowing into the surf zone, not when the discharge is pushed back into the drain. Responsible agencies must submit a coordinated monitoring plan within 120 days of the effective date of the TMDL, in which this assurance should be included.

9.1.1 Follow-up Monitoring

If a single sample shows the discharge or contributing area to be out of compliance, the Regional Board may require, through permit requirements or the authority contained in Water Code Section 13267, daily sampling in the wave wash or at the existing monitoring location (if it is not already) until all single sample events meet bacteria water quality objectives. Furthermore, if a location is out-of-compliance as determined in the previous paragraph, the Regional Board shall require responsible agencies to initiate an investigation, which at a minimum shall include daily sampling in the wave wash or at the existing monitoring location until all single sample events meet bacteria water quality objectives. If bacteriological water quality objectives are exceeded in any three weeks of a four-week period when weekly sampling is performed, or, for areas where testing is done more than once a week, 75% of testing days produce an exceedance of bacteria water quality objectives, the responsible agencies shall conduct a source investigation of the subwatershed(s) pursuant to protocols established under Water Code Section 13178 (see Appendix I for these protocols). Responsible jurisdictions and responsible agencies may wish to conduct compliance monitoring at key jurisdictional boundaries as part of this effort.

If a location without a freshwater outlet is out-of-compliance or if the outlet is diverted or being treated, the adjacent municipality, County agency(s), or State or federal agency(s) shall be responsible for conducting the investigation and shall submit its findings to the Regional Board to facilitate the Regional Board exercising further authority to regulate the source of the exceedance in conformance with the Water Code.

9.2 Reference Characterization

The reference system characterization will allow the Regional Board to refine estimates of the "reference" level of exceedance, which is used to set allowable exceedance days at target beaches where the antidegradation criterion does not apply. As discussed in Section 7, the TMDL waste load allocations are set such that the number of exceedance days at a target beach should be the lesser of that observed in the reference system or the historical level of exceedance for the target beach. Regional Board staff selected Arroyo Sequit Canyon and Leo Carrillo Beach as the best candidate "reference" system for the purpose of setting the "reference" allowable exceedance days at this stage. However, currently, bacteriological monitoring is not conducted in the wave wash (where Arroyo Sequit initially mixes with the ocean water). Over the next few years, the Regional Board intends to work with the SMB Watershed Steering Committee and other agencies to re-evaluate the details of using a reference system approach. This evaluation will include assessing alternative reference systems and collecting data from these systems to better define the "reference" level(s) of exceedance observed in local natural systems during both wet and dry weather.[36]

[36] Possible alternatives may include selecting a large subwatershed (such as Arroyo Sequit) and a small subwatershed (such as Tuna Canyon) to control for differences in exceedance levels due to drainage area and flow or using a modeling approach where each subwatershed is assumed to be 100% open space and the number of exceedance days in the critical year is then derived for these "model" subwatersheds.

9.3 Source Characterization

The purpose of the source characterization component is to allow the Regional Board to better calibrate and validate the model used in the wet-weather SMB beaches TMDL and refine estimates of the necessary exceedance day reductions for each subwatershed and by municipality. Over the next two years, the Steering Committee will collect water quality data under wet weather conditions to refine estimates of bacteria densities from particular land uses and critical sources and at various instream locations. This will be a continuation of the wet-weather sampling program described in Section 4.

The source characterization component will also assist responsible agencies to implement the TMDL. The data collected on average bacteria densities from different land uses, and the range of bacteria densities within a land use, during different storm events, and within storm events will be used in the model to evaluate different management scenarios (such as capturing and treating the first flush from certain land uses) and prioritize areas for implementation of storm water best management practices.

10 References

Aquatic Bioassay and Consulting Laboratories, Inc. The Marine Environment of Marina del Rey Harbor. July 1996-June 1997; July 1997-June 1998; July 1998-June 1999; July 1999-June 2000; July 2000-June 2001; July 2001-June 2002.

Cabelli, V. J. 1983. Health effects criteria for marine recreational waters. U.S. Environmental Protection Agency, EPA-600/1-80-031, Cincinnati, Ohio.

California Code of Regulations, Title 17, Section 7958.

Chesler, Joseph. 2003. Los Angeles County Department of Beaches and Harbors. Personal communication. June 5, 2003.

Cheung, W.H.S., Chang, K.C.K., Hung, R.P.S. 1990a. Health effects of beach water pollution in Hong Kong. Epidemiol. Infect. 105:139-162.

Cheung, W.H.S., Chang, K.C.K., Hung, R.P.S. 1990b. Variations in microbial indicator densities in beach waters and health-related assessment of bathing water quality. Epidemiol. Infect. 106:329-344.

CH2MHILL. 2002. PLOAD Model for Marina del Rey Harbor, Preliminary Results. July 2002.

City of Los Angeles. 2002. Letter from Judith Wilson to Dennis Dickerson, Executive Officer, California Regional Water Quality Control Board, Los Angeles Region, May 20, 2002.

City of Los Angeles. 2001. Low-flow diversion of dry weather urban runoff. January 12, 2001.

City of Los Angeles. 1999. Santa Monica Bay Biennial Assessment Report 1997-98. Environmental Monitoring Division.

Corbett, S.J., Rubin, G.L.R., Curry, G.K., Kleinbaum, D.G. 1993. The health effects of swimming at Sydney beaches. American Journal of Public Health 83(12):1701-1706.

County Sanitation Districts of Los Angeles County. 2001. Joint Water Pollution Control Plan Annual Monitoring Report 2000. NPDES No. CA0053813.

Dwight, Ryan. University of California at Irvine, unpublished data.

Fattal, B., Peleg-Olevsky, E., Yoshpe-Purer, Y., and Shuval, H.I. 1986. The association between morbidity among bathers and microbial quality of seawater. Wat. Sci. Tech. 18(11):59-69.

Favero, M.S. 1985. Microbiologic indicators of health risks associated with swimming. AJPH 75(9):1051-1053.

Haile, R.W., Witte, J.S. 1997. Addendum to "An epidemiological study of possible adverse health effects of swimming in Santa Monica Bay." Santa Monica Bay Restoration Project.

Haile, R.W., Witte, J.S., Gold, M., Cressey, R., McGee, C., Millikan, R.C., Glasser, A., Harawa, N., Ervin, C., Harmon, P., Harper, J., Dermond, J., Alamillo, J., Barret, K., Nides, M., Wang, G. 1999. The health effects of swimming in ocean water contaminated by storm drain runoff. Epidemiology 10(4):355-363.

Haile, R.W., Alamillo, J., Barret, K., Cressey, R., Dermond, J., Ervin, C., Glasser, A., Harawa, N., Harmon, P., Harper, J., McGee, C., Millikan, R.C., Nides, M., Witte, J.S. 1996. An epidemiological study of possible adverse health effects of swimming in Santa Monica Bay, Santa Monica Bay Restoration Project.

Hanemann, Michael, Pendleton, Linwood, Layton, David. 2001. "Modeling the regional economic and social impact of marine pollution in southern California." Address to the California Coastal Commission. August 6, 2001.

Heal the Bay, Inc. 2002. 12th Annual Beach Report Card.

Las Virgenes Municipal Water District. 1999. Tapia Water Reclamation Facility 1999 Annual Report.

Los Angeles Convention and Visitors Bureau. 2000. LA Travel Statistics.

Los Angeles County Department of Public Works. 2002. Sampling Result for Marina del Rey TMDL. June 6, 2002; June 18, 2002; July 1, 2002; July 16, 2002.

Los Angeles Regional Water Quality Control Board. 2002. Santa Monica Bay Beaches Wet Weather Bacteria TMDL. Preliminary Technical Draft, November 7, 2002.

Los Angeles Regional Water Quality Control Board. 2002. Santa Monica Bay Beaches Dry Weather Bacteria TMDL. Preliminary Technical Draft, January 14, 2002.

Los Angeles Regional Water Quality Control Board. 2001. "Proposed amendment of the Water Quality Control Plan - Los Angeles Region to revise bacteria objectives for waters designated for contact recreation." July 31, 2001.

Los Angeles Regional Water Quality Control Board. 2000. Trash TMDL for the Los Angeles River Watershed. Preliminary Technical Draft, March 17, 2000.

Los Angeles Regional Water Quality Control Board. 1998. Proposed 1998 list of impaired surface waters (the 303(d) List). March 24, 1998.

Los Angeles Regional Water Quality Control Board. 1996. Regional Water Quality Control Board, Los Angeles Region 1996 California Water Quality Assessment – 305(b) Report: Supporting Documentation for Los Angeles Region.

Los Angeles Regional Water Quality Control Board. 1994. Water Quality Control Plan, Los Angeles Region.

Los Angeles County Department of Public Works. 2000. Integrated Storm Water Assessment Report 1994-2000.

Los Angeles County Department of Public Works. 1999. Los Angeles County 1998-99 Stormwater Monitoring Report. July 14, 1999.

Los Angeles County Fire Department, Lifeguard Operations. 2001. www.lacountylifeguards.org.

National Research Council. 1999. Monsoons to microbes: Understanding the ocean's role in human health. National Academy Press, Washington, D.C.

National Technical Advisory Committee. 1968. Water Quality Criteria. Federal Water Pollution Control Administration, Department of Interior, Washington, D.C.

Noble, Rachel T., J.H. Dorsey, M.K. Leecaster, M. Mazur, C.D. McGee, D. Moore, V. Orozco-Borbon, D. Reid, K. Schiff, P.M. Vainik, S.B. Weisberg. 2000a. Southern California Bight 1998 Regional Monitoring Program: III. Storm event shoreline microbiology. Southern California Coastal Water Research Project, Westminster, CA

Noble, Rachel T., Dorsey, J., Leecaster, M., Mazur, M., McGee, C., Moore, D., Victoria, O., Reid, D., Schiff, K., Vainik P., Weisberg, S. 2000b. Southern California Bight 1998 Regional Monitoring Program, Vol II: Winter shoreline microbiology. Southern California Coastal Water Research Project, Westminster, CA.

Noble, Rachel T., Dorsey, J., Leecaster, M., Mazur, M., McGee, C., Moore, D., Victoria, O., Reid, D., Schiff, K., Vainik P., Weisberg, S. 1999. Southern California Bight 1998 Regional Monitoring Program, Vol I: Summer shoreline microbiology. Southern California Coastal Water Research Project, Westminster, CA.

O'Connell, Linda. 2001. State Water Resources Control Board, Division of Water Quality. Personal communication.

Pike, E.B. 1992. "Statistical aspects of microbial populations in recreational waters" in Recreational water quality management, Volume I: Coastal waters, Kay, D. (ed.). Ellis Horwood Limited, England.

Pruss, A. 1998. Review of epidemiological studies on health effects from exposure to recreational waters. International Journal of Epidemiology 27:1-9.

Santa Monica BayKeeper. 2001. Unpublished data.

Southern California Association of Governments. 1993. GIS coverage of land use.

SCCWRP, 2001. "Retrospective evaluation of shoreline water quality along Santa Monica Bay beaches" in Southern California Coastal Water Research Project Annual Report 1999-2000.

SCCWRP, 2001. Unpublished data.

Schiff, Kenneth C., Jeffrey S. Brown, Stephen B. Weisberg. 2002. Model monitoring program for large ocean discharges in southern California. Technical Report #357, Southern California Coastal Water Research Project.

Schiff, Kenneth C., Jessica Morton, Stephen B. Weisberg. 2001. Retrospective evaluation of shoreline water quality along Santa Monica Bay beaches. Southern California Coastal Water Research Project Annual Report 1999-2000.

Soule, Dorothy F., Mikihiko Oguri, Richard E. Pieper. 1997. The Marine Environment of Marina del Rey. July 1995 - June 1996.

Southern California Coastal Water Research Project. 2000. General workplan for wet weather modeling of the Los Angeles River and Santa Monica Bay watersheds.

State Water Resources Control Board (SWRCB). 2003. Clean Water Act Section 303(d) List of Water Quality Limited Segments. February 4, 2003.

SWRCB. 1997. Water Quality Control Plan for Ocean Waters of California. Sacramento, California.

Taggart, Mitzy. 2001. Heal the Bay, Unpublished data.

U.S. Army Corps of Engineers. 1999. Marina del Rey and Ballona Creek Feasibility Study Sediment Control Management Plan – Main Report, Preliminary Draft Baseline Conditions (F3) Report. April 1999.

United States District Court, Northern District of California. 1999. Heal the Bay Inc., *et al*. v. Browner, *et al.* Case No. 98-4825 SBA. March 22, 1999.

U.S. EPA. 2001. Protocol for developing pathogen TMDLs. EPA 841-R-00-002. Office of Water (403F), United States Environmental Protection Agency, Washington, D.C.

U.S. EPA. 1997. Guidelines for preparation of the comprehensive state water quality assessments (305(b) Reports) and electronic updates: Supplement. EPA 841-B-97-002B. Office of Water, Washington, D.C.

U.S. EPA. 1991. Guidance of water quality-based decisions: The TMDL process. EPA 440/4-91-001. Office of Water Regulations and Standards, Washington, D.C.
U.S. EPA. 1986. Ambient water quality criteria for bacteria – 1986. EPA 440/5-84-002, Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C.

U.S. Environmental Protection Agency. 1986. Ambient Water Quality Criteria for Bacteria – 1986.

U.S. Environmental Protection Agency. 1976. Quality Criteria for Water. U.S. EPA, Washington, D.C.

U.S. EPA, Region 9. 2002. Field Sampling and Analysis Pan for the Marina del Rey TMDLs. April 15, 2002.

Von Schirnding, Y.E.R., Strauss, N., Robertson, P., Kfir, R., Fattal, B., Mathee, A., Franck, M., and Cabelli, V.J. 1993. Bather morbidity from recreational exposure to sea water. Wat. Sci. Tech. 27(3-4):183-186.